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Taxonomy, Biology and Damage Status of Coneboret of *Pinus gerardiana*

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ABSTRACT : Cones of *Pinus gerardiana* are heavily attacked in the natural conditioned by a coneborer, *Dioryctria abietella* (Lepidoptera: Pyralidae) which completes its life cycle inside the cone during cone development. This lepidopteron species behaves differently during lab. And field conditions. Complete life cycle of the species in the field and laboratory conditions have been studied. Morphology, wing venation and genitalia have been studied to update the taxonomy of the species.

Keywords : Biology, life cycle, *Dioryctria*.

INTRODUCTION

Insects constitute one of major biological destructive agents in tree seed productivity. Cones and seeds of coniferous tree species are heavily attacked by coneworms, *Dioryctria abietella* and *Cateremna* (Euzophera) *Cedrella* (Lepidoptera: Pyralidae) in western Himalaya (Thakur, 2000). *Dioryctria abietella* is responsible for causing economic losses in cones and seeds of various conifer species. In Chilgoja pine, Singh and Bhandari (1986) reported almost 100% attack at Kalpa, Himachal Pradesh. Rahman and Chaudhry, (1987) reported the attack of *Dioryctria abietella* on the seeds of silver fir in Northwest Province of Pkistan.

The export of Chilgoja seeds contribute appreciably to the annual income of the most of the families living in the areas of its distribution. In the district of Kinnaur alone, the approximate value of export of its annual produce is around 18 crore of rupees in a year. But the cone and seeds are now being attacked by variety of insect-pests and pathogens causing degradation in the quality of seeds and even loss of seed crop.

The *Pinus gerardiana* Wall. 1832, commonly called as chilgoza pine, mostly grows in valleys at 2000-3350 m, amsl elevation (Farjon, 1984), in the dry temperate forest of the inner ranges of the Himalaya, where the summer monsoon is weak and precipitation, mostly in the form of snow, rarely exceeds 1000 mm per year. In these forests it occurs with *Cedrus deodara*, *Quercus* spp. and *Juniperus excelsa* (Bhattacharyya *et al.*, 1988). Female cones 12-20 cm long, 10 cm wide when open, with wrinkled, reflexed apophyses and a umbo curved inward at the base. Seeds >2 cm long with a rudimentary wing (Farjon 1984, Richardson and Rundel 1998). Studies by Richardson and Rundel (1998) shows that harvest pressure because of economic benefits that it provides; *e.g.*, in a good year, about 13,000 indigenous people in the Suleiman Mountains of Pakistan derive income from the nut harvest.

The most damaging seed and cone insects of pines are two seed-bugs (*Leptoglossus corculus* and *Tetyra bipunctata*) and five species of coneworms in the genus *Dioryctria*. Other insect species that cause seed losses include the slash pine flower thrips *(Gnophothrips fuscus*), pine seedworms (*Cydia* spp.), pine conelet looper (*Nepytia semiclusaria*), cone borers (*Eucosma* spp.), cone beetles (*Conophthorus* spp.), and tip moths (*Rhyacionia* spp). Seed and cone insects occur throughout the known range of the hosts. Cone and seed insects limit the production of seed for nursery stock. (Pruthi and Singh, 1950; Mathur et. al. 1958; Coneway, 1975 and Bhandari, 1988).

Insect damage varies greatly, depending on age, tree species, location, and insect control plan. On occasion, orchards may lose their entire seed crop. Such damage could result in repercussions for future production and revenue loss due to wasted time and effort spent on managing orchard cone crops or collecting infested natural stand cone crops. During the present study complete life cycle of the sconeborer in the field and lab. conditions have been studied. Morphology, wing venation and genitalia have been studied to update the taxonomy of the species.

Material and Methods

To make observations on insect-pests and pathogens of cones and seeds survey tours were organized to the Kinnaur and Six sites i.e.

1. Pangi, 2750 m, Eastern, N 31°33' 26.5" E 078°15' 38.5"

2. Labrang, 2915 m, Eastern, N31°35'08.4"E078°22'48.2"

3. Jhangi (Akpa), 2742 m, Eastern N 31°35' 23.9" E 078°25' 51.0"

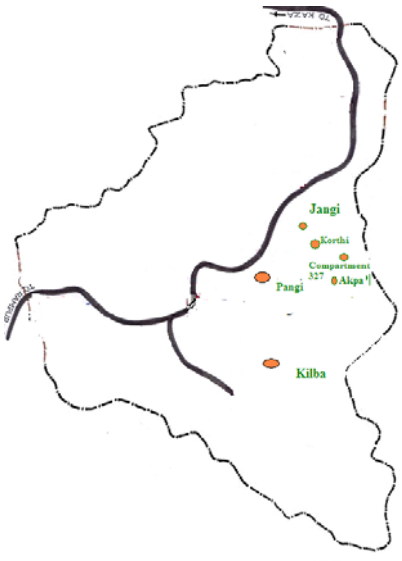
4. Kilba, 1894 m, Northern N 30°31' 51.0" E 078°08' 46.8"

5. Akpa FRH 2503 m, Eastern N 31°35' 19.5" E 078°23' 32.0"

6. Korathi 2753 m, Eastern N31°35' 33.4" E 078°25' 34.0" have been included for study for carrying out survey, sample collection and observational activities on insect and pathogens of the Chilgoza cone and seeds. These areas were surveyed to assess the infestation of insect-pests and pathogens on the cones and seeds of the Chilgoza pine. Samples were also collected from these sites.

The life cycle of the borer has been studied in the field as well as lab. condition. The wing venation and genitlia has been studied by following the methodologies adopted by Srivastava et. al. (2005, 2006), Kumar et. al. (2007) and Kumar and Thakur (2009).

Study sites of Chilgoza Pine in Kinnaur



Observations and results

During two years study on survey on insect pests and pathogens of cone and seeds of Chilgoza, following observations were made:

Studies on cone Borer

Taxonomic Classification

Genus : Dioryctria Zeller, 1846. Isis, Leipzig 1846 : 732.

Status : Available Name **Homonyms : 1**

Higher classification :

PYRALOIDEA : PYRALIDAE : PHYCITINAE

Type-species :

Tinea abietella Denis & Schiffermüller, 1775 Ankündung syst. Werkes. Schmett. Wienergegend: 138.

Type-species designation :

By subsequent designation by, Ragonot, 1893, in Romanoff, Mém. Lépid. 7 : 188

Diagnostic feature of Coneborer

Moth : The cone moth grey-fuscous, small forewing predominantly grayish with transverse zigzag band bordered by a dark brown margin hind wing uniformly grey and semi hyaline. Male as usual smaller than female body length 12-13 mm long with wing expanse 22-27mm while in female the body length 13-14mm long with wing expanse 23-25mm.

Eggs : The eggs are oval flattened with rough surface creamy whitish when freshly laid.

Larva : The larva has five larval instars early immature instars light brown with black head capsule becoming brownish in successive larval stages. Mature larva 20mm long.

Pupa : Pupa 10mm long obtect type reddish brown turning brownish towards the emergence time.

Life History

Mating occur after midnight and last till early hour in morning. The female moths start laying eggs after about 12-14 hour of emergence. The eggs are laid singly in depression of the scale of the young cone. More than one eggs may be laid on a single cone Under captivity female moth has been found to lay eggs on all the substrata i.e. Needle, filter paper etc. the female moth lay eggs for 2-6 days @7-18 eggs per day. Total number of eggs laid by single female moth varies from 18-59 eggs. The incubation period varies from 3-7 days. The neonate larva hatches from the eggs after cutting a hole on the surface of the eggs and start boring the cone through the scale. And gradually feed on the tender tissue of the cone. Subsequent larval stages make a covering over it by fastening the seed with the silken thread and keep on feeding on the seeds. The larval period varies from 16-32 days. Pupation occurs in loosely woven papry silk cocoon in cone the fully grown larva stop feeding and become inactive. It comes out on the surface of the cone the larva make a cocoon with its feacle matter and debris coated tissue material of cone the prepupal period last for 8-11 days and the pupal period last for 8-17 days. The moth appears after mid summer and the eggs are laid on cone and shoots of plants.

Life cycle under Field Condition: Under Field Condition Pests have 2 complete generations. Occurrence of various stages is as follow. Coarse frass without resin and some webbing on the outside of cones indicate infestation by cone worms. The instars over winter as prepupa from 1st week of September to May of the following year when the insect resume feeding and pupae. Emergence of moth of 2nd generation appear late in May when the fresh cone are in the process of development. The moth laid eggs on fresh young cone during 3rd week of May and the life cycle lasts till half of July. Life cycle from egg to adult varies 42-65 days.

Under Lab condition: Under lab condition 3 complete generations recorded. 1st Generation: The over wintering prepupae of previous generation resume feeding in Spring (March-April) and pupate during the Ist half of April. The Adult emerge late in the third week of April and lays eggs

by the end of April. The first generation last for 48-56 days. The longevity of adult moth is about 7 days. 2nd Generation: The moths of the Ist generation commence laying of eggs some time during the 3rd week of June and the adult appear during the 2nd week of August. The length of life cycle varies from 51-60 days The adult longevity recorded as 7 days. 3rd Generation: Laying of eggs by moth of 2nd generation during the 2nd generation during the 2nd week of august after the larval period of about 3-4 week the pest enter prepupal stage and enter as prepupa from 2nd half of September to the April of next year. The total over wintering period of pest varies from 192-212 days. Some pupae instead of overwintering undergoes pupation and adult emerge in the last week of October but these adult do not mate if mate they fail to lay fertilized egg.

Adult of *Dioryctria abietella*(Denis & Schiffermuller,1775)

Fig. 1.

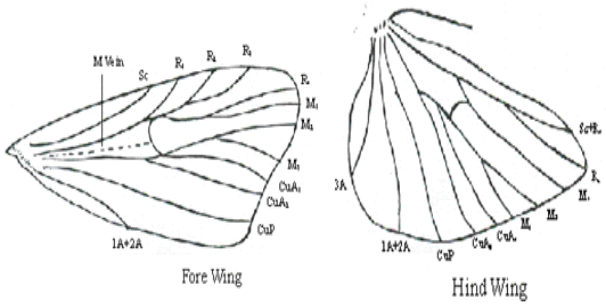


Fig. 2. Forewing and Hind wings of coneborer.

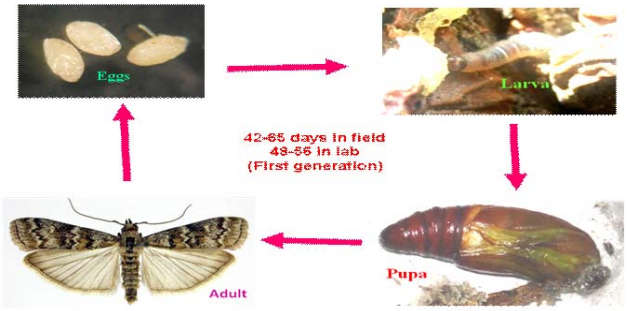


Fig. 3. Life cycle of Coneborer.

After cone harvest the data on cone infestation was recorded by visiting the cone storage places and 300 cones were randomly picked from five households at each site. Average cone infestation data of each site is tabulated below in Table-1:

Table 1: Average cone infestation data.

Locality Altitude (m amsl)	*Cone selected (per year)*	*% Infected cones (2008)*	*% Infected cones (2009)*
Pangi 2750	300 × 5	48	29
Labrang 2915	300 × 5	62	32
Akpa/Janghi 2742	300 × 5	47	27.7
Kilba 1894	300 × 5	69	34.7
Akpa FRH 2503	300 × 5	63	28
Korathi 2753	300 × 5	54	23.7
Rispa 2406	300 × 5	–	21.1
Bharmour 2143	300 × 5	–	26.4

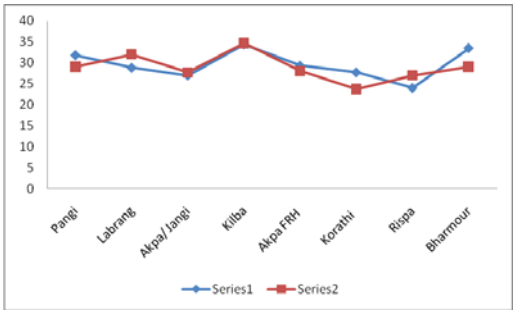
It was observed that cones are heavily infested by insect borers and at some places e.g. at Kilba, around 69% of cones are damaged by insect borer, *Dioryctria abietella* but not affected by pathogens.

Table 2: Observations of damage by cone borer at different sites, 2008.

Locality Altitude (m amsl)	*Aspect/location*	*Avg. Temp. (°C)*		*Humidity*		*% Infected cone*
		Max.	Min.	Max	Min	
Pangi 2750	EasternN31°33'26.5" E078°15'38.5"	32.4	18.4	71%	42%	48%
Labrang 2915	Eastern N31°35'08.4" E078°22'48.2"	29.0	18.4	59%	42%	62%
Jhangi 2742	Eastern N31°35'23.9" E078°25'51.0"	26.0	17.9	55%	43%	47%
Kilba 1894	Northern N30°31'51.0" E078°08'46.8."	34.0	19.2	75%	41%	69%
Akpa 2503	Eastern N31°35'19.5" E078°23'32.0"	28.8	18.4	53%	42%	63%
Korathi 2753	Eastern N31°35'33.4" E078°25'34.0"	26.0	17.9	55%	43%	54%

Table 3: Damage threshold inside the cone by the borer during, 2009.

Locality Altitude (m amsl)	*Aspect/location*	*Avg. Temp. (°C)*		*Humidity*		*% Infected cone*
		Max.	Min.	Max.	Min.	
Pangi 2750	Eastern N31°33'26.5" E078°15'38.5"	31.8	19.9	65	38	29.0
Labrang 2915	Eastern N31°35'08.4" E078°22'48.2"	28.8	19.4	54	45	32.0
Janghi 2742	Eastern N31°35'23.9" E078°25'51.0"	27.0	18.3	51	37	27.7
Kilba 1894	Northern N30°31'51.0" E078°08'46.8"	34.4	21.7	63	40	34.7
Akpa 2503	Eastern N31°35'19.5" E078°23'32.0"	29.3	18.9	51	37	28.0
Korathi 2753	Eastern N31°35'33.4" E078°25'34.0"	27.7	18.9	52	39	23.7
Rispa 2406	Northern N30°28'50.4" E078°24'45.8"	24.0	14.3	54	35	27.0
Bharmour 2143	Eastern N32°27'22.9" E076°28'68.3"	33.5	13.0	52	20	29.0



Series 1 Represents Temperature & Series 2 Represents % Infestation

Graph representing Temperature & Infestation Relation during 2009 at different sites

Table 4.

Locality	*Average larvae Number/cone*	*% seeds damaged by cone borer*
Pangi	15	80
Labrang	17	85
Kilba	18	91
Akpa/Jangi	8	82
Akpa FRH	9	89
Korathi	5	89
Rispa	7	65
Bharmour	4	59

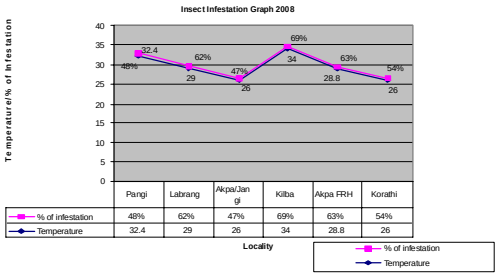


Fig. 4. Effect of temperature on cone infestation in different sites.

During year 2009, cones were collected from all study sites for the infestation study. Cone infestation data were collected from the heap of cone harvested by the villager, 300 cones had been randomly counted. The insect infestation data from Pangi was 87/300 (29%), in Labrang site infestation was 96/300 (32%), Jangi infestation was 83/300 (28%), in Kilba infestation was 104/300 (35%), in Akpa infestation was 84/300 (28%) and in Korathi insect infestation was 71/300 (24%). Maximum infestation was recorded at Kilba locality having maximum temperature (34.4) and humidity (63%).

To observe the larval pathogenicity ten infected cones from each locality were collected and exposed to count the population of larvae inside the cone. The details are given in table-4. It was observed that 91 % seeds of the cones of Kilba were damaged by 18 larvae of Dioryctria abietella in Kilba area. Bhandari et al. (1988) has earlier reported almost 100% attack in Kalpa area.

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