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Field Efficacy of Insecticides for Management of Lepidopteran Pests in Cashew

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Efficacy of different insecticides against lepidopteran pests of cashew were tested at Dr. YSRHU-Cashew Research Station, Bapatla, AICRP on Cashew during 2015-16 to 2021-22. Among the insecticides lamda-cyhalothrin 5 EC @ 0.6 ml/l was found effective in managing the foliage and floral pests such as, leaf and blossom webber, leaf miner, shoot tip caterpillar, apple and nut borer followed by Dr. YSR Horticultural University package of practices (POP) i.e. monocrotophos 36 SL @ 1.6 ml/l during the flushing stage, chlorpyrifos 20 EC @ 2.0 ml/l during the flowering stage and profenophos 50 EC @ 1.0 ml/l during the apple and nut development stage. Further, the spider population was observed to be highest in untreated check and *Beauveria bassiana* treatments compared to insecticidal treatments.

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Keywords: Cashew; lepidopteran pests; leaf and blossom webber; leaf miner; shoot tip caterpillar; apple and nut borer; insecticides.

1. INTRODUCTION

Currently a highly significant commercial crop, cashew was brought to India from Brazil for afforestation. Additionally, it works well for restoring deteriorated soils. With little scientific thought given to it at first, cashew was planted as a crop to save soil. However, throughout time, its acreage grew to 11.24 lakh hectares, and in 2019-20, it produced 6.91 lakh MT [1]. Cashew crop is reported to be infected by more than 180 insect pests in India. In which Tea mosquito bug and cashew stem and root borer consider to be the important pests. In addition, a variety of insect pests attack cashew during different phases of their growth. However, certain insect pests are significant in a certain area. For many years, considerable research has been done in the field of cashew entomology. However, cashew growers are still not using appropriate management techniques to keep cashew insect pests under control. Even though we have a large area under cashew cultivation, our productivity and production are lower than those of Vietnam and Nigeria. Numerous issues, such as the poor genetic makeup of the existing plantations, cultivation on marginal and less fertile lands, inadequate plant health management, damage from insects, diseases, weeds, and climatic fluctuations, among others, hinder cashew production [2]. Among these, insect pests are crucial since they can cause significant harm, including a 100% yield loss in cashew on certain instances. In general, cashew plantations resemble "a single - species forest," providing a steady microclimate and food sources for different insect groups. The biodiversity of cashew plantations is high. More than 180 insect pests have been documented for cashew in India [3]. The majority of these pests are hemipterans, coleopterans, and lepidopterans. If these pests are not controlled, they can severely reduce cashew yield during several growth stages, such as flushing, blooming, and fruit development. The tea mosquito bug, in particular, is a significant pest that severely reduces yields during the flushing, flowering, and apple and nut development stages. In addition, pests unique to a particular area, such as leaf and blossom webber, leaf miner, shoot tip caterpillar and apple and nut borer also significantly reduce yield [4]. The productivity of cashew in India is influenced by many factors out of which insect pests is one of the major factors causing a crop loss of around 30-40 per cent [5]. Considering the significance of controlling pests unique to a certain area, research was conducted to determine the best insecticide for controlling lepidopteron pests that affect cashew. The experiment was carried out at the Cashew Research Station, Bapatla, AICRP on Cashew, Dr. YSR Horticultural University, Andhra Pradesh, with the goal of minimizing the quantity of sprays and determining the most effective insecticide for the management of foliage and flower pests of cashew.

2. MATERIALS AND METHODS

The experiment was carried out in the experimental plot of cashew at Cashew Research Station, Bapatla, Dr. YSR Horticultural University, Andhra Pradesh during 2015-16 to 2021-22 under AICRP on Cashew.

The trees with variety BPP-5 were planted during 2003 at 8 m x 8 m spacing. The experiment was designed using Randomized Block Design with nine treatments and four replications. The number of trees per replication was two and all the agronomic practices were followed as and when required. The treatment details were, T_1 (Thiamethoxam 25 WG @ 0.1 g/l), T_2 (Thiamethoxam 25 WG @ 0.2 g/l), T_3 (Carbosulfan 25 EC @ 2.0 ml/l), T_4 (Buprofezin 25 SC @ 2.0 ml/l), T_5 (*Beauveria bassiana* WP @ 1.0 g/l), T_6 (*Beauveria bassiana* WP @ 5.0 g/l), T_7 (λ – Cyhalothrin 5 EC @ 0.6 ml/l), T_8 (POP, Dr. YSR Horticultural University i.e. Monocrotophos 36 SL (1.6 ml/l) at flushing, Chlorpyriphos 20 EC (2.0 ml/l) at flowering and Profenofos 50 EC (1.0 ml/l) at fruit & nut development stage) and T_9 (Untreated check).

The data on pest incidence from eight trees per each treatment was recorded from 52 leader shoots of each tree by covering East, West, North and South sides of the trees with respect to leaf and blossom webber, shoot tip caterpillar at one day before the spray and 30 days after each spray. The number of healthy shoots and infested shoots were recorded and per cent damage was calculated. With regard to leaf miner, damage was recorded on leaves from five randomly selected shoots from each side of canopy of each plant where number of healthy leaves and infested leaves were recorded and per cent damage was calculated as per the

procedure given by Kanhar et al., [6]. Apple and nut borer (ANB) damage was recorded by counting the total nuts in 52 leader shoots and the nuts damaged by the ANB were counted and per cent damage was calculated. Further counts of spiders were recorded at 30 days after third spray by tapping 52 panicles per tree on 1 sq.foot card board.

The data was compiled and tabulated for statistical analysis. The data was subjected to suitable transformation. Analysis of variance (ANOVA) was done with OPSTAT and Web Agri Stat Package (WASP)

The first and second sprays were skipped as the pest load of foliage and floral pests were quite low. Further, only one spray was applied during at apple and nut development stage.

3. RESULTS AND DISCUSSION

The trial field efficacy of insecticides for management of lepidopteran pests in cashew was conducted during 2015-16 to 2021-22. However, treatments were not implemented during 2019-20 and 2020-21 due to extremely low insect pest prevalence. The primary focus of this experiment is on lepidopteron pests that are peculiar to the foliage and flowers in Andhra Pradesh, such as leaf and bloom webber (LBW) *Lamida* (*Macalla*) *moncusalis* Wlk, leaf miner (*Acrocercops syngramma* M), shoot tip caterpillar (*Hypotima* (*Chelaria*) *haligramma* M) and apple and nut borer (ANB) (*Thylacoptila paurosema* Meyrick). Only the years 2015-16 and 2016-17 showed incidence of LBW. During the rest of the experimental period, the incidence of LBW was essentially negligible in all treatments. The pooled data (2015-16 and 2016-17) results revealed that (Table 1) all the treatments were found better in managing the incidence of LBW after 30 days of application. After 30 days of insecticide application, treatment T_7 (Lamda-cyhalothrin 5 EC @ 0.6 ml/L) was shown to be superior among all treatments, recording 4.83 percent shoot damage, followed by treatment T_8 (POP of Dr. YSRHU), which recorded 9.42 percent shoot damage. These results are consistent with those of Anamika [7], who found that lamda-cyhalothrin 0.003 % was most efficient insecticide for managing LBW, followed by profenophos @ 0.05 %which recorded 2.84 % and 3.45 %, respectively. According to Siva Moorthy et al. [8], lamda-cyhalothrin decreased the number of webs per tree by 69.0% and the number of larvae per web by 63.0% in mango trees. Lamda-cyhalothrin 5 EC @ 0.6 ml/L was proven to be the most effective treatment for managing leaf miner throughout the trial period which recorded 2.07 % damage (Table 2), it was followed by Dr. YSRHU's POP, which recorded 3.45%. Further, these two treatments were on par to one another. Similar trend was also observed in managing the shoot tip caterpillar and apple and nut borer (Tables 3 &4). Lamda-cyhalothrin 5EC @ 0.6 ml/L and POP of Dr. YSRHU were recorded 3.62 % and 6.20 % of shoot tip caterpillar damage, 3.34 % and 5.49 % apple and nut borer damage respectively after 30 days of spraying. These findings are consistent with those of Anamika [7], who reported that 30 days after spraying, lamda-cyhalothrin (0.003%) and acetamiprid (0.01%) were the most effective treatments for controlling leaf miner and apple

Table 1. Efficacy of different insecticides against leaf and blossom webber in cashew during 2015-16 to 2021-22

T. No.	2015-16	2016-17	Cumulative
T1	17.48 (24.71)^{e}	14.52^{cd} (22.26)	16.00^{cd} (23.53)
T2	14.67 (22.51)^{d}	13.22^{bc} (21.04)	13.94^{cd} (21.91)
T3	11.75 (20.04)^{c}	12.36^{bc} (20.55)	12.06^{bc} (12.3)
T4	18.42 (25.41)^{e}	15.70^{cd} (23.29)	17.06^{b} (24.37)
T5	16.34 (23.83)^{de}	21.12^{e} (27.26)	18.73^{d} (25.58)
T6	15.54 (23.21)^{de}	18.60^{ed} (25.46)	17.07^{d} (24.37)
T7	3.49 (10.76)^{a}	6.18^{a} (14.26)	4.83^{a} (12.56)
T8	8.63 (17.07)^{b}	10.22^{b} (18.6)	9.42^{b} (17.85)
T9	25.54 (30.34)^{f}	27.63^{f} (31.69)	26.58^{e} (31.02)
CD (5%)	1.658	3.45	3.67
SE (m) ±	0.565	1.18	1.14

Figures in parentheses are arc sin transformed values
Figures followed by same alphabet (s) are not differing significantly at 5% level

Table. 2. Efficacy of different insecticides against leaf miner in cashew during 2015-16 to 2021-22

T.No.	2015-16	2016-17	2017-18	2018-19	2021-22	Cumulative
T1	11.36 (19.68)^{d}	13.65^{bc} (21.63)	3.95^{bc} (11.42)	9.23^{b} (17.64)	8.35^{bc} (16.80)	9.31^{cde} (17.43)
T2	10.75 (19.13)^{d}	11.34^{c} (19.63)	4.10^{bc} (11.58)	6.10^{c} (14.28)	5.74^{c} (13.86)	7.61^{e} (15.70)
T3	8.82 (17.27)^{d}	10.41^{c} (18.77)	4.60^{b} (12.26)	9.69^{b} (18.01)	6.81^{bc} (15.13)	8.07^{de} (16.29)
T4	18.00 (25.09)^{b}	16.53^{b} (23.93)	4.75^{b} (12.50)	10.06^{b} (18.44)	8.98^{b} (17.44)	11.66^{bcd} (19.48)
T5	17.36 (24.61)^{b}	17.07^{ab} (24.37)	5.13^{b} (13.05)	10.67^{b} (19.05)	14.62^{a} (22.48)	12.97^{b} (20.71)
T6	14.06 (22.02)^{c}	16.13^{b} (23.60)	4.78^{b} (12.39)	11.37^{b} (19.67)	12.64^{a} (20.83)	11.80^{bc} (19.70)
T7	0.83 (5.21)^{f}	2.59^{d} (9.02)	1.78^{d} (7.52)	3.59^{d} (10.79)	1.58^{d} (7.22)	2.07^{f} (7.95)
T8	3.70 (11.09)^{e}	4.06^{d} (11.52)	2.98^{c} (9.91)	3.62^{d} (10.90)	2.91^{d} (9.82)	3.45^{f} (10.65)
T9	30.11 (33.27)^{a}	20.71^{a} (27.02)	8.10^{a} (16.48)	16.62^{a} (24.01)	14.45^{a} (22.34)	18.00^{a} (24.62)
CD (5%)	2.616	2.95	2.32	2.31	3.04	3.23
SE (m) ±	0.891	1.01	0.79	0.79	1.04	1.12

Figures in parentheses are arc sin transformed values
Figures followed by same alphabet (s) are not differing significantly at 5% level

Table 3. Efficacy of different insecticides against shoot tip caterpillar in cashew during 2015-16 to 2021-22

T.No.	2015-16	2016-17	2017-18	2018-19	2021-22	Cumulative
T1	25.43 (30.27)^{c}	21.99^{b} (27.83)	7.15^{bc} (15.33)	12.39^{cd} (20.27)	4.85^{d} (12.72)	14.36^{bc} (21.28)
T2	23.38 (28.90)^{d}	17.73^{cd}(24.52)	5.68^{c} (13.67)	8.41^{de} (16.61)	4.92^{d} (12.82)	12.02^{cd} (19.30)
T3	13.42 (21.48)^{e}	15.21^{de}(22.61)	5.23^{c} (13.13)	11.01^{cd} (19.21)	3.25^{e} (10.39)	9.62^{d} (17.36)
T4	28.25 (32.09)^{b}	21.70^{bc}(27.55)	7.58^{bc}(15.79)	13.74^{c} (21.64)	6.64^{cd} (14.94)	15.58^{bc} (22.40)
T5	22.68 (28.43)^{d}	25.21^{b} (30.04)	8.23^{b} (16.64)	16.63^{bc} (23.86)	9.28^{ab} (17.73)	16.41^{b} (23.34)
T6	22.08 (28.02)^{d}	23.27^{b} (28.79)	6.30^{bc}(14.47)	20.85^{ab} (27.01)	8.05^{bc} (16.49)	16.11^{b} (22.96)
T7	1.74 (7.57)^{g}	9.43^{f} (17.78)	2.33^{d} (8.65)	3.09^{f} (9.6)	1.53^{f} (7.11)	3.62^{e} (10.14)
T8	7.51 (15.90)^{f}	13.04^{ef} (20.65)	3.15^{d} (10.21)	5.39^{ef} (13.25)	1.94^{ef} (8.01)	6.20^{e} (13.60)
T9	30.35 (33.41)^{a}	36.12^{a} (36.9)	12.20^{a}(20.41)	27.13^{a} (31.34)	11.06^{a} (19.42)	23.37^{a} (28.30)
CD (5%)	2.153	3.05	2.9	4.87	2.26	3.52
SE (m) ±	0.733	1.04	0.99	1.66	0.77	1.22

Figures in parentheses are arc sin transformed values
Figures followed by same alphabet (s) are not differing significantly at 5% level

Table 4. Efficacy of different insecticides against apple and nut borer in cashew during 2015-16 to 2021-22

T.No.	2015-16	2016-17	2017-18	2018-19	2021-22	Cumulative
T1	22.31 (28.18)^{b}	20.38^{bc} (26.81)	2.38^{cde} (8.60)	2.88^{cd} (9.70)	13.71^{abc} 21.73)	12.33^{cd} (19.00)
T2	20.42 (26.85)^{c}	18.86^{c} (25.65)	3.48^{c} (10.69)	2.98^{cd} (9.89)	12.27^{bc} (20.51)	11.60^{cd} (18.72)
T3	13.50 (21.55)^{e}	18.29^{c} (25.24)	3.05^{cd} (9.90)	4.73^{bc} (12.02)	10.07^{c} (18.50)	9.93^{d} (17.44)
T4	17.32 (24.58)^{d}	23.57^{b} (29.03)	9.23^{ab} (17.60)	8.45^{ab} (16.53)	15.73^{ab} (23.36)	14.86^{b} (22.22)
T5	18.25(25.28)^{cd}	20.97^{bc} (27.22)	8.68^{ab} (16.95)	8.39^{a} (16.67)	14.18^{abc} (22.12)	14.09^{b} (21.65)
T6	16.37(23.85)^{de}	17.08^{c} (24.37)	7.20^{b} (15.46)	7.20^{ab} (15.46)	13.67^{abc} (21.70)	12.30^{bc} (20.17)
T7	4.47 (12.20)^{g}	5.72^{e} (13.78)	1.40^{e} (4.72)	1.61^{d} (6.03)	3.49^{d} (10.76)	3.34^{f} (9.50)
T8	9.04 (17.49)^{f}	11.21^{d} (19.52)	1.35^{de} (6.48)	1.36^{d} (6.49)	4.51^{d} (12.26)	5.49^{e} (12.45)
T9	28.27 (32.11)^{a}	29.79^{a} (32.95)	12.23^{a}(20.34)	10.78^{a} (18.98)	17.48^{a} (24.71)	19.71^{a} (25.82)
CD (5%)	3.16	3.25	4.2	4.62	3.82	2.63
SE (m) ±	1.078	1.108	2.03	1.57	1.30	0.91

Figures in parentheses are arc sin transformed values
Figures followed by same alphabet (s) are not differing significantly at 5% level

Table 5. Influence of different insecticides on spider population on cashew during 2015-16 to 2021-22

T.No.	2015-16	2016-17	2017-18	2018-19	2021-22	Cumulative
T1	0.90 (0.95)^{e}	2.25 (1.46)^{cd}	10.00^{bc} (3.14)	11.50^{bc} (3.37)	3.93^{c} (1.98)	5.72^{de} (2.18)
T2	0.65 (0.81)^{f}	1.25 (1.10)^{d}	8.25^{c} (2.87)	10.25^{c} (3.19)	4.70^{bc} (2.16)	5.02^{e} (2.03)
T3	0.50 (0.71)^{g}	1.50 (1.04)^{d}	8.25^{c} (2.85)	10.50^{c} (3.21)	5.41^{bc} (2.32)	5.23^{e} (2.06)
T4	1.63 (1.27)^{b}	4.00 (1.97)^{bc}	11.00^{ab} (3.31)	12.25 ^{bc} (3.50)	4.81^{bc} (2.18)	6.74^{cd} (2.45)
T5	1.65 (1.28)^{b}	4.75 (2.16)^{bc}	15.00^{a} (3.85)	17.75^{a} (4.21)	7.92^{a} (2.79)	9.41^{b} (2.86)
T6	1.55 (1.24)^{c}	5.00 (2.21)^{ab}	12.25^{ab} (3.49)	15.00^{ab} (3.85)	6.41^{ab} (2.50)	8.04^{bc} (2.66)
T7	0.00 (0.00)^{h}	0.25 (0.25)^{e}	5.25^{d} (2.25)	4.75^{d} (2.15)	1.75^{c} (1.32)	2.40^{g} (1.19)
T8	1.25 (1.12)^{d}	1.25 (0.96)^{de}	5.00^{d} (2.20)	6.50^{d} (2.52)	1.57^{c} (1.25)	3.11^{f} (1.61)
T9	7.35 (2.71)^{a}	8.25 (2.87)^{a}	15.00^{a} (3.85)	17.75^{a} (4.20)	8.31^{a} (2.88)	11.33^{a} (3.30)
CD (5%)	0.413	0.71	0.59	0.53	0.38	0.34
SE (m) ±	0.141	0.24	0.19	0.18	0.13	0.12

Figures in parentheses are Square root transformed values
Figures followed by same alphabet (s) are not differing significantly at 5% level

and nut borer damage. Ravindra et al. [9] reported that lamda-cyhalothrin (0.003%) was most promising insecticide for the management of flower and fruit pests of cashew. Zote et al. [10] were also reported, lamda-cyhalothrin 0.003% all sprays was found effective in managing the tea mosquito bug in cashew which recorded 1.68% incidence followed by application of monocrotophos 0.05 per cent at flushing, profenophos 0.05% at flowering and lamda-cyhalothrin 0.003% at fruit and nut development stage which recorded 3.93% incidence. Further Barkade et al. [11] found that application of lamda-cyhalothrin @ 0.005% proved 90 per cent mortality of leaf eating caterpillar (*Thalassodes dissata* Walker) larvae on mango and cashew, these above findings were in agreement with the present findings.

In addition to evaluating the effectiveness of various insecticides against cashew lepidopteran pests, research was also done on how these insecticides affected the cashew spider population from 2015 to 2022 (Table 5). According to the findings, spider populations were decreased with insecticidal spray treatments. More number of spider populations was observed in untreated check, *Beauveria bassiana* WP (1 g/L), *B. bassiana* WP (5g/L) and buprofezin 25 SC (2.0 ml/L) treatments compared to other treatments. T_8 (POP, Dr. YSRHU) and T_7 (lamda-cyhalothrin) were recorded less number of spider population compared to other treatments.

4. CONCLUSIONS

In the cashew ecosystem, during various growth stages such as flushing, flowering, and apple and nut forming, cashew trees were affected by a variety of insects and pests. A significant reduction in crop productivity is caused by leaf and blossom webber, leaf miner, shoot tip caterpillar and apple and nut borer during crop season. According to the results of the present investigation, cashew plantations can effectively manage the aforementioned insect pests by spraying lamda-cyhalothrin 5EC @ 0.6 ml/lit at all three sprays or Monocrotophos 36 SL (1.6 ml/l) during flushing stage, Chlorpyriphos 20 EC (2.0 ml/l) during flowering stage, and Profenofos 50 EC (1 ml/l) during fruit & nut development stage.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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