Some Significant Threats to Lychee Production and their Management Options in Bangladesh

Muhammad Abu Taher, Md. Mahbubur Rahman*, Khandakar Shariful Islam and Mohammad Mahir Uddin

Department of Entomology, Faculty of Agriculture, Bangladesh Agricultural University, Mymensingh, Bangladesh.
*Email address of corresponding author: rahmanmm_ent@bau.edu.bd

Abstract

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Lychee (*Litchi chinensis* Sonn.) production is severely hampered by pest infestations in Bangladesh. To help in management of three major lychee pests, namely, lychee fruit borer (*Conopomorpha sinensis*), lychee mite (*Aceria litchi*) and lychee leaf roller (*Platypeplus aprobola*), the efficacy of seven different insecticides were assessed in a commercial lychee orchard at Gopalpur, Tangail, Bangladesh, in two consecutive fruiting seasons. Lychee fruit infestations by the lychee fruit borers (>50%) reached a peak in early to late May and in late April by the lychee mites (>42%). Leaves and inflorescences infestations by the lychee mites (>14%) and lychee leaf rollers (10-33%) were high from February to March. Among the treatments, the mixture of imidacloprid and abamectin resulted in a maximum reduction of infestation over the control trees (98.08% by lychee fruit borer, 87.10% by lychee mite and 92.12% by lychee leaf roller). The highest cost-benefit ratio was achieved by applying Novastar 56 EC (bifenthrin + abamectin) (1:10.36) and ranked second in reducing infestations. Solo application of systemic insecticide and combination of systemic and contact insecticide were effective. The combination imidacloprid + abamectin was the most efficient in reducing the damage by the pests, and the mixture of bifenthrin and abamectin was the most cost-effective to control the selected pests.

Keywords: Lychee fruit borer, lychee mite, lychee leaf roller, chemical controls, seasonal abundance.

Introduction

Lychee, *Litchi chinensis* Sonn. (Sapindaceae: Sapindales) is an evergreen subtropical fruit tree. This fruit is known to consumers in Bangladesh as the queen of fruits because of their attractive colours, refreshing taste and flavoured juice. Lychee is consumed as fresh fruit and various processed products (Sharma, 1985; Singh *et al.*, 2012). Over thirty thousand acres of land are dedicated for lychee production in Bangladesh, where the annual yield is eighty thousand metric tons (BBS, 2020). Due to its high economic return and increased demand in the domestic and overseas markets, commercial lychee production is gaining popularity in other areas in Bangladesh, such as greater Dinajpur, Rangpur, and Pabna Districts.

Lychee production in Bangladesh is affected by many factors. Insect and mite infestations are major threats to lychee production. Lychee fruit borer (*Conopomorpha sinensis*), lychee mites (*Aceria litchi*) and lychee leaf roller **(***Pletypeplus aprobola*) cause severe damage to the lychee production (Bhagat *et al.*, 2019; FAO, 2001; Ranjan *et al.*, 2019; Srivastava & Nath, 2015; Srivastava *et al.*, 2015). Because of global warming, the severity of these pests is getting worse in the Indian subcontinent (Sharma, 1985; Srivastava & Nath, 2015). Farmers often use chemical insecticides indiscriminately, which increases complexity and ends in unsuccessful management of the target pests, in addition to the environmental damages. Hence, it is essential to have an efficient approach for the control of lychee fruit borer, lychee mites and lychee leaf roller. In the present study, some widely used insecticides were evaluated in a field trial to identify the efficient and need-based options for controlling the above-mentioned pests.

Materials and Methods

Experiments were carried out in a commercial lychee orchard in Gopalpur, Tangail, Bangladesh, during the 2014 and 2015 fruit seasons. The treatments were laid out in a completely randomised block design. Trees were treated with either of the following treatments, namely: mixture of imidacloprid (Imitaf 20 SL 0.5 ml) and abamectin (Sunmectin 1.8 EC 0.5 ml) at 1ml/L of water, mixture of deltamethrin (Decis 2.5 EC 0.5 ml) and abamectin (Sunmectin 1.8 EC 0.5ml) at 1ml/L of water and solo application of Novastar 56 EC (bifenthrin + abamectin) at 1ml/L of water, imidacloprid at 1ml/L of water, abamectin at 1ml/L of water, deltamethrin at 1ml/L of water, spinosad (Tracer 45 SC) at 0.5 ml/L of water. Treatments were applied 15 days before blooming, during fruit setting and two times after fruit settings at 15 days intervals using a foot pump sprayer. Three trees were assigned for each treatment, and each considered as a replicate. For comparisons, three trees were and left untreated as control.

Data on pest occurrence were gathered 15 days after treatment and immediately before the subsequent spray. Five twigs (approx. 1ft long) from each of the treated and untreated trees were randomly selected for data collection. The numbers of healthy and infested leaves of selected twigs were recorded to assess the severity of lychee mites and

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lychee leaf roller attacks. The infestations of the lychee fruit borer were recorded by observing the ripen fruits from the treated and control trees. From each tree, 50 ripen fruits were randomly collected, and the presence of the larvae/larval excreta in the aril was recorded.

One-way ANOVAs followed by DMRT (Duncan's Multiple Range Test) were performed to determine the efficacies of the treatments using the statistical program MSTAT-C. The cost-benefit ratio (CBR) was calculated considering the total expenditure and return for a treatment per acre of the orchard area.

Results

Efficacy of treatments to control lychee fruit borer

The fruit infestation by the lychee fruit borer started in the second week of April, and reached 1.2% by the end of April. The infestation increased rapidly during early to mid-May (29.78% - 45.67%) when lychee started to change colour and peaked (51.95%) during middle to late May. Higher infestation rate led to higher fruit drop during the study period. The fruit borer larvae (
Figure **1**) mined the developing fruits near the stalk and damaged the developing seeds and arils. All the treatments resulted in a significant ($p<0.05$) reduction of fruit borer infestation over control trees (
Table **1** and
Table 2). The lowest fruit infestation rate (1%) was recorded from the imidacloprid + abamectin treated trees
followed by Novastar 56 EC (2%), the mix of deltamethrin and abamectin (2.31%), imidacloprid (2.33%), abamectin (2.67%), deltamethrin (3.3%) and spinosad (4.31%). The highest infestation rate was 51.95% in the control trees (Table 1). The insecticides treatment significantly reduced the lychee fruit borer infestation (
Table **1**). The reduction of fruit infestations over control trees in all treatments was more than 90%. The highest reduction in fruit infestation rate was for imidacloprid + abamectin (98.08%). The second highest fruit infestation reduction was for Novastar 56 EC (96.15%), followed by the mixture of deltamethrin and abamectin (95.55%), imidacloprid (95.51%), abamectin (94.86%), deltamethrin (93.65%) and spinosad (91.70%).

Figure 1. Lychee fruit borer infested (a) young fruits, (b) infrested seed, (c) mature fruit, (d) developing fruit with larval excreta and (e) larva.

Table 1. Means of fruit/leaf infestation rate (%) by the lychee pests under different treatments in two fruiting seasons.

Treatments	Fruit infestation rate by lychee fruit borer	Leaf infestation rate by lychee mites	Leaf infestation rate by lychee leaf roller
Imidacloprid	2.33 bc	9.31 bc	5.35 bc
Deltamethrin	3.30 bc	11.95 b	6.31 bc
Abamectin	2.67 bc	5.21 cde	3.14 c
Spinosad	4.31 b	9.52 bc	8.69 b
Novastar 56 EC (bifenthrin + abamectin)	2.00 bc	4.07 de	2.67 c
Imidacloprid + abamectin	1.00 c	1.05 e	2.63 c
Deltamethrin + abamectin	2.31 bc	7.00 cd	4.32 bc
Control	51.95 a	42.64 a	33.25 a

Values followed by same letters in in the same column are not significantly different at P=0.05.

Table 2. Reduction of fruit/leaf infestation rate and cost-benefit ratios (CBR calculated for an acre of lychee growing area) under different insecticides treatments.

Treatments	Reduction of infestation rate (%) over control			Cost-benefit ratio (CBR)
	Lychee fruit borer	Lychee mite	Lychee leaf roller	
Imidacloprid	95.51	69.52	69.21	1:6.8
Deltamethrin	93.65	63.86	66.36	1:7.4
Abamectin	94.86	78.29	75.75	1:7.6
Spinosad	91.70	69.05	59.29	1:2.2
Novastar 56 EC (bifenthrin + abamectin)	96.15	80.65	77.15	1:10.4
Imidacloprid+ abamectin	98.08	87.10	92.12	1:9.2
Deltamethrin+ abamectin	95.55	74.46	72.27	1:8.9

Efficacy of treatments to control lychee mites

The characteristic chocolate brown velvety structures detected the presence of lychee mites on the leaves/inflorescence are shown in Figure 2. Usually, the young leaves (Figure 2a), inflorescence (Figure 2b) and young developing fruits (Figure 2c) were infested with the lychee mites. In some cases, galls on the upper surface and twisted infested leaves (Figure 2d) were observed. Green patchy growth was observed on fruits infested with mites. Mite incidence was observed on new leaves (14.23%) in February, and inflorescence (10.91%) in March. Young fruits infestations by lychee mites (7.43%) were detected in early April and peaked in late April (42.64%). All the insecticides were effective in reducing mite infestation (Tables 1 and 2). The lowest infestation rate (1.05%) was found following the imidacloprid + abamectin application. There was no significant difference in the infestation levels between trees treated with Novastar 56 EC (4.07%), abamectin (5.21%), deltamethrin + abamectin (7.00%) and imidacloprid (9.31%) and they were better than the application of spinosad (9.52%) or deltamethrin (11.95%). The highest reduction of mite infestations rate over controls was for imidacloprid + abamectin (97.54%) followed by Novastar 56 EC (90.45%), abamectin (87.78%), deltamethrin + imidacloprid (83.58%), imidacloprid (78.17%), spinosad (77.67%) and deltamethrin (71.97%) (Table 2).

Figure 2. Lychee mite affected (a) young leaves, (b) leaves and inflorescence, (c) leaves and young fruits, (d) twisted leaves and (e) chocolate velvety brown growth on leaves.

Efficacy of treatments to control lychee leaf roller

The strenuous activity of the lychee leaf roller was observed during February to March (10-33%). The larval infestation caused rolling of tender leaves (
Figure **3**). All the treatments used in the trial were effective in reducing lychee leaf roller infestation (Tables 1 and 2). The lowest leaf infestation (2.63%) was found for the application of imidacloprid + abamectin. However, the infestation with imidacloprid + abamectin application were not different from the Novastar 56 EC (2.67%), abamectin (3.14%) and deltamethrin + abamectin (4.32%) applications. Solo application of imidacloprid (5.35%), deltamethrin (6.31%) and spinosad (8.69%) had minor impact on controlling lychee leaf roller (Table 1). The reduction of leaf infestations over control was highest for imidacloprid + abamectin (92.09%), followed by Novastar 56 EC (91.97%), abamectin (90.56%), the mixture of deltamethrin and abamectin (87.01%), imidacloprid (83.91%), deltamethrin (81.02%) and spinosad (73.86%) (Table 2). The highest cost-benefit ratio (CBR) was obtained from Novastar 56 EC treatment (1:10.36), followed by the combination of imidacloprid and abamectin (1:9.15), the mixture of deltamethrin and abamectin (1:8.87), abamectin (1:7.58), deltamethrin (1:7.40), imidacloprid (1:6.83) and spinosad (1:2.21) (Table 2).

Figure 3. Lychee leaf roller infestations on (a) leaves and (b) inflorescences of lychee.

Discussion

Compared to untreated control trees, the tested insecticides resulted in significantly lower infestation rate with lychee fruit borer, lychee mites and lychee leaf roller. The application of imidacloprid + abamectin and Noastar 56 EC (bifenthrin 50% + abamectin 6%) were found the most effective control options of lychee fruit borer. Distinctly, systemic insecticides alone or in combination with other control options showed better performances. For instance, Novastar 56 EC combined with bagging of fruits provided better protection from lychee fruit borer (Taher *et al.*, 2022). Many researchers reported that systemic insecticides are the most efficient for controlling internal feeders like lychee fruit borer (Majlish *et al.*, 2015; Purbey, 2016; Rahman *et al.*, 2013; 2016).

Similar to their effect on other sucking pests, systemic insecticides can affect lychee mites. Usually, miticides are used to control mites. However, systemic insecticides can reach mites while sucking plant sap and cause their death similar to other sucking pests, such as aphids (Jahan *et al.*, 2013). As more than one insecticide has been found effective in controlling lychee mites, they can be rotated to have better control (IRAC, 2019). Considering the availability and the pest status, either single application or a mixture of two insecticides can be applied. Lychee leaf roller is not an internal feeder. However, they can escape contact insecticides when they remain inside the leaf rolls made by them, but they are still susceptible to systemic insecticides, same like internal feeders (Rajwanshi *et al.*, 2017). Adults may be harmed by contact insecticides if they come into touch with them. For instance, maximum protection from the lychee leaf roller can be achieved from spinosad application (Ranjan *et al.*, 2019).

Overall, it is apparent that the mixture of imidacloprid and abamectin exhibited the maximum infestation reduction

over the control, and the highest cost-benefit ratio was achieved with the application of Novastar 56 EC. Although, Novastar 56 EC was the second most effective insecticide to control all targeted pests. Therefore, considering the ability to reduce infestation rate and increase cost-benefit ratio, the mixture of imidacloprid and abamectin can be recommended as the most efficient control option, and Novastar 56 EC (bifenthrin + abamectin) can be recommended as the second-most efficient option to control the lychee pests mentioned above.

الملخص

طاهر، م.أ.، م. محبوب الرحمن، خ. شريف الإسلام و م. ماهر الدين. 2023. بعض التهديدات الخطيرة لإنتاج فاكهة الليتشي وخيارات إداراتها في بنغلادش. مجلة وقاية النبات العربية، 41(2): https://doi.org/10.22268/AJPP-041.2.114118

يعدّ تفشّي الآفات معوّقاً كبيراً لإنتاج فاكهة الليتشي (*Litchi chinensis* Sonn.) في بنغلادش. وبهدف المساعدة في إدارة ثلاث آفاتٍ رئيسة تصيب هذه الفاكهة، وهي: ثاقبة ثمار الليتشي (*Conopomorpha sinensis*) وحَلَم الليتشي (*Aceria litchi*) ولفَّافة أوراق الليتشي (*Platypeplus aprobola*)، فقد تمّ تقييم فعّالية سبعة مبيدات حشرية مختلفة ضمن بستان تجاري لإنتاج الليتشي في مقاطعة جوبالبور (Gopalpur) بمدينة تانغل (Tangail) في بنغلادش، خلال موسمين متتاليين. سُجّلت إصابة ثمار الليتشي بثاقبات الثمار (بنسبة > 50%) وبلغت الإصابة ذروتها في أوائل وحتى أواخر شهر أيار/مايو، وكانت الإصابة بحَلَم الليتشي (< 14%) في أواخر شهر نيسان/أبريل؛ في حين أن إصابة أوراق نبات الليتشي ونوراته الزهرية بحَلَم الليتشي (< 14%) ولفَّافة أوراق الليتشي (10–33%) كانت مرتفعة اعتباراً من شهر شباط/فبراير وحتى شهر آذار/مارس. ومن بين المعاملات، فقد حقّقت معاملة مزج الإيميداكلوبراييد مع الأبامكتين أعلى نسبة تخفيض للإصابة وتفوّقت على معاملة الشاهد (ثاقبة ثمار الليتشي 98.08%، حَلَم الليتشي 87.10%، لفَّافة أوراق الليتشي 92.12%). وتحقّقت أعلى عائدية اقتصادية عند تطبيق المبيد نوفاستار 56 EC (بيفنثرين + أبامكتين) (1: 10.36) والذي احتل المرتبة الثانية في تخفيض الإصابة. وثبتت جدوى تطبيق المبيدات الجهازية بمفردها وكذلك التوليف بين مبيدٍ جهازي وآخر تلامسي. كانت التوليفة المكوَّنة من الإيميداكلوبراييد والأبامكتين هي الأكثر كفاءةً في الحدّ من أضرار هذه الآفات، وكان خليط البيفنثرين مع الأبامكتين أكثرها كفاءةً اقتصادية في مكافحة الآفات المُستهدَفة.

كلمات مفتاحية: ثاقبة ثمار الليتشي، حَلَم الليتشي، لفَّافة أوراق الليتشي، المكافحة الكيميائية، الوفرة الموسمية.

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