



Seasonal occurrence and management of litchi fruit and shoot borer, *Conopomorpha sinensis* (Bradley)

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ABSTRACT: A field trial was conducted consecutively for two years at ICAR-National Research Centre on Litchi, Mushahari, Muzaffarpur, Bihar, India to study the population build-up, compute yield losses caused by litchi fruit and shoot borer, *Conopomorpha sinensis* (Bradley) and its management through newer insecticides. Initial presence of litchi fruit & shoot borer was noticed in 13th standard week (5.33 pupae/ 10 shoot) and maximum number of pupae (9.33 pupae/10 shoot) were observed in 15th standard week. Negative correlation was observed with T_{Max} while positive correlation was observed with T_{Min} and RH (%) for population build-up of litchi fruit & shoot borer. Fruit bearing was maximum (33.17/ shoot) with 10% level of infestation and minimum (10.00 fruits) at 80% level of infestation against 40.33 fruits in control. Fruit retention at harvest stage was maximum (21.00) with 10% level with minimum 2.00 fruits at 100% level against 27.33 fruits in control. Mean weight of infested fruit was 17.35g against 24.33g of healthy fruit. At harvest stage, minimum fruit infestation (0.33%) was observed in two treatments namely, spinosad 45 SC (1.75 ml/5l) and flubendiamide 39.35 SC (1.5 ml/5l) followed by spinetoram 11.7 SC (1ml/l) with 0.67 % infestation against 12.33 in control. Thus, newer insecticide molecules, namely spinetoram, flubendiamide, novaluron 5.25% + indoxacarb 4.5%, Triazophos 35 % + deltamethrin 1% EC and spinosad can be incorporated against litchi fruit & shoot borer management programme.

Keywords: Litchi fruit & shoot borer, *Conopomorpha sinensis*, seasonal incidence, insecticides, pest management

INTRODUCTION

Litchi, *Litchi chinensis* Sonn is a commercial fruit crop of India, also considered as the queen of the subtropical fruits due to its eye-catching pink/red colours and flavoured juicy aril. The fruit has high nutritive value and excellent pulp (aril) quality known for its characteristics flavor and taste (Kumar *et al.* 2015). Additionally, litchi is gaining more momentum among the farmers due to its adoptability in integrated farming system (IFS) module, particularly in low lying areas (Kumar *et al.* 2014, Patel *et al.* 2020_a, Patel *et al.* 2020_b). This important crop is attacked by various insect pests which cause considerable damage resulting in reduced yield and marketability of fruits (Srivastava *et al.* 2015_a). Among them litchi fruit and shoot borer (*Conopomorpha sinensis* Bradley; Lepidoptera: Gracillariidae) is a major pest, responsible for infestation at different crop phases *viz.*, leaf/shoot (09-70%) and fruit (25-60%), resulting severe economic loss (Srivastava *et al.* 2016). The insects (larvae) damage the newly emerged shoot during September- October resulting in failure of shoot to bloom. Further, it punctures the peduncle of fruits (both developing as well as mature) during April-May

resulting to heavy loss through early fruit drop and appearance of excreta/larvae, when fruit is cut/opened after ripening (Reddy *et al.* 2016, Srivastava *et al.* 2018). Eco-friendly insect pest management is crucial for achieving sustainable food production. Several environmentally conscious and sustainable approaches to pest control should be prioritized to protect crops while minimizing negative impacts on pollinator bees and beneficial organisms. These methods include the use of botanicals (Divekar *et al.*, 2022; Divekar *et al.*, 2024), host plant resistance (HPR) (Divekar *et al.*, 2019), plant secondary metabolites (Divekar *et al.*, 2022), bio-control agents (Divekar P. 2023; Shinde *et al.*, 2021), defense proteins (Divekar *et al.*, 2023), and safer chemical control options (Kodandaram *et al.*, 2024).

The population build-up pattern and computation of the yield losses are the two major prerequisites for scheduling a successful IPM programme. Additionally, to overcome the ill effects of conventional insecticides *viz.*, resistance to insecticide, outbreak of secondary pests, harmful to non-target organisms, health hazards and problems related to environmental pollution; newer molecules with selective action, safer to non-target

organisms and environmentally sound may be explored to protect this important cash crop. Therefore, series of experiments were carried out during 2018-19 to 2019-20 to study the population build-up pattern, effect of different level of infestation on fruit retention and fitness of safer/newer insecticides against *Conopomorpha sinensis* Bradley.

MATERIALS AND METHODS

Present study was conducted at experimental farm of ICAR-National Research Centre on Litchi, Muzaffarpur, Bihar (latitude and longitude of 26°5'87"N and 85°26'64"E, respectively at altitude of 210m asl) during 2018-19 to 2019-20.

Study the population build-up of litchi fruit & shoot borer during fruiting season: To study the population build-up of litchi fruit & shoot borer during fruiting season 30 shoots and/or fruits were selected randomly from selected trees and brought to the laboratory. The samples were equally distributed and put in three different jars having mouth covered with muslin cloth. The jars containing 10 fruits and/or shoots were kept in the BOD till the pupa emerged from the sample or the specimens dried completely. Daily observations were recorded where presence of pupa was considered as infestation. Total no. of pupae from each jar was used for data analysis.

Computation of losses caused by litchi fruit & shoot borer: The losses caused by litchi fruit & shoot borer, different levels of infestation (0.00 to 100%) caused by the pest were identified by conducting trial in Randomized Block Design (RBD) at ICAR-NRCL Research Farm. With in treatment five units of each sample were considered as one replication. Observations were recorded on panicle length (cm), panicle diameter (cm), panicle paracladia (no.), fruit lets at initial stage (no.) and fruit retention at harvest stage (no.). At harvest stage, ten healthy and ten infested fruits were brought to the laboratory for analysis. Observations on fruit weight, peel weight, pulp weight and seed weight were recorded to quantify the loss caused by litchi fruit & shoot borer.

Study the efficacy of newer insecticides against litchi fruit & shoot borer: A separate experiment was conducted in RBD with 6 treatments and four replications viz., T₁- Spinetoram 11.7 SC (0.012%); T₂- Flubendiamide 39.35 SC (0.012%); T₃- Novaluron 5.25 % +Indoxacarb 4.5 % SC (0.0098%); T₄- Triazophos 35 % + Deltamethrin 1% EC (0.072%); T₅- Spinosad 45 SC (0.016%) and T₆- Control (without spray) to evaluate

the efficacy of various insecticides against litchi fruit & shoot borer in cv. Shahi. One foliar spray of neem-based formulation was given at the time of panicle emergence before flowering to avoid egg laying by the moth. Three sprays of all the insecticides were applied at different interval during April-May. First spray was given at clove size fruit, second spray at cardamom size fruit (after fifteen days of first spray) while third spray was given at 10 days after second spray (about 15 days before harvest). Spraying was done on outer as well as inner canopy in all the direction on the tree with the help of power sprayer having hollow cone nozzles. Observations were recorded based on damaged fruit at early stage, mid stage and harvesting stage. To observe the borer infestation at early stage (clove size fruit) and mid stage (cardamom size fruit), the fallen fruits were collected from each treatments and cut/open with the help of sharp knife. At fruit maturity, 100 fruits from each treatment were plucked randomly for recording observation. The peduncle of harvested fruit was removed and presence of larva or their excreta was considered as infested fruits (Srivastava *et al.* 2017). The damage was assessed based on the weight of total number of fruits and damaged fruits in the different treatments and the percent damage was worked out.

The data was analysed statistically using statistical software SPSS version 16.0. Data recorded were compared by the means of critical differences at five per cent level of significance in field studies.

RESULTS AND DISCUSSION

Population build-up of litchi fruit & shoot borer during fruiting season: The incidence of litchi fruit & shoot borer was recorded from the standard week 11th to 22nd and observations were correlated with weather data. The first presence of litchi fruit & shoot borer was noticed in 13th standard week (5.33 pupae/ 10 shoot) and maximum number of pupae (9.33 pupae/10 shoot) were observed in 15th standard week. An increasing trend was observed in population build-up of fruit & shoot borer up to 15th standard week followed by decreasing has been noticed with minimum population (1pupa/10 fruit) during 22nd standard week (Figure-1). In relation to weather parameters negative correlation was observed with T_{Max}, while positive correlation was observed with T_{Min} and RH (%) for population build-up of litchi fruit & shoot borer (Table 1). It is clear from the data recorded during the cropping season, that the weather parameters have established relation with the incidence of fruit & shoot borer. The moderate temperature (32.80-32.84°C) coupled with high humidity (80.00%) have positive

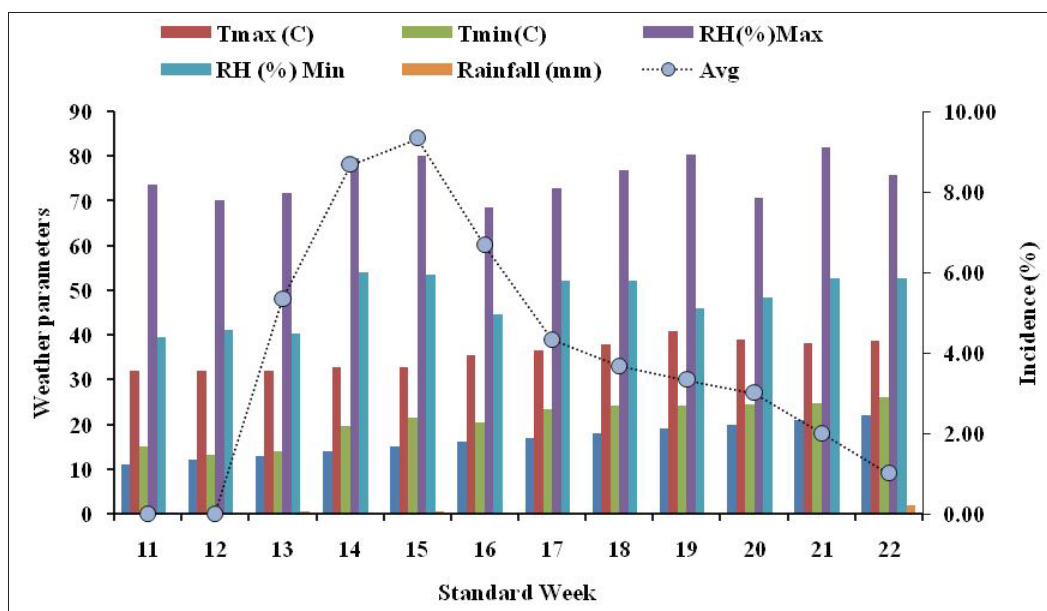


Fig.1. Relationship of weather parameters with incidence of litchi fruit & shoot borer

Table 1: Effect of weather parameters on the incidence of litchi fruit & shoot borer during the fruiting season

Parameters	Equation	R ² Value
T _{max} vs Incidence	$y = -0.216x + 11.68$	$R^2 = 0.045$
T _{min} vs Incidence	$y = 0.145x + 0.746$	$R^2 = 0.040$
RH (%) _{Max} vs Incidence	$y = 0.003x + 3.704$	$R^2 = 0.9E-05$
RH (%) _{Min} vs Incidence	$y = 0.083x + 0.003$	$R^2 = 0.046$
Rainfall (mm) vs Incidence	$y = 0.116x + 3.907$	$R^2 = 0.000$

correlation with population build up of litchi fruit & shoot borer. The weather factors are responsible for the population upsurge of fruit & shoot borer in the field conditions. But, other environmental factors were also been responsible for the incidence. Similar to our findings, Srivastava *et al.* (2017) also reported that occurrence of intermittent rains during fruit growth and development, which might have created the congenial environment for borer survival resulting higher borer population than usual days. From present study it may be concluded that intermittent rains favors population increase of fruit & shoot borer and temperature also plays crucial role. Presence of larvae in shoot/ panicle was noticed up to 16th standard week, after which it was shifted to fruit, clearly showed that pest preferred fruit over shoot/panicle. This study gives preliminary information which needs to be further intensifying with detailed observations, field biology and simulation studies. Less infestation of litchi fruit & shoot borer was noticed during study period due to non favorable climatic conditions for population build-up of pest.

Computation of losses caused by litchi fruit & shoot borer: Effect of different level of infestation (0-100%) caused by fruit & shoot borer are presented in Table-2. Data clearly showed that, there is no significant difference on infested panicle length of litchi shoots caused by fruit & shoot borer. However, maximum infested panicle length (45.67cm) was observed with 20% infestation level followed by 30% level of infestation with 41.33 cm panicle length along with minimum 35.30cm infestation due to 90% level of infestation against 45.70cm healthy panicle length in control (0.00% infestation level). However, significant effect was observed on panicle diameter due to fruit & shoot borer infestation. Maximum panicle diameter (0.49 cm) was noticed with 10 % level of infestation followed by 0.48 cm diameter with 20 % level of infestation and minimum (0.39 cm) due to 60 % level of infestation against 0.52 cm diameter in control (0.00 % infestation level). Further, in case of paracladia study no significant effect of infestation level was observed due to fruit & shoot borer infestation. Maximum no. of paracladia (16.00) was recorded with 50 % level of

Table 2: Effect of different level of fruit & shoot borer infestation on panicle size and fruit retention in litchi

Level of infestation	Mean of panicle length (cm)	Mean of panicle diameter (cm)	Mean of panicle paracladia (no.)	Fruit retention at initial stage (no.)	Fruit retention at harvest stage (no.)
100 %	36.93	0.42	15.67	12.33	2.00
90 %	35.30	0.40	13.33	15.33	5.67
80 %	36.60	0.40	14.00	10.00	2.67
70 %	37.43	0.41	14.33	14.00	4.67
60 %	37.43	0.39	15.67	15.00	3.67
50 %	35.70	0.41	16.00	28.17	8.33
40 %	40.43	0.47	14.00	29.00	10.67
30 %	41.33	0.46	15.33	30.83	12.00
20 %	45.67	0.48	15.67	30.00	15.00
10 %	40.20	0.49	15.00	33.17	21.00
0 %	45.70	0.52	16.00	40.33	27.33
SEm ($\pm$)		0.025		0.39	1.53
CD (P=0.05)	NS	0.075	NS	1.15	4.54

Table 3: Effect of infestation of litchi fruit borer on weight of fruit components in litchi

Parameters (mean of 10 fruits)	Fruit weight (g)	Peel weight (g)	Pulp weight (g)	Seed weight (g)
Healthy	24.33	2.74	17.51	4.08
Infested	17.35	2.39	11.33	3.63
SE (Healthy)	1.88	0.24	0.24	0.08
SE (Infested)	0.95	0.04	1.05	0.11

infestation followed by 15.67 paracladia was observed at three different level of infestation (100, 60 and 20% level of infestation) with minimum paracladia (13.33) at 90 % level of infestation against 16.00 paracladia in control. In case of fruit bearing potential, a significant difference was recorded at different level of infestation due to fruit & shoot borer (Table 2). At early stage Maximum no. (33.17 fruits/panicle) of fruit bearing was noticed with 10 % level of infestation followed by 30.83 fruits with 30 % level of infestation along with minimum (10.00 fruits) due to 80 % level of infestation against 40.33 fruits in control. A precise mark difference on fruit retention at harvest stage was noticed at different level of infestation. Maximum no. of fruits (21.00) were observed with 10 % level of infestation followed by 15.00 fruit due

to 20% level of infestation with minimum 2.00 fruits at 100 % level of infestation against 27.33 fruits in control (no infestation.). No. of fruit retention increased with decreasing the level of infestation is due to less fruit drop in healthy panicle/shoot. Moreover, as per accessible literature no such work has been conducted so far and therefore, to compute yield losses and establish Economic Threshold Level (ETL) against litchi fruit & shoot borer a series of experiments may be conducted.

Effect of fruit & shoot borer infestation on weight of fruit components were examined in the laboratory (Figure-2). Results clearly demonstrate that fruit borer reduce the fruit weight. Mean weight of infested fruit was 17.35 g against 24.33 g of healthy fruit. Similarly,

Table 4: Efficacy of newer insecticides against litchi fruit borer & shoot borer

Treatments details	Fruit infestation (%)			Yield (kg/ tree)
	Early stage	Mid stage	Harvest stage	
T ₁ - Spinetoram 11.7 SC (0.012%)	0.67 (4.58)	0.67 (4.58)	0.67 (4.58)	48.67 (44.22)
T ₂ - Flubendiamide 39.35 SC (0.012%)	1.33 (6.47)	0.33 (3.29)	0.33 (2.65)	50.00 (44.98)
T ₃ - Novaluron 5.25 % +Indoxacarb 4.5 % SC (0.0098%)	0.33 (3.29)	0.00 (0.00)	1.33 (6.47)	49.00 (44.41)
T ₄ - Triazophos 35 %+ Deltamethrin 1% EC (0.072%)	3.00 (9.96)	0.67 (4.69)	1.00 (5.68)	49.33 (44.60)
T ₅ -Spinosad 45 SC (0.016%)	0.00 (0.00)	0.00 (0.00)	0.33 (3.29)	50.33 (45.17)
T ₆ -Control	5.67 (13.73)	9.33 (17.78)	12.33 (20.54)	41.00 (39.80)
SEm (±)	0.73	0.13	0.20	1.25
CD (P=0.05)	1.56	0.67	0.81	4.00

*values in parenthesis are angular transformed

pulp weight of healthy fruit was also significantly more (17.51 g) against weight of infested fruit (11.33). However, no significant difference was noticed on peel weight while, healthy fruit registered less weight (2.74 g) against 2.39 g of infested fruit. Correspondingly to peel weight, no significant difference was observed with seed weight, as weight of healthy fruit seed was 4.08 against 3.63 g of infested ones (Table-3). Therefore, based on above findings it may be concluded that fruit & shoot borer considerably reduces the bearing potential of the litchi tree as well as reduce the fruit weight.

Study the effect of newer insecticides against litchi fruit & shoot borer: All the treatments significantly reduced the fruit borer infestation in comparison to control during the period of experimentation. No infestation was observed in treatment with spinosad 45 SC (0.016%) which is closely followed by novaluron 5.25 % +indoxacarb 4.5 % SC (0.0098%) with 0.33 % infestation at early stage against 5.67 in control (Table - 4). At mid stage, 0.00 population was observed in both the treatments [spinosad 45 SC (0.016%); novaluron 5.25 % + indoxacarb 4.5 % SC (0.0098%) followed by flubendiamide 39.35 SC (0.012%)] with 0.33 % infestation against 9.33 in control. At harvest stage, minimum infestation (0.33%) was observed in two treatments namely spinosad 45 SC (0.016%)

and flubendiamide 39.35 SC (0.012%) followed by spinetoram 11.7 SC (0.012%) with 0.67 % infestation against 12.33 in control. The results are in line with the findings of Srivastava *et al.* (2017) who recorded minimum (2.23%) litchi fruit borer infestation with novaluron 0.015% against 16.90 % in control. Field efficacy of IGRs, spinosad and flubendiamide are quite effective in regulating lepidopteran pests at very low doses due to their advance chemistry, good persistence and novel mode of action. (Srivastava *et al.*, 2004, Sreedhar 2019). Additionally, insecticidal combinations with different properties such as nature and action, are more effective against target pests (Reddy *et al.*, 2018). Further, these molecules are less hazards as comes under green umbrella as per toxicity level and therefore, safer to natural enemies and environment while spraying in field (Tohnishi *et al.*, 2005, Srivastava *et al.*, 2007). Similarly, Srivastava *et al.* (2015b) also reported flubendiamide, chlorantraniliprole, neonicotinoids and pyrethroids are highly effective against lepidopteran pests of litchi. The results are also in line with the findings of Srivastava *et al.* (2016) who reported that the three spraying of flubendiamide and/or thiacloprid or chlorantraniliprole at recommended dose kept the litchi fruit & shoot borer infestation below threshold level and care other insect pests too.

From this study, it can be concluded that intermittent rains favors population build-up of fruit & shoot borer and temperature also plays crucial role. Further, fruit & shoot borer considerably reduces the bearing potential of the litchi tree as well as reduce the fruit weight. Newer molecules, namely spinetoram, flubendiamide, novaluron 5.25 % + indoxacarb 4.5 %, Triazophos 35 % + deltamethrin 1% EC and spinosad may be incorporated against litchi fruit & shoot borer management programme.

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REFERENCES

- Divekar, P., Kumar, P., Suby, S. B. 2019. Screening of maize germplasm through antiobiosis mechanism of resistance against *Chilopartellus* (Swinhoe). *Journal of Entomology and Zoology Studies*, **7**:1111-4.
- Divekar, P. A., Majumder, S., Halder, J., Kedar, S. C., Singh, V. 2024. Sustainable pest management in cabbage using botanicals: Characterization, Effectiveness and Economic Appraisal. *Journal of Plant Diseases and Protection*, **131**(1):113-30. <https://doi.org/10.1007/s41348-023-00848-z>.
- Divekar, P. A., Narayana, S., Divekar, B. A., Kumar, R., Gadratagi, B. G., Ray, A., Singh, A. K., Rani, V., Singh, V., Singh, A. K., Kumar, A. 2022. Plant secondary metabolites as defense tools against herbivores for sustainable crop protection. *International journal of molecular sciences*, **23**(5):2690.
- Divekar, P. A., Patel, S. K., Singh, V., Singh, J. 2022. Spinetoram, a Selective Novel Insecticide Able to Check Key Lepidopteran Pests in Cabbage Ecosystem. *Pakistan Journal of Zoology*, **56**(2) DOI: <https://dx.doi.org/10.17582/journal.pjz/20220724130756>.
- Divekar, P. A., Rani, V., Majumder, S., Karkute, S. G., Molla, K. A., Pandey, K. K., Behera, T. K., Govindharaj, G. P. 2023. Protease inhibitors: an induced plant defense mechanism against herbivores. *Journal of Plant Growth Regulation*, **42**(10):6057-73. <https://doi.org/10.1007/s00344-022-10767-2>.
- Divekar, P. A., Singh, K., Verma, C. K., Rai, A. B., Singh, B., Yadav, S., Karkute, S.G. 2023. Assessment of bee flora and development of a floral calendar in relation to pharmaceutical potential of honey and bee pollen in Eastern Uttar Pradesh, India. *Annals of Phytomedicine*, **12**(1):844-55.
- Divekar, P. A., Singh, K., Yadav, S., Manimurugan, C., Patel, S. K. 2023. Diversity and foraging behaviour of insect pollinators in Cauliflower. *Ecology Environment & Conservation*, **29**(2):971-978.
- Kodandaram, M. H., Divekar, P. A., Wangi, N., Mohite, N. R., Rai, A. B. 2024. Optimizing sucking pest control in okra: an analysis of flupyradifurone 200 SL effectiveness, phytotoxicity, safety to natural enemies, pollinators and cost-efficiency. *Journal of Plant Diseases and Protection*, **131**(3):757-71.
- Kumar, A., Pandey, S. D., Patel, R. K., Rai, R. R., Srivastava, K. and Nath, V. 2014. Studies on feasibility of intercropping under litchi based cropping system. *The Ecoscan Special issue* **5**:101-109
- Kumar, A., Pandey, S. D., Patel, R. K., Singh, S. K., Srivastava, K. and Nath, V. 2015. Induction of flowering by use of chemicals and cincturing in Shahi litchi. *The Ecoscan Special issue*, **7**: 493-496.
- Patel, R. K., Srivastava, K., Kumar, A., Pandey, S. D. and Nath, V. 2020a. Technology for improving productivity of low lying area through land shaping techniques with litchi based cropping system. *Hort Flora Research Spectrum*, **9**: 59-60.
- Patel, R. K., Srivastava, K., Pandey, S. D., Kumar, A., Purbey, S. K. and Nath, V. 2020b. Productivity improvement of low lying area with litchi (*Litchi chinensis*) based integrated system. *Indian Journal of Agricultural Sciences*, **90**: 762–766.
- Reddy, B. K., Paul, A., Anitha, N., George, T. and Amritha, V. S. 2018. Efficacy of insecticide mixtures against sucking pests of Cowpea. *Journal of Entomology and Zoology studies*, **6**: 2246-2250.
- Reddy, P. V. R., Srivastava, K. and Nath, V. 2016. Litchi fruit borers. *Current Science*, **10**:758-759.
- Shinde, P. G., Divekar, P. A., Singh, D. K., Pal, D. S., Nadaf, A. 2021. Bio-pesticide management strategy for mustard aphid *Lipaphis erysimi* (Kaltenbach) (Homoptera: Aphididae). *The Pharma Innovation Journal*, **10**(7):397-400.

- Sreedhar, U. 2019. Field evaluation of new insecticides against budworm, *Helicoverpa armigera* (Hubner) in flue cured Virginia tobacco. *Journal of Entomology and Zoology studies*, **7**: 417-420.
- Srivastava, K., Choudhary, J. S., Patel, R. K., Reddy, P. V. R. and Nath, V. 2018. Identification and phylogenetic analysis of fruit borer species of litchi using DNA barcode sequences. *Indian Journal of Horticulture*, **75**: 415-422.
- Srivastava, K., Patel, R. K., Kumar, A., Pandey, S. D., Reddy, P. V. R. and Nath, V. 2017. Integrated management of litchi fruit and shoot borer (*Conopomorpha sinensis*) using insect growth regulators under subtropics of Bihar. *Indian Journal of Agricultural Sciences*, **87**: 1515–1518.
- Srivastava, K., Patel, R. K., Kumar, A., Rai, R. R. and Nath, V. 2015a. Seasonal incidence and management of ash weevil (*Myloecerus undecimpustulatus*) population on litchi. *The Ecoscan*, **8**: 161-65.
- Srivastava, K., Patel, R. K., Pandey, S. D., Kumar, A. and Nath, V. 2015b. Integrated management of lepidopteran defoliators in litchi under subtropics of Bihar. *The Ecoscan. Special issue*, **7**: 483-487.
- Srivastava, K., Purbey, S. K., Patel, R. K. and Nath, V. 2016. Managing fruit borer for having healthy litchi. *Indian Horticulture*, **61**: 39-4.
- Srivastava, K., Rahman, S. M. A. and Ram, S. 2004. Effect of sublethal doses of lufenuron against *Spodopteralitura* Fab. and *Spilarctia obliqua* Walk. *Indian Journal Entomology*, **66**: 287-292.
- Srivastava, K., Rahman, S. M. A. and Ram, S. 2007. Evaluation of insect growth regulators against soybean defoliators. *Annals of Plant Protection Sciences*, **15**: 294-298.
- Tohnishi, M., Nakao, H., Furuya, T., Seo, A., Kodama, H., Tsubata, K. 2005. Flubendiamide, a novel insecticide highly active against Lepidopterous insect pests. *Journal of Pesticide Science*, **30**: 354-360.

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