



Plant Archives

Journal homepage: <http://www.plantarchives.org>
DOI Url : <https://doi.org/10.51470/PLANTARCHIVES.2022.v22.sppecialissue.001>

STEM BORER INFESTATION AND THEIR MANAGEMENT THROUGH IPM APPROACHES IN TASAR FOOD PLANTS

J. Singh^{1*} M.M Baig¹, V. Mittal¹, S. Das¹, H. Gadad¹, R. Banerjee² and K. Sathyanarayana¹

¹Central Tasar Research and Training Institute, Ranchi – 835303 India

¹ Indian Agricultural Statistical Research Institute, New Delhi-110012. India

*Corresponding author: Email: jitendrasingh.iari@gmail.com & Mob. 91+9811301952

ABSTRACT

The mean severity of stem borer was low in tasar food plants in tasar growing areas of Jharkhand (3.5%), Chhattisgarh (2.4), Odisha (0.7%), Maharashtra (2.5%) and Telangana state (2.8%). Directional approach for monitoring and management of stem borer was quite effective (half part of the plot N-W-S showed near two times more infestation in Asan plants and three times more in Arjun plants as compared to half part of the plot N-E-S). Spray of Neem based pesticide (1:5 ratios) and lime (5 & 10 %) with fevicol (1 ml/l) was effective practice to avoid oviposition of stem borer. Clean hole with knife & aluminum wire + Insert cotton wool soaked in emulsion of Neem based pesticide 1:5 and emulsion of Kerosin/diesel/petrol showed best results for management of stem borer at grub stage; whereas, at adult stage, light trap was effective method to control younger stage of stem borer in food plants.

Keywords: Congenial weather, directional approaches, infestation, IPM and light trap.

Introduction

Primary tasar food plants namely Arjun, *Terminalia arjuna* (Bedd.) and Asan *T. tomentosa* (W&A) are infested by many insect pests. The degree of damage caused by these pests varies depending upon their nature. Few of them, eats the whole leaves; others suck the sap and/or feed bark of the tree. Certain pests tunnel into the stem and branches and cause severe damage during younger and fully grown stages of plants. Stem borers is a highly destructive pest in tasar food plants. It considerably damage (05-15%) the stems of tasar host plants extends up to 30% while heavy infestation. It not only affects the quantity and quality of leaves but also cause death of affected branches or entire plants. Stem borer is widely distributed in India and attacks on tasar food plants primarily *T. tomentosa* W. & A. (Asan) and *T. arjuna* W. & A. (Arjun), at older growth stages because it prefers eggs laying on old tree with rough surface and crack bark. Heavy infestation of stem borers kills both Arjun & Asan by making tunnels inside main stem by grubs. The grub is damaged either on roots or stems. The grubs after hatching from eggs first feed on bark and make irregular cavities. It makes tunnels which may either be in boring upward, resulting in drying of branches or entire plants (Sources – Extension Technical Bulletin-2017, CTR & TI, Ranchi). Hence, this comprehensive study was investigated to know egg laying behaviour (direction wise infestation at individual plant and plot levels) in nature and management practices of stem borer in tasar food plants.

Materials and Methods

Region wise assessment of stem borer infestation in tasar food plants: A region wise survey was conducted at major

tasar growing states viz., Jharkhand, Chhattisgarh, Odisha, Maharashtra and Telangana to assess the average infestation of stems borer in tasar food plants.

Description of the study area for infestation (% and direction wise) and management: Study area is situated at Piska- Nagri, district of Ranchi, Jharkhand state. It is lying between 22° 30' and 24° 30' N E Latitude and between 83°22' and 85° 06' E Longitude at an altitude of 651 meters above MSL.

Plot wise infestation of stem borer in tasar food plants: Arjun and Asan plants were randomly selected and assessed total numbers of infested plants by stem borer at CTR&TI, Ranchi farm.

Direction wise infestation of stem borer in tasar food plants: Each plant has categorized into four direction viz., East (E), West (W), North (N), South (S) and plant axis (EW) & (NS). Likewise, each plot has initially categorized into four parts viz., North East (NE), North West (NW), South East (SE) and South West (SW).

Formulation of Neem based pesticide in lab : About 1 kg Neem leaf was mixed in bucket containing 500 g curd diluted to two liter with water). Solution was, then, stored in an earthen pot after pot mouth covered with muslin cloth. This was remaining undisturbed in dark room for 15 days. After 15 days, this solution was blended by using mixture grinder or *Silbatta* followed by filtered by muslin cloth. This filtrate was used as a mother solution for bio – pesticides. Prepared mother solution and water were used in the ratio of 1:5 and 1:10 (i.e. 1 time mother solution and 5 and 10 times water) to assess the effectiveness of Neem based pesticide formulation on stem borer (Singh *et al.*, 2018).

Treatment combinations to avoid the egg laying of stem borer in tasar food plants

- T₀ - Control
 T₁ - Scrubbing the bark
 T₂ - T₁ + Spray Azadirachtin at 5 ml/l
 T₃ - T₁ + Spray Azadirachtin at 10 ml/l
 T₄ - T₁ + Spray Neem extract + water at 1:5 ratio
 T₅ - T₁ + Spray Neem extract + water at 1:10 ratio
 T₆ - T₁ + Spray lime 5%
 T₇ - T₁ + Spray lime 10%

Treatment combinations for management of stem borer at larval stages in food plants

- T₀ - Control
 T₁ - Clean hole with knife and aluminum wire/cycle spoke
 T₂ - T₁+ Insert cotton wool soaked in emulsion of Azadirachtin (25ml/l)
 T₃ - T₁+ Insert cotton wool soaked in emulsion of Azadirachtin (50ml/l)
 T₄ - T₁+Insert cotton wool soaked in emulsion of 1:5 Neem extract+water
 T₅ - T₁+Insert cotton wool soaked in emulsion of 1:10 Neem extract+water
 T₆ - T₁+ Insert cotton wool soaked in emulsion of Kerosin oil
 T₇ - T₁+ Insert cotton wool soaked in emulsion of Diesel oil
 T₈ - T₁+ Insert cotton wool soaked in emulsion of Petrol oil

Statistical analysis: Standard statistical analysis was carried out for directional approach for monitoring and management of stem borer in tasar food plants. The data was analyzed using PAST-3.14 Statistical software Analysis of Variance for unreplicated data was carried out considering the four directions viz. North, south, West, East as the four factors at plant level and plot level followed by Multiple Comparison Procedures were used; The data being analyzed following Tukeys'Q procedure to show statistically significant differences between each of the directions based on p-values for both Arjun and Asan at Plot level and Plant level.

Results and Discussions

Survey on stem borer infestation in various states

Details on Stem borer infestation in tasar food plants from various tasar growing states viz., Jharkhand (CTR & TI, Ranchi, BSM & TC, Kharswan, BSM & TC, Kathikund), Chhattisgarh (BSM & TC, Pali, BSM & TC, Pendari), Maharashtra (RTRS, Bhandara, BSM & TC, Bhandara) Odisha (RTRS, Baripada, BSM&TC, Baripada) and Telangana (BSM&TC, Chennur) was given in Table -1. Maximum infestation of stem borer was observed in Asan plants at CTR & TI, Ranchi (5%) and minimum at RTRS, Baripada (0.5%). In Arjun plants, BSM & TC, Bhandara (3.2%) recorded higher infestation of stem borer and lower infestation at RTRS, Bhandara (1.8).

Stem borer infestation in tasar food plants at different PPC, centre in Jharkhand

Arjun plant is growing in all the PPC Centre for rearing of tasar silkworm except PPC, Kathikund where grown Asan. A higher stem borer infestation was observed at PPC, Naomundi (4%) and lower infestation in PPC, Kathikund (0.4%) with 2.36% average infestation. This indicates low severity of stem borer in all PPC centre; hence, mechanical and organic pesticides were only used for stem borer management. These methods not only help to reduce the cost of protection but also decreases rely on chemicals.

Direction wise stem borer severity for assess egg laying behavior and management strategy

Assessment of stem borer infestation at plots level and direction wise in primary tasar food plants namely, Asan *Terminalia tomentosa* (plot number 4, 9, 10, 14, 19, 23, 24) and Arjun *Terminalia arjuna* (plot number 5, 11, 18) are given in table number (3 and 4). The results showed that average 5% stem borer infestation was recorded in Asan plots whereas 3% infestation occurs in Arjun plots at CTR&TI, Ranchi. The infestation was higher in plot number 4 (16% of total infestation) and lower infestation about 2% observed from each Plot 14, 19 and 23 for Asan plots with mean 5%. While in Arjun plots, higher infestations *i.e.* 8.3 % was observed in plot number 18 and lower in plot number 11 (0.5 %). Direction wise plant level results further revealed that stem borer infestation was severe from west direction of individual plant (65 no,s) in plot number 4 and minimum observed from north direction (3 no,s) in the plot number 14 and from south direction in plot number 23 for Asan growing plots whereas in case of Arjuna plots, the maximum pest severity was observed from west direction (52) in plot number 18 and minimum from north direction (1) in plot number 11. Overall direction wise average infestation of pest was highest from west direction (27) whereas lowest from north direction (10) at individual plant level. Similar trend was also observed for Arjuna plants. Direction wise at plot level average infestation of stem borer from North-East – South and North-West- South was 18 and 37, respectively in Asan plant. Similar trend was also observed for Arjuna plants. This simple approach would reduce monitoring time, pesticide application, cost of protection pollution load and can be incorporated as a component of integrated pest management (IPM) in tasar food plants (Singh *et al.*, 2018).

Table 1 : Stem borer infestation in different tasar growing states

State	Centre	Food plants	Severity %
Jharkhand	CTR&TI, Ranchi	Asan	5.0
		Arjun	3.0
	BSM&TC, Kharswan	Arjun	2.0
	BSM&TC, Kathikund	Arjun	2.5
Chhattisgarh	BSM&TC, Pali	Arjun	2.5
	BSM&TC, Pendari	Arjun	2.3
Maharashtra	RTRS, Bhandara	Arjun	1.8
	BSM&TC, Bhandara	Arjun	3.2
Odisha	RTRS, Baripada	Asan	0.5
	BSM&TC, Baripada	Asan	1.0
Telangana	BSM&TC, Chennur	Arjun	2.8

Table 2 : Stem borer infestation in tasar food plants at different PPC, centre in Jharkhand

S.No.	Centre	Food plants	Severity %
1	PPC, Kharsawan	Arjun	3.0
2	PPC, Chaibasa	Arjun	1.0
3	PPC, Naomundi	Arjun	4.4
4	PPC, Hatgamharia	Arjun	2.0
5	PPC, Debrasai	Arjun	2.5
6	PPC, Chakradharpur	Arjun	2.8
7	PPC, Bharbharia	Arjun	3.5
8	PPC, Manoharpur	Arjun	1.5
9	PPC, Kathikund	Asan	0.4
10	PPC, Bengabad	Arjun	2.5
Mean			2.36

Table 3 : Stem borer infestation in Asan (*Terminalia tomentosa*) plants

Plot wise infestation				Direction wise stem borer infestation							
Plot. No.	Total plants	Infested plants	Severity (%)	Plant level				Plot level			
				East (E)	West (W)	North (N)	South (S)	N-E	S-E	N-W	S-W
4	810	129	16	32	65	32	34	20	26	38	45
9	840	66	8	21	29	9	20	15	6	20	25
10	812	30	4	9	12	4	11	5	4	13	8
14	1470	28	2	4	18	3	4	6	4	10	8
19	3560	85	2	26	35	10	22	14	11	25	35
23	874	19	2	4	15	5	3	2	3	8	6
24	763	33	3	11	14	6	8	4	6	8	15
Mean	1304	56	5	15	27	10	15	9	9	17	20
				E-W (42)		N-S (25)		N-E-S (18)		N-W-S (37)	

P values, uncorrected significance				
	East (E)	West (W)	North (N)	South (S)
East (E)		0.1146	0.2677	0.8743
West (W)	0.1146		0.007362*	0.1149
North (N)	0.2677	0.007362*		0.3174
South (S)	0.8743	0.1149	0.3174	

*Significant difference was observed between North and west direction in Asan plants at plants level

P values, uncorrected significance				
	North- East (NE)	South – East (SE)	North- West (NW)	South- West (SW)
North- East (NE)		0.7484	0.07774	0.06916
South – East (SE)	0.7484		0.0371*	0.03251*
North- West (NW)	0.07774	0.0371*		0.9574
South- West (SW)	0.06916	0.03251*	0.9574	

* Significant difference was observed between south east and (north west & south west) in Asan plot at plot level

Table 4 : Stem borer infestation in Arjuna (*Terminalia arjuna*) plants

Plot wise infestation				Direction wise stem borer infestation							
				Plant level				Plot level			
Plot. No.	Total plants	Infested plants	Severity (%)	East (E)	West (W)	North (N)	South (S)	N-E	S-E	N-W	S-W
5	2550	29	1.14	11	9	4	6	6	4	9	10
11	2385	12	0.5	4	6	1	2	3	0	4	5
18	840	70	8.3	17	52	3	3	8	9	17	36
Mean	1925	37	3	11	22	3	4	6	4	10	17
				E-W (33)		N-S (7)		N-E-S (10)		N-W-S (27)	

P values, uncorrected significance				
	East (E)	West (W)	North (N)	South (S)
East (E)		0.6631	0.03961*	0.07959
West (W)	0.6631		0.0394*	0.04207*
North (N)	0.03961*	0.0294*		0.5516
South (S)	0.07959	0.04207*	0.5516	

*Significant difference was observed between North and south direction with west direction in Arjun plants in plant level

P values, uncorrected significance				
	North- East (NE)	South – East (SE)	North- West (NW)	South- West (SW)
North- East (NE)		0.6273	0.24469	0.08577
South – East (SE)	0.6273		0.1003	0.02755*
North-West (NW)	0.2469	0.1003		0.5753
South- West (SW)	0.08577	0.01755*	0.5753	

*Significant difference was observed between south east and south west in Arjun plots at plot level

Effect of Azadirachtin, Neem based pesticides spray and Lime with fevicol brushing on Asan plant to avoid stem borer egg lying on tasar food plants

Effect of Azadirachtin, Neem based pesticides spray and Lime with fevicol brushing on Asan and Arjun plants to avoid stem borer egg lying on tasar food plants are given in Table -5A and 5B. A higher number of stem borers was recorded in control (3) and lower (nil) infestation in treatment 6 and 7 (scrubbing the bark with different dose of lime with fevicol). Most of the treatment combinations showed positive effect towards avoidance of the egg laying

of stem borer in Asan plants at CTR&TI, Ranchi research farm. Besides, application of Lime with fevicol was found more effective than other treatments in Asan plants. Similar results were also observed in arjun plants. Spraying 10% lime (spray lime at 20kg in 200 litres of water along with 200 ml Fevicol DDL) on main stem and thick primaries is found to afford good protection against the borer attack. It is best if the lime spray is taken up after a light scrubbing of the stem so that the loose scaly bark is removed and the lime adheres better (Sources: Central Coffee Research Institute).

Table 5A : Assessment of Azadirachtin, Neem based pesticides and Lime on Asan plants on stem borer egg laying

Treatments	R ₁	R ₂	R ₃	R ₄	R ₅	Total stem borer on 5 plants
T ₀ (Control)	0	1	0	0	1	2
T ₁	0	0	1	0	0	1
T ₂	0	1	0	0	0	1
T ₃	0	0	1	0	0	1
T ₄	0	0	0	0	1	1
T ₅	0	0	0	0	0	1
T ₆	0	0	0	0	0	0
T ₇	0	0	0	0	0	0

Table 5B : Assessment of Azadirachtin, Neem based pesticides and Lime on Arjun plants on stem borer egg laying

Treatments	R ₁	R ₂	R ₃	R ₄	R ₅	Total stem borer on 5 plants
T ₀ (Control)	0	1	1	0	0	2
T ₁	0	0	1	0	0	1
T ₂	0	0	0	1	0	1
T ₃	0	1	0	0	0	1
T ₄	0	0	0	0	0	1
T ₅	0	0	0	1	0	1
T ₆	0	0	0	0	0	0
T ₇	0	0	0	0	0	0

Effect of treatment combinations for management of Stem borer at larval stages in asan plants

Effect of different treatment combinations for management of Stem borer at larval stages in tasar asan and arjun plants are given in table number 6A and 6B. Under this experiment, five stem borer infected asan plants were randomly selected and applied management practices for assessing the efficacy of different treatment combinations of stem borer management in Asan food plants. Most of the treatment combinations showed positive effect for controlling / killing of stem borer in Asan plants. Among these treatment combination clean hole with knife and aluminum wire / cycle spoke + Insert cotton wool soaked in emulsion of Neem based pesticide 1:5 and clean hole with knife and aluminum

wire / cycle spoke + Insert cotton wool soaked in emulsion of Kerosin/diesel/petrol showed best results for management of stem borer in Asan plants. Similar results were also observed in arjun plants. Spray 1.5 ml/liter azadirachtin 10000 PPM (EC) reduced 56.67% flat heated stem borer in Arjuna plants (Preeti *et al.*, 2019). Clean hole and insert cotton wool soaked in emulsion of kerosene or petrol in each hole and plug them with mud was effective method for stem borer control (Sources: Extension Bulletin No. 1 - IPM schedule for mango pests, 2012). Block the tunnel hole by cleaning and inserting cotton wool soaked in emulsion of DDVP (0.05%) or kerosene/ petrol and pack them with mud (Godse *et al.*, 2015).

Table 6A : Assessment of different treatment combination on Asan plants for management of stem borer

Treatments	R ₁	R ₂	R ₃	R ₄	R ₅	Stem borer after treatment in Asan plant
T ₀ (Control)	1	1	1	1	1	3
T ₁	1	1	1	1	1	2
T ₂	1	1	1	1	1	1
T ₃	1	1	1	1	1	1
T ₄	1	1	1	1	1	0
T ₅	1	1	1	1	1	1
T ₆	1	1	1	1	1	0
T ₇	1	1	1	1	1	0
T ₈	1	1	1	1	1	0

Table 6B : Assessment of different treatment combination on Arjun plants for management of stem borer

Treatments	R ₁	R ₂	R ₃	R ₄	R ₅	Stem borer after treatment in Arjun plant
T ₀ (Control)	1	1	1	1	1	2
T ₁	1	1	1	1	1	1
T ₂	1	1	1	1	1	1
T ₃	1	1	1	1	1	1
T ₄	1	1	1	1	1	0
T ₅	1	1	1	1	1	1
T ₆	1	1	1	1	1	0
T ₇	1	1	1	1	1	0
T ₈	1	1	1	1	1	0

Assessment of congenial weather for stem borer in tasar food plants at CTR & TI, Ranchi research farm

Assessment of congenial weather for stem borer in tasar food plants at CTR&TI, Ranchi research farm are given in Table -7. On the basis of interactive approach between weather and stem borer collected from per light trap, a higher infestation was observed in 32 standard meteorological week; whereas, no infestation was observed in 26 standard meteorological week. Congenial weather for outbreak of stem borer was observed from 30 standard meteorological weeks (SMW) to 32 SMW during this period. Number of

Stem borers per light trap was high viz., 30SMW (8stem borer/light trap), 31 SMW (11 stem borer/light trap) and 32 SMW (12 stem borer / light trap). Before 28 SMW and after 33 SMW, severity of stem borer was quit low or nil. On the basis of average two year data, application of light trap was just effective from 27 SMW to 34 SMW for trapping adults stem borer. The infestation of stem borer in tasar food plants was showed positive correlation with RHI, RHII and rainfall; whereas, negative correlation was recorded with maximum and minimum temperature.

Table 7 : Assessment of congenial weather for management of stem borer in tasar food plants

SMW	T max (°C)	T min (°C)	RHI (%)	RHII (%)	RF (mm)	Borer/light trap
26	27.57	23.42	82.00	88.42	120	0
27	49.14	24.14	80.28	83.00	100	1
28	29.28	25.42	77.71	75.00	67	3
29	28.00	24.57	79.14	86.28	260	3
30	26.14	23.28	94.14	92.00	422	8
31	26.24	23.42	76.28	77.71	205	11
32	26.85	23.57	83.00	79.85	346	12
33	27.83	24.66	80.33	80.66	201	4
34	29.00	24.20	69.40	82.80	320	1
C.C	-0.51	-0.25	0.07	0.34	0.30	1.00

Conclusion

The severity of stem borer was low in tasar food plants in tasar growing areas in India. Directional approach for monitoring and management of stem borer was quite effective in tasar food plants which could reduce the monitoring time and pesticide application. Spray Neem based pesticide and lime with fevicol (1 ml/l) was effective practices to avoid egg laying of stem borer. Clean hole with knife and aluminum wire + Insert cotton wool soaked in emulsion of Neem based pesticide 1:5 and insert cotton wool soaked in emulsion of Kerosin/diesel/petrol showed best results for management of stem borer at grub stage; whereas, at adult stage, light trap was effective method to control adult stem borer in food plants.

Acknowledgement

Work is an output of the Project ARE- 4719- entitled “Studies of population dynamics of stem borer (s) in tasar host plant and their management through IPM approaches’ funded by Central Silk, Board, Bangalore.

References

Godse, S.K.; Pushpa, D.P.; Ajay, M. and Ahuja, D.B. (2015). Major insect pests and diseases of mango and their management, Pests of Fruit Trees (Citrus, Banana, Mango, Pomegranate and Sapota) E-Pest Surveillance and Pest Management Advisory, publishers ICAR-

National Research Centre for Integrated Pest Management, New Delhi and State Department of Horticulture, Commissionerate of Agriculture, Pune (Maharashtra): (35):124.

Tirkey, P.; Chandrashekharaiiah, M.; Rathore, M.S.; Singh, R.K.; Sinha, R.B. and Sahay, A. (2019). Studies on Level of Infestation of Flat Headed Borer and Bark Eating Caterpillar on *Terminalia arjuna* and their Management using Insecticides, *International Journal of Current Microbiology and Applied Sciences* ISSN: 2319-7706 8 (01): 598-605.

Singh, J.; Mittal, V.; Singh, G.P. and Kumar, N. (2018). “Directional approach: a new direction for monitoring and management of stem borer in tasar food plants” National conference on Harmony with Nature in Context of Biodiversity Conservation and Ecosystem Management, Organized by Dept. of Zoology, St. Xavier College, Ranch – Jharkhand Oct, 28-30, 51.

Singh, J.; Vishal, M.; Singh, G.P. and Kumar, N. (2018). Formulation and implementation of Neem based pesticide for management of bark eating caterpillar in tasar food plants, National conference on Harmony with Nature in Context of Biodiversity Conservation and Ecosystem Management, Organized by Dept.of Zoology, St.Xavier College, Ranch – Jharkhand Oct, 28-30, 54.