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## Seasonal incidence and population dynamics of important insect pests infesting gambhar *Gmelina arborea* Roxb. at coastal agro ecosystem of Odisha, India

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### Abstract

*Gmelina arborea* Roxb (Gambhar) is a rapidly growing tree, with its drought and shade tolerance and excellent wood properties. The present study revealed that *Calopepla leayana* is the major defoliator of this species recorded at Bhubaneswar during the study period (2017-18). Out of the total 22 species recorded 10 species were foliage feeders(47.61%),8 species were sap feeders (38.09%), one species each from shoot borer (4.76%) and bark feeder, and 2 species were recorded as root and bark feeders (9.52%). Gambhar defoliator larval population in leaves was first noticed during June 2018 with peak population recorded during 1st fortnight of September 2017(9.30/leaf) after which a downward trend was recorded up to November 1st fortnight 2017. Population of Gambhar shoot weevil was recorded throughout the experimental period with highest population (6.20/branch) recorded during 2nd fortnight of January 2017. The lowest population was recorded during 2nd fortnight of June 2018.

**Keywords:** *Gmelina arborea*, population dynamics, defoliators, shoot borer

### Introduction

*Gmelina arborea* Roxb. (Gambhar) is a rapidly growing tree, with its drought and shade tolerance and excellent wood properties, considered as an important plantation species for afforested and avenue plantations. The greatest threat to plantations of this tree is damage due to pests and diseases. Numerous insect pests and pathogens have been recorded in stands of *Gmelina* in areas where the trees are native. In plantations within the natural range of the tree, insects have caused substantial damage. Among these, the defoliator *Calopepla leayana* (Chrysomelidae) appears to be most important followed by the shoot borer *Alcidodes ludificator*. Losses are more recorded in Asiatic countries including India, Myanmar, Malaysia etc. *Calopepla leayana* (Latreille) alone reported to damage 10% seedlings in Indiaby Nair, 2007 [1]. Other earlier workers considered it as the most damaging pest. Aung-Zeya, 1981 [4], 1983 [5]; Nair and Mathew, 1988 [11]. All indications are available that pathogens and insect pests will become much more serious constraint to the propagation of *Gmelina* in the future. However, excellent opportunities exist to resolve such problems through biological control of insects and integrated pest management. Hence, in the present investigation an attempt is being made to document the species of insect pests attacking Gambhar, their seasonal variation in abundance to initiate work on formulation of integrated pest management programme in the agro climate of coastal Odisha

### Materials and Methods

Abundance of insects were recorded from 3 different locations of Bhubaneswar during first fortnight July, 2017 to Aug 2018. Bhubaneswar is situated at an elevation of 25.9 m above mean sea level at 20° 15' N latitude and 85° 52' E longitude. It is situated in the East & South East Coastal Plain zone of Odisha, which falls under Tropical wet-dry or Tropical Savanna forest type. At different locations, trees showing uniform growth pattern and age were selected, plants were divided into 3 categories such as (i) Seedlings (ii) Plants- 1-3 year old (Saplings) (iii) Plants- more than 3 years old as followed by Pandey *et al.*, 2010 [14]. For saplings and third category plants, ten number of saplings and ten terminal twigs/sapling were randomly selected and from more than three years plants five plants were selected and 10 no of twigs were selected from lower, middle and upper canopy, from which all leaves were sampled

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for observing the presence of grubs or adults of defoliator/standard branch. No of infested twigs due to shoot weevil attack out of total twigs present per branch was also recorded to calculate the percentage. No of infested foliage out of total was recorded from 100 no's of randomly selected seedlings and % defoliation was computed in each case after using standard formula

$$\% \text{ defoliation} = \frac{\text{no. of infested leaves}}{\text{total no. of leaves in the seedlings plants of 1-3 years or more than 3 years old}} \times 100$$

Flying and slow moving insects were collected by means of a swift net and preserved appropriately. Immature stages of Lepidopterous and Coleopterous insects were reared in the post graduate laboratory up to adult stage in natural food medium in plastic cups of 4 inch diameter and 4 inch depth after following all the sanitation practices. Identification was established either by personnel experience or from Entomology museum or by consulting professors of Entomology Department or from Internet sources as followed by Patil *et al.*, 2016 <sup>[15]</sup>, and Tripathy *et al.*, 2018 <sup>[17]</sup>. Specimens were preserved by following appropriate techniques. In case of delay in identification appropriate preservation technique was followed. Insects were identified either by directly collected from field or by rearing of field collected countable number of eggs. The identity was confirmed from bio-control laboratory of Department of Entomology, College of Agriculture O.U.A.T, and Bhubaneswar-3.

## Results and Discussion

As depicted in table 1 a total of 22 insect pests were recorded during the study period. While categorizing the recorded insects on the basis of mode of damage foliage feeders are found as the dominant groups comprising 47.61% of total recorded insect pests followed by sap feeders (38.09%). The bark as well as root feeders like termites comprised the third largest group (9.52%) and *Inderbela quadrinotata*, the bark feeder and the shoot weevil *Alcidodes ludificator* were the smallest groups recorded from the studied location (Fig-1). While categorizing the available insects on taxonomic aspects (fig-2) Hemipterous insects are found as pioneer among all, comprising of 38% followed by the Lepidopterous insects. A brief introduction regarding their morphology and nature of damage is given below.

### Coleoptera

**Gambhar defoliator:** Major defoliating beetle and adults are metallic in colour 12-16mm in length, violet to blue elytra and pale yellow to reddish brown pronotum and legs. Larvae are having lateral spines. The excrement instead of being ejected is extruded in fine black filaments; longer than body and formed bunches at anal end. The molted skin is also attached to the last abdominal segment. When disturbed the larvae assumes defensive posture. Pupae are dull coloured and (Plate. 3, 5, 6.) attached to infested leaves.

**Gambhar shoot weevil:** Adults are small weevil with 5-8mm length, dark brown in colour and with few light bands on the elytra. Snout long. They found changing the growing points of main or side branches or petioles of younger leaves. Beetle falls down on the ground feigning dead at slightest touch. More prevalent during rainy and summer season. Grubs are yellowish in colour, small and apodous. Remain inside the

shoot tip, feeds on the internal content and causes killing of the growing shoots. So forms epicormic branches at the tip.

### Hemiptera

**Mealy bugs:** Three species of mealy bugs as per Table 1 has been recorded. They are stationary sap feeding and soft bodied insect, and their body is covered with white waxy secretions. First instar nymphs are active and called as crawlers which are reddish in colour and active in habit. After hatching from eggs in soil they climb upon the trees and this stage provides a good opportunity for control.

**Aphids:** One species of aphid was recorded. They are small, soft bodied, pyriform, black coloured sucking pests and feeds on sap by sucking through stylets. Also secretes honey dew which invites shooty mould growth prevalent at the onset of summer and rainy season.

**Leaf hoppers:** Both adults and nymphs are pale green in colour, small insects which moves side wise and found on the under surface of leaves of seedlings and large plants mostly during summer season, causes minor damage.

**Spittlebugs:** Both the nymphs and adults feeds on the sap by sucking through stylets. It is more prevalent during Kharif season. Nymphs are covered by frothy mass hence protected from action of natural enemies. Adults upon touch can jump to a height of 12 ft. Causes deforming of leaves and twigs. Also ovipositional punctures cause damage. Eggs and nymphs are mostly found in the underside of leaves of seedlings as well as larger plants.

**Leaf footed bugs:** Fore tibiae are swollen, blackish body with grayish wings. both nymphs and adults sucks and feed upon the sap from leaves and growing tips.

### Lepidoptera

**Leaf minor:** Very small tiny moths which lay eggs inside leaf tissues. Larvae feed on the leaf materials by mining. Don't affect much in development of large sized trees.

**Looper:** Black colored fleshy medium sized larvae with white strips over the body. Feeds upon the foliage's and appeared during rainy season only.

**Bagworms:** One species of bagworm was recorded during the observation period. The caterpillar was protected by a bag prepared out of stick, plant material and saliva and it protrudes to outside to feed on foliage by making circular holes. Very often attached to stem and pupae are found hanging from branches. Sexual dimorphism is well pronounced in adults of this species.

**Bark eating caterpillar:** Larvae are brown to pale black in colour with triangular chitinous plates in each abdominal segment. Nocturnal in habit and remains in a hole excavated by larvae at the branch initiation points. Feeds on the bark and prepares tunnels with frass materials made up of cellulose, excreta and saliva. Colouration of frass materials varies as per chemical constituent of the bark concerned. Plants become weak and succumb to natural calamities due to boring by larvae.

**Leaf folder:** The caterpillar is slender, pale green and remains inside the leaf fold made by it. Feed upon the green matter and skeletonize the leaves. The adults are medium sized moths with pale green fore wings.

**Gelatin Grub:** Green colour, slow moving and elliptical in shape, looks like a gelatin hence the name. Causes less damage to the leaves. Appeared in rainy season mostly.

### Orthoptera

**Grasshoppers:** Two species of brown grasshoppers were recorded during the study. Both nymphs and adults are polyphagous and cause extensive damage to seedlings throughout the year except in winter. Because of dark green and bushy foliage they are attracted towards the leaves.

### Isoptera

**Termite:** Two species of termites were recorded; very much prevalent in winter season in red and dry soil conditions and in natural as well as agro forestry plantations. The worker caste constructs mud galleries over the bark and feeds on bark materials. Causes mortality in fresh transplants. Larger plants get weakened and succumb to natural diseases. Mostly omnivorous in feeding habit.

Total defoliation in Gambhar seedlings and other two categories and population dynamics of two major pests are presented in Table-2. Defoliation dynamics as an index of pest activity has been used by several earlier workers like Nair *et al.* (1985) [13] for teak in Kerala. Gambhar defoliator larval population in leaves was first noticed during June 2018 with peak population recorded during 1st fortnight of September 2017 (9.30/leaf) after which a downward trend was recorded up to November 1st fortnight 2017. (0.68/branch). Population of Gambhar shoot weevil was recorded throughout the experimental period with highest population (6.20/branch) recorded during 2nd fortnight of January 2017. The lowest population was recorded during 2nd fortnight of June 2018

As high as 101 insect pests infesting to *Gmelina arborea* has

been recorded from India by several workers. Mathur and Singh (1960) recorded 21 defoliators and 13 shoot borers infesting this plant species but *Calepepla leayana* and *Tingis beesoni* was found as most destructive. The present study also corroborate the same fact that *Calepepla leayana* is the major defoliator of this species recorded at Bhubaneswar during the study period out of the total 22sp of insect pests recorded. Ahmad and Sen-Sharma (1990) [2] from India and Baksha (1997) [6] from Bangladesh also viewed this as important pest in Gambhar plantations. Suratmo (1996) [16] listed this pest as most destructive infesting *Gmelina arborea* in Indonesia.. Another important pest recorded here is Gambhar shoot weevil, *Alcidodes ludificator* which is a small weevil and bores the shoot and kill the young plants and branches and the infestation was recorded throughout the year. Its population density remained available throughout the year with highest peak observed between January 2018 when rainfall, temperature and RH was low, a small but second peak also appeared during late monsoon seasons of October 2nd fortnight, 2017 when rainfall was quite high (102.2mm) and maximum temperature recorded was 32.5. Workers like Gotoh *et al.* 2003 [11] reported this reported this pest to cause infestation of 7-12% at Malaysia. This species is also described as a major pest of nursery and seedlings in West Bengal [1] and the life cycle is reported as annual with peak of population seen during August and September. Workers like Beeson 1941 [7], Nair 2007 [11] and Meshram 2001 [9] from India also viewed this shoot weevil as one of the minor pests attacking Gambhar plants but the magnitude of attack recorded in the present study appears to be major (8.28/Branch). The data from Table 3 revealed that maximum temperature prevailed during the period was negatively correlated with defoliation (%) of the three categories of plants. A significant but strongly positive correlation was obtained between rainfalls (mm) as well as RH (%) recorded at 14hrs along with population density of Gambhar defoliator, whereas the correlation was negative for shoot weevil population which remains within the plant bores during post rainy and winter season.

**Table 1:** Succession of different insect pests associated with Gambhar during the observation period at Bhubaneswar (2017-2018).

Sl No	Common name	Scientific name	Order	Family	Pest category	Status
1	Gambhar defoliator	<i>Calypepla leyanalatr.</i>	Coleoptera	Chrysomelidae	Foliage feeder	Major in seedlings and pole sized plants
2	Gambhar shoot weevil	<i>Alcidodes ludificator</i> Marshal.	Coleoptera	Curculionidae	Shoot borer	Major in pole sized plants
3	Brown winged grasshopper	<i>Arphia conspersa</i> Scudder	Orthoptera	Acrididae	Foliage feeder	Major in seedlings
4	Mealy bug	<i>Pseudococcus filamentosus</i> Cockrell	Hemiptera	Pseudococcidae	Sap feeder	Attacks leaves and young shoots
5	Mealy bug	<i>Nipaecoccus viridis</i> Newsted	Hemiptera	Pseudococcidae	Sap feeder	Attacks leaves and young shoots
6	Mealy bug	<i>Planococcus citri</i> Risso	Hemiptera	Pseudococcidae	Sap feeder	Attacks leaves and young shoots
7	Gambhar leaf miner	<i>Phyllocnistis amydropa</i> Mayr	Lepidoptera	Gracillariidae	Eat leaf tissues by mining	Attack leaves
8	Semilooper	<i>Ectropis bhurmitra</i> Walkar	Lepidoptera	Geometridae	Foliage feeder	Attack leaves
9	Termite	<i>Odentotermus obesus</i> Rambur	Isoptera	Termitidae	Rood and bark feeder	Major in trees.
10	Termite	<i>Microtermus obesi</i> Holm Grain	Isoptera	Termitidae	Root and bark feeder	Major in trees
11	Bark borer	<i>Inderbela quadmotata</i> Walk.	Lepidoptera	Arbellidae	Bark borer	Major in trees
12	Tortoise beetle	<i>Aspidomorpha miliaris</i>	Coleoptera	Chrysomelidae	. Foliage feeder	Major in tree but seasonal

		Fab.				
13	Gelatin grub	<i>Belippala leana</i> Moore.	Lepidoptera	Limacodidae	Foliage feeder	Major but seasonal
14	Leaf folder	<i>Pygidasp</i>	Lepidoptera	Crambidae	Foliage feeder	Major but seasonal
15	Spittle bug	<i>Poophilus costalis</i> Walk.	Hemiptera	Aphrophoridae	Sapfeeder	Minor
16	Aphids	<i>Aphis gossypii</i> Glover	Hemiptera	Aphididae	Sap feeder	Minor and occasional
17	White flies	<i>Unidentified</i>	Hemiptera	Alyrodidae	Sap feeder	Minor and occasional
18	Jassids	<i>Unidentified</i>	Hemiptera	Cicadellidae	Sap feeders	Minor and occasional
19	Defoliating caterpillar	<i>Eupterote geminate</i>	Lepidoptera	Eupterotidae	Foliage feeders	Major in rainy season
20	Defoliating beetle	<i>Unidentified</i>	Coleoptera	-	Foliage feeder	Minor during rainy seasons
21	Brown grass hopper (sp.2)	<i>Diubolocatan top spinguis</i> Stal	Orthoptera	Acrididae	Foliage feeder	Major in seedlings
22	Coreid bug	<i>Homeocerus inornatus</i> Stål	Hemiptera	Coreidae	Sap feeders	Major in seedlings

**Table 2:** Population dynamics of important insect pests infesting *Gmelina arborea* during the study period at Bhubaneswar (2017-18).

Month and Fortnight	Percentage defoliation in seedlings	Percentage defoliation in saplings	Percentage defoliation in full grown plants	Gambhar shoot weevil/Branch	Gambhar defoliator (larvae/pupae)/ leaf
JULY I 2017	38.00±3.07	38.23 ±3.02	15.61 ±1.33	0.06±0.8(0.00-1.00)	2.03±0.06 (0.00-4.00)
JULY II 2017	36.57±2.85	32.57 ±2.85	13.98 ±1.07	0.34±0.02(0.00-1.00)	3.35±1.03 (0.00-7.00)
AUG I 2017	35.73±3.13	31.73 ±3.13	15.70 ±1.03	0.83±0.03(0.00-1.00)	7.21±0.04 (2.00-9.00)
AUG II 2017	27.00±1.45	22.14 ±1.45	21.96 ±1.83	2.00±0.06(0.00-4.00)	8.37±1.05 (4.00-12.0)
SEPT I 2017	43.63±2.83	41.63 ±2.83	33.11 ±2.26	2.55±0.12(0.00-5.00)	9.30±0.05 (4.00-14.0)
SEPT II 2017	43.72±5.15	35.72 ±3.15	29.84 ±1.92	3.17±0.11(1.00-5.00)	4.00±0.07 (0.00-7.00)
OCT I 2017	39.82±1.41	32.52 ±1.62	42.62 ±3.73	4.56±0.08(2.00-6.00)	3.00±0.08 (0.00-4.00)
OCT II 2017	44.29±3.50	40.39 ±2.34	36.83 ±2.40	4.98±0.12(2.00-7.00)	1.05±0.04 (0.00-3.00)
NOV I 2017	38.97±3.50	32.77 ±3.50	40.44 ±2.09	3.18±0.18(4.00-8.00)	0.089±0.09 (0.0-2.00)
NOV II 2017	41.76±3.27	38.53 ± 3.27	55.35 ±5.32	4.12±0.05(0.00-6.00)	0.00
DEC I 2017	31.55±4.51	33.44 ±4.52	51.29 ± 6.4	2.23±0.75(0.00-4.00)	0.00
DEC II 2017	33.45±2.80	30.85 ±2.30	48.10 ±2.63	2.00±1.12(1.00-5.00)	0.00
JAN I 2018	27.42±3.49	2.30±4.43	47.57 ±4.94	3.00±1.24(2.00-8.00)	0.00
JAN II 2018	12.97±2.28	18.54 ±2.38	30.19 ±3.41	8.20±0.08(3.00-9.00)	0.00
FEB I 2018	8.11±3.23	8.18 ±3.35	7.74 ± 1.01	4.00±0.78(1.00-6.00)	0.00
FEB II 2018	0.00±0.00	0.00	9.95 ± 1.44	2.58±0.25(2.58-0.25)	0.00
MAR I 2018	0.00±0.00	0.00	10.55 ±0.80	1.24±0.05(1.00-3.00)	0.00
MAR II 2018	2.55±1.34	2.40 ± 1.34	10.16 ±1.41	1.20±0.80(1.00-4.00)	0.00
APR I 2018	7.07±2.30	10.27 ± 2.3	6.78 ± 1.00	1.65±0.48(1.00-4.00)	0.00
APR II 2018	5.17±2.40	8.33 ± 2.4	6.43 ± 0.86	1.24±0.3(1.00-4.00)	0.00
MAY I 2018	0.00±0.00	0.00	7.36 ± 1.19	1.00±0.03(0.00-3.00)	0.00
MAY II 2018	0.00±0.00	0.00	11.70 ±0.71	0.80±0.30(0.00-1.00)	0.00
JUN I 2018	4.79±1.98	4.79 ±1.98	24.75 ±1.66	0.47±0.04(0.00-1.00)	1.23±0.08 (0.00-2.00)
JUN II 2018	5.6±1.6	5.6 ± 1.6	12.35 ±1.15	0.68±0.26 (.00-1.00)	2.24±0.06(0.0-3.00)
JULY I 2018	57.31±5.2	57.31 ±5.2	15.70 ±1.03	0.80±0.03 (0.00-2.00)	3.49±0.80 (1.0-6.00)

Each figure is the mean of 5 samples each from 10 plants ±SE. Figures in parenthesis are range values I-First fortnight, II-Second fortnight

**Table 3:** Correlation coefficient of defoliation percentage and population density of major pests of Gambhar with weather parameters at Bhubaneswar during 2017-18

Insect parameters/weather parameters	Maximum temperature (°C)	Minimum temperature (°C)	Rainfall (mm)	RH (%)/7hr	RH(%)14hr	BSH (hrs)
Defoliation percentage in seedlings	-0.5505	-0.0250	0.3867	0.1950	0.6096**	-0.5116
Defoliation percentage in saplings	-0.5831	-0.0465	0.3653	0.2232	0.5757**	-0.4990
Defoliation percentage in full grown plants	-0.7453	-0.3879	0.1952	0.2041	0.0520	-0.0645
Gambhar shoot weevil adult /branch	-0.4685	-0.3757	0.3694	0.2763	-0.2504	-0.3235
Gambharskeltoniseradult,larvae/branch	0.0091	0.2229	0.6638**	0.2229	-0.6818**	-0.5502

\*\* Significant at 5% level





**Plate 1:** Larva of leaf folder



**Plate 5:** Grub of *Calopepla*



**Plate 2:** Pupa of leaf folder



**Plate 6:** Adult of *Calopepla*



**Plate 3:** Pupa of *Calopepla*



**Plate 7:** Leaf with damaging stages



**Plate 4:** Eupterotid caterpillar



**Plate 8:** Mealy bugs along with ants



Plate 9: Leaf minor damage



Plate 10: Damage of Calopepla



Plate 11: Coreid bug



Plate 12: Shoot weevil damage

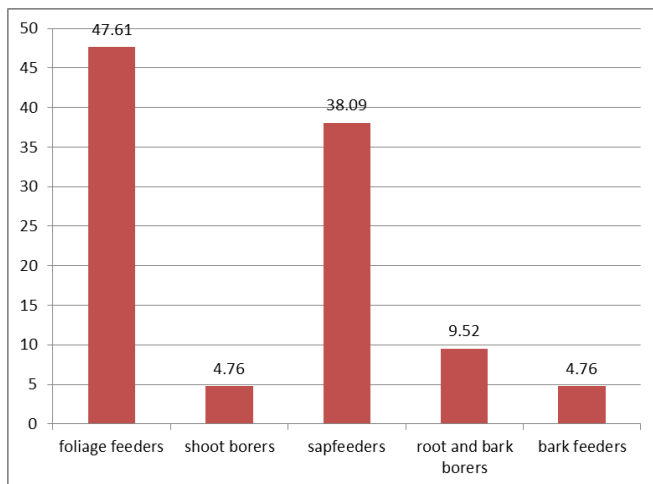


Fig 1: Classification of pest of Gambhar asper nature of Damage (percentage of total) at Bhubaneswar (2017-2018)

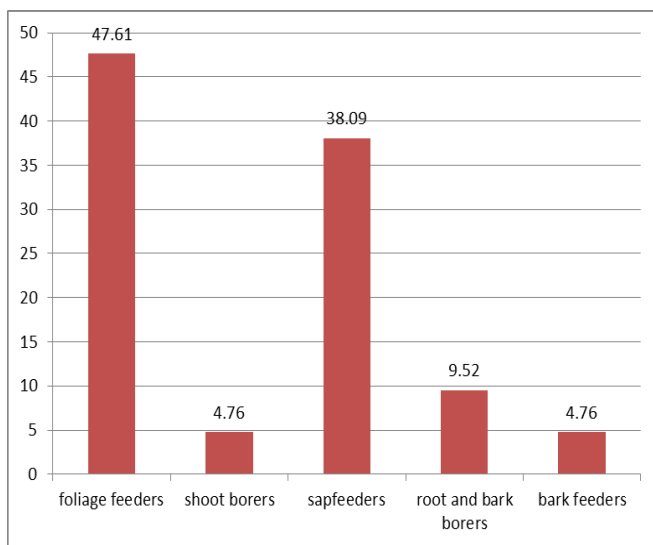
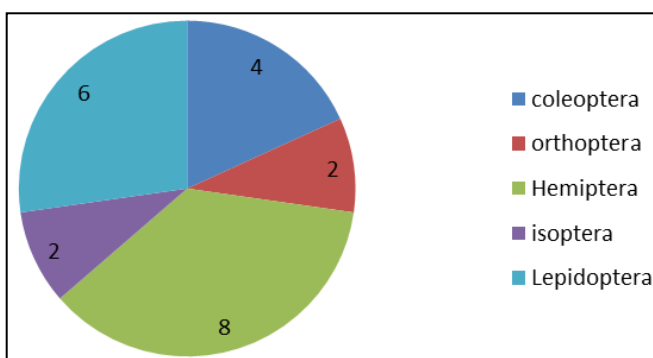


Fig 2: Order wise distribution of insect pests (no of species) infesting Gambhar at Bhubaneswar (2017-2018)

**Conclusion**

It can be concluded from the present study that defoliator and shoot weevil are the important pest of Gambhar in eastern tract of the Country .The defoliator is available during the rainy season and shoot weevil throughout the year. Hence, special studies are required on bio ecology and available bio control agents in natural conditions of this location to formulate IPM strategies for existing afforested plantations.

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