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Population dynamics of insect pests in *Dalbergia sissoo* and turmeric based agroforestry system

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Abstract

Insect-pest regulation in agroforestry is a function of interactions among the components of the system. The interactions are more intricate in complex agroforestry systems than in simple ones. The management population also reduce pest population under agroforestry system. The present investigation was carried out at New Dusty Acre area, Department of Forestry, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.) during Kharif season of 2013-14 in well established 15 years old *Dalbergia sissoo* plantation. The experiment was consisted with four pruning intensity of *Dalbergia sissoo* P₀ - Un pruned, P₁ - 25% (pruned *Dalbergia sissoo*), P₂ - 50% (pruned *Dalbergia sissoo*), P₃ - 75% (pruned *Dalbergia sissoo*), Open condition- No tree (Crop only) with different date of sowing of turmeric in subtreatment. The result showed that shoot borer *Conogethes punctiferalis*, Leaf roller - *Udaspes folus* and Rhizome fly *Mimegralla coeruleifrons* was found in turmeric and Shisham defoliator - *Plecoptera reflexa* was found in shisham tree in all the pruning intensity. Number of all insect was less in open condition as compared to turmeric growing under shisham tree.

Keywords: turmeric, *Dalbergia sissoo*, insect, pruning intensity, agroforestry

Introduction

Dalbergia sissoo has a rich complex of insect fauna of about 125 species; however, only 10 species are known to have attained economic status as potential pests of nursery and plantations. Insects and pests belonging to 9 families of Lepidoptera, 10 of Coleoptera, 5 of Hemiptera, one of Orthoptera, and one of Diptera have been assessed in stand of *D. sissoo*. Among them *Plecoptera reflexa* Gurnee (Lepidoptera: Noctuidae) and *Apoderus sissoo* Marshal (Coleoptera: Curculionidae) are most common and destructive^[1] (Ali *et al.*, 2006)^[1]. Pest management in agroforestry has not received much attention so far, but recent emphasis on producing high value tree production in agroforestry and using improved germplasm in traditional systems, and emergence of serious pest problems in some promising agroforestry systems have increased awareness on risks posed by pests. Trees also affect pest infestations by acting as barriers to movement of insects, masking the odours emitted by other components of the system and sheltering herbivores and natural enemies. In sequential agroforestry systems, it is mostly the soil-borne and diapausing insects that cause and perpetuate damage to the common hosts in tree crop rotations over seasons or years. An integrated approach combining host-plant resistance to pests, exploiting alternative tree species, measures that prevent pest build up but favours natural enemies and biological control is suggested for managing pests in agroforestry.

The insect pests of an agroforestry system are essentially the pests of its components, the crops and woody perennials. The dynamics of insect pests and their natural enemies are be governed by the complexity and composition of the agroforestry system. The pest situation in these systems will be influenced by the degree of interaction between the components, the type of agroforestry system and the composition of the plant communities in each component. The distribution and infestation level of various insect pest was affected by the climatic condition such as rain fall, temperature and humidity. The present study was carried out in the field to find out the effect of different meteorological week in population dynamics of insect pest in *Dalbergia sissoo* and Turmeric based agroforestry system.

Material and Methods

The present investigation was carried out at New Dusty Acre area, Department of Forestry, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.) during

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Kharif season of 2013-14 in well established 15 years old *Dalbergia sissoo* plantation. The weather condition was almost favourable for the growth and development of Turmeric as well as Shisham tree. During the growing season (June 2013 to March 2014) maximum temperature (28.85) was recorded in the month of June and minimum (16.97) was recorded in the month of January. The average Relative humidity was 44 to 96% in the morning and 17 to 88% in the evening. The rainfall during the crop season was 2551.6mm and was received in 81 rainy days which had a beneficial effect on growth and development of turmeric crop as well as for the shisham tree. The field experiment was consisted with four pruning intensity of dalbergia sissoo P₀ - Un pruned, P₁ - 25% (pruned *Dalbergia sissoo*), P₂ - 50% (pruned *Dalbergia sissoo*), P₃ - 75% (pruned *Dalbergia sissoo*), Open condition-No tree (Crop only) with different date of sowing of turmeric in subtreatment.

Seasonal incidence and population of insect pest of *Dalbergia sissoo*.

The observation were recorded at weekly interval in the field condition starting from second week of July up to second week of November. The nature of damage of major insect pests was also studied. The meteorological data of corresponding period of observation was also noted.

Table 1: Succession of insect pest complex of turmeric and *Dalbergia sissoo* during 2013-14

S. No.	Common Name	Scientific Name	Order	Family
Turmeric				
1.	Shoot borer	<i>Conogethes punctiferalis</i>	Lepidoptera	Pyralidae
2.	Leaf roller	<i>Udaspes folus</i>	Lepidoptera	Hesperiidae
3	Rhizome fly	<i>Mimegralla coeruleifrons</i>	Diptera	Diaspididae
<i>Dalbergia sissoo</i>				
1.	Shisham defoliator	<i>Plecoptera reflexa</i>	Lepidoptera	Noctuidae

Population dynamics of insect and pest

Shoot borer (*Conogethes Punctiferalis* Guen)

First appearance of the shoot borer on the turmeric was observed on first week of September at the vegetative stage of turmeric. Number of insects varied from block to block due to shade of sissoo in the open block number of insects was less because of more sunlight as compare to the block of 75%, 50%, 25% and no pruned tree (Table 2).

Population dynamics which started from first week of August that is shown in the form of standard meteorological week 31 The average number of insects in open block was 2 and under the 75%, 50%, 25% and no pruned tree in all four replications 2.3., 2.4., 2.6 and 3 respectively. The minimum and maximum temperature was 23.7°C and 30 °C and the relative humidity was 93% in the morning and 78% in the evening.

Maximum population was recorded on the last week of August (35th meteorological week) where the insect population was 13.1, 14.5, 15.71 16.3, and 17.3 respectively, in open condition, under the 75%, 50%, 25% and no pruned tree. The minimum and maximum temperature was 23.3 °C and 28.4 °C and the relative humidity was 94% in the morning and 81% in the evening.

Population of Shoot borer in last week of September was observed was 1.9 in open condition and 2.3, 2.4, 2.5, and 2.6 under 75%, 50%, 25% and no pruned tree. After this no insect was found. The minimum and maximum temperature was 20. °C and 26.6 °C and the relative humidity was 80% in the morning and 62% in the evening.

Average population of shoot borer in all treatments and replications was 7.5, 7, 7.7, 12.6, 15.6, 8.6, 2.6 and 2.4 in 31st,

Distribution of insect pest

The distribution and infestation level of various insect pests of shisham and turmeric were surveyed at fortnightly interval and the observations were noted on the incidence of major insect pest on 4 randomly selected plant per locality. Ten randomly selected branches in each plant were observed for major pest i.e. moth/caterpillar.

The infestation/Damage would be consider accordingly as:

$$\% \text{ Damage} = \frac{\text{Number of branch damaged by insect/pest}}{\text{Total number of branch or grains examined}} \times 100$$

Both healthy as well as infested branches were counted and per cent infestation was worked out.

Result and Discussion

Studies on insect pest succession as it evident by the field incidence in four treatment (different pruning) respectively, revealed that about three species of insects on Turmeric and one on *Dalbergia sissoo* were observed to be associated upto 6 months (i.e. July to December) of rainy season at Jabalpur, Madhya Pradesh in Central India during 2013 (Table 1).

32th, 33th, 34th, 35th, 36th 37th and 38th standard meteorological weeks respectively similar finding was also illustrated by [08] (Kotikal and Kulkarni, 2000 and Ali *et al.*, 2006) [7, 1].

Table 2: Seasonal incidence and population dynamic of shoot borer

Treatment	Standard Meteorological Weeks							
	31	32	33	34	35	36	37	38
Pruning Intensities	Incidence/ Population							
Po- No Pruning	3	4.6	10.7	14.1	17.3	8.8	3	2.6
P1-25% Pruning	2.6	4.4	10	13.3	16.3	8.4	2.9	2.5
P2-50% Pruning	2.4	4.4	8.8	12.8	15.1	7.8	2.8	2.4
P3-75% Pruning	2.3	4.3	8.1	11.8	14.5	7.4	2.6	2.3
Open- No tree	2.2.	4.2	7.8	11.1	13.6	6.9	2.6	1.9
Sem	0.7	0.3	0.2	0.5	0.7	0.3	0.3	0.2
CD (P=0.05)	NS	0.9	0.7	1.2	2	0.7	NS	NS
Turmeric date of planting								
D1	2.8	4.5	9.3	13	17	7.9	3.1	2.4
D2	2.5	4.5	8.8	12.6	14.5	7.8	2.8	2.2
D3	2.2	4.3	9.3	12.3	14.9	7.9	2.5	2.2
Sem	0.1	0.1	0.2	05	0.7	0.	0.1	0.6
CD(P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS

Leaf roller *Udaspes folus* (Lepidoptera: Hesperiidae)

The result of population dynamics which started from first week of August at vegetative stage of turmeric that is shown in the form of standard meteorological week 32. The average number of insects in open block was 3.6 and under the 75%, 50%, 25% and no pruned tree in all four replications respectively 3.8, 4.1, 4.8 and 5.1. The minimum and

maximum temperature was 27.7 °C and the relative humidity was 96% in the morning and 88% in the evening (Table 3). Maximum population was recorded on the last week of September (36th meteorological week) where the insect population was 6.8, 6.8, 7.6, 7.9 and 8 respectively in open condition, under the 75%, 50%, 25% and no pruned tree. The minimum and maximum temperature was 30.8°C and the relative humidity was 93% in the morning and 89% in the evening.

Population of leaf roller in third week of October was observed 2.7, 2.8, 3, 3.5 and under 75%, 50%, 25% and no pruned tree and 2.5 in open condition. After this leaf roller was not found. The minimum and maximum temperature was 18.4°C and 30.1°C and the relative humidity was 95% in the morning and 50% in the evening.

Average population of leaf roller all treatments and replications was 4.2, 6.1, 6.5, 7.4, 18.4, 9.4 and 2.9 in 36nd, 37nd, 38th, 39th, 40th, 41th and 42th standard meteorological weeks respectively similar finding was also illustrated b Pradesh [07, 08] by (Kotikal and Kulkarni, 2000 and Ali *et al.*, 2006 [7, 1].

Table 3: Seasonal incidence and population dynamic of Leaf roller

Treatment	Standard Meteorological Weeks						
	36	37	38	39	40	41	42
Pruning Intensities	Incidence/ Population						
Po- No Pruning	5	6.6	7.3	11.5	14	9.9	3.5
P1-25% Pruning	4.6	5	7	11	13	9.8	3
P2-50% Pruning	3.8	4.9	6.5	10.7	11.6	9.6	2.8
P3-75% Pruning	3.7	4.6	6	7.7	10.5	9.4	2.7
OPEN	3.6	4.5	5.8	7.2	10	8.4	2.5
Sem	0.6	1	0.6	1.2	1.1	0.4	0.2
CD (P=0.05)	NS	NS	NS	2.9	2.5	1.1	NS
Turmeric date of planting							
D1	4	4.8	6.7	7.9	10.7	9.6	2.9
D2	3.6	5	6.7	7.9	10.6	9.6	2.9
D3	3.3	4.8	6.2	7.5	10.6	10.3	3
Sem	0.3	0.2	0.3	0.2	0.5	0.5	0.1
CD(P=0.05)	NS	NS	NS	NS	NS	NS	NS

Rhizome fly, *Mimegralla coeruleifrons* (Diptera, Diaspididae)

The result of population dynamics which started from first week of November that is shown in the form of standard meteorological week 46, the minimum and maximum temperature was 8.9.1°C and 26.0 °C The relative humidity was 93% in the morning and 36% in the evening. The average number of insects in open block was 2.5 and under the 75%, 50%, 25% and no pruned tree in all four replications it was 1.2, 1.5, 1.6, 1.7 and 1.8 respectively (Table 4).

Table 5: Seasonal incidence and population dynamic of *Plecoptera reflexa*

Treatments	Standard Meteorological Weeks								
	30	31	32	33	34	35	36	37	38
Pruning Intensities	Incidence/ Population								
Po- No Pruning	41	41.9	31.1	29.5	19.5	19.1	19.1	9.8	5
P1-25% Pruning	38.4	38.6	29	28.1	18.5	18.3	17.8	9.5	4.8
P2-50% Pruning	37.3	37.5	27.5	27.3	17.6	17.6	17.3	8.5	4.1
P3-75% Pruning	34.1	33.4	26.1	24	16.1	14.9	15.3	7.1	3
SEm±	0.1	0.3	0.1	0.2	0.1	0.2	0.1	0.4	0
CD (P=0.05)	0.4	0.9	0.4	0.5	0.3	0.5	0.7	1.1	0.1
Turmeric date of planting									
D1	26.1	23.9	21.9	15.6	13.9	10.8	8.6	6.7	2.5
D2	25.9	23.6	21.4	15.2	13.9	10.4	8.5	6.6	2.6
D3	26.1	23.9	21.9	15.4	13.9	10.8	8.7	6.4	2.8
Tree alone (no crop)	25.8	23.7	21.8	15.5	13.8	10.5	8.6	6.5	2.7
SEm±	0.4	0.3	0.3	0.3	0.2	0.3	0.3	0.2	0.2
CD(P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

Maximum population was recorded on the first week of December (49th meteorological week) the minimum and maximum temperature was 9.1 °C and 27.8 °C and the relative humidity was 91% in the morning and 33 in the evening where the insect population was 2.83, 3., 3.1, 3.3, and 3.9 in open condition, under the 75%, 50%, 25% and no pruned tree respectively.

Population of turmeric third week of December was observed 2.4, 2.42, 2.4, 2.7 and 2.8 open condition and under 75%, 50%, 25% and no pruned tree After this no rhizome fly was found. The minimum and maximum temperature was 7.5°C, 26.°C and the relative humidity was 91% in the morning and 34 % in the evening.

Average population of rhizome fly in all treatments and replications was 1.5, 2.5, 1.8, 3.4, 2.5 and 2.5 in 46nd, 47rd, 48th, 49th, 50th, and 51th standard meteorological weeks respectively similar finding was also illustrated by [07, 08] (Kotikal and Kulkarni, 2000, Ali *et al.*, 2006 and Kotikal and Kulkarni, 2009) [7, 1, 8].

Table 4: Seasonal incidence and population dynamic of rhizome fly

Treatment	Standard Meteorological Weeks					
	46	47	48	49	50	51
Pruning Intensities	Incidence/ Population					
Po- No Pruning	1.8	2.4	2.5	4.9	3	2.8
P1-25% Pruning	1.7	2.4	2.3	3.3	2.7	2.7
P2-50% Pruning	1.6	2.2	2.3	3.1	2.4	2.42
P3-75% Pruning	1.5	2.08	2	3	2.3	2.42
OPEN	1.25	1.75	2	2.83	2.25	2.4
Sem	0.4	0.5	1.5	0.5	0.5	0.4
CD (P=0.05)	NS	NS	NS	1.9	NS	NS
Turmeric date of planting						
D1	1.8	2.35	2.45	3.25	2.8	2.8
D2	1.4	2.1	2.25	3.25	2.4	2.45
D3	1.3	2.05	2	3.15	2.35	2.4
Sem	0.2	0.2	0.2	0.5	0.4	0.2
CD(P=0.05)	NS	NS	NS	NS	NS	NS

Shisham defoliator *Plecoptera reflexa* (Leiodoptera: Noctuidae) Population dynamics:

Maximum population was recorded during fourth week of July (30th standard meteorological week). Average number of insects on trees was 34.1 on 75% pruned trees, 37.3 on 50% pruned trees, 38.4 on 25% pruned trees and 41. on no pruned trees (Table 5). The average temperature was 29.2 °C max. and 23.6° C min. and relative humidity was 95% in the morning and 88% in the evening Similarly, [04] reported defoliator caterpillar *Plecoptera reflexa* as an important defoliator of *D. sissoo* in Pakistan. In India this pest was reported in the province Madhya Pradesh [03, 05] (Kalia *et al.*, 2000 and Bhan, *et al.*, 2005) [6, 3]

Conclusion

Insect pest association in *Dalbergia sissoo* and turmeric studies revealed that four different insect pest were observed (three on Turmeric and one on sissoo). The group of insect pest observed at the vegetative stage from first week of August to third week of September of turmeric were shoot borer *Conogethes punctiferalis* (Lepidoptera,) Leaf roller (*Udaspes folus*), from first week of September to third week of October and Rhizome fly (Diptera) from second week of November to third week of December in rhizome formation. Shisham defoliator *Plecoptera reflexa* (Lepidoptera) was observed from fourth week of July to fourth week of September. No insect pest was found which was common in sissoo and turmeric.

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