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National Academy of Agricultural Science (NAAS) Rating : 3. 03

Density and diversity of thrips (Insecta: Thysanoptera) inhabiting the paddy and grassland ecosystems of Manipur, NE India

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Abstract: *During the survey carried out at the paddy growing areas in the Imphal (west) district of Manipur, NE India, eight species of thrips were collected from Oryza sativa L. and Echinochloa stagnina (Retz.) P. Beauv. Among them, Stenchaetothrips biformis (Bagnall) was considered as the dominant species, followed by Anaphothrips sudanensis Trybom, Haplothrips ceylonicus Schmutz and H.gangalbaueri Schmutz both on paddy and grass ecosystem. The remaining four species such as Plicothrips apicalis (Bagnall), Phibalothrips peringueyi (Faure), Helionothrips parvus Bhatti and Frankliniella schultzei (Trybom) were observed only on the grasses sporadically. Average density of the individuals present on the tender leaf blades of paddy was 16.2 thrips/m^2, whereas on E.stagnina, it was 26.6 thrips/m^2 especially that grew on the bund region of the paddy field. Thrips inhabiting the grasses play a dominant role in the agro-ecosystem by virtue of their movement not only among the grasses but also between the grasses and paddy, thereby making the grasses as a temporary reservoir especially during the off-seasons of the crop.*

INTRODUCTION

Thrips are one of the economically important insects, belonging to the order Thysanoptera having long, fine fringes along the wing margin, protrusible bladder-like structure at the end of tarsus (Physapoda), in having asymmetrical mouthparts with vestigial right mandible and having at least a pre-pupal stage between the larva and pupa. With the piercing and sucking type of mouthparts, thrips feed on the plant sap and cause appreciable damage. Therefore, thrips have received better attention as a potential pest and invasive species in the recent years, besides being vectors of plant diseases, gall makers and a few acting as efficient predators and pollinators [1]. Thrips inhabiting the grasses play a dominant role in the agro-ecosystem by virtue of their movement between not only the grasses but also between the grasses and crops, thereby making the grass as a temporary reservoir [2, 3]. Grasses belong to the family Poaceae (= Graminae) comprising of nearly 9000 species and support various groups of insect herbivores [4]. Grassland is said to be one of the dynamic ecosystems occupying nearly 26% of the earth's surface [5] and is capable of harbouring large number of insects including thrips. About 300 species of thrips depend on grasses and bamboos, that form about 10% of all phytophagous thrips[6].

The grass thrips exploit four distinct niches on the grass *i.e.*, (a) florets of the grass, (b) lamina and leaf sheath, (c) grass litter tussocks and (d) base of the grass clump feeding on mites by virtue of predatory habit. The grass inhabiting species play an important role owing to the fact that they act as pest of crops and sustain their density on grasses during off season of the crop [7]. They exhibit dual functions by feeding the crop seed and disseminating the seed for the propagation of grasses [8]. In the present study the species diversity and density of thrips inhabiting the grass as well as paddy are highlighted with the view to understand their interactions in harboring the pest species like thrips.

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MATERIALS AND METHODS

Manipur is situated in the north-eastern region of India, located between 93p 03′-94p 78′ E longitudes and 23p 80′-25p 68′ N latitudes, with a total geographical area of about 22,327 Km^2, comprising both the hill and valley sectors. The hills encircle the valley all over the state. The ambient temperature of the state varies from 0 to 21p C (minimum) and 22-36p C (maximum) with the relative humidity ranging from 49 to 81% and an annual average rainfall of about 150 cm. based on the meteorological records of the Imphal Airport. The density as well as diversity of grass thrips was studied by collecting the samples at fortnightly interval from the specific sites such as paddy field (Oryza sativa L. variety – Priya, a local cultivar) at Moidangpok, [District: Imphal west] and also the bunds of the paddy field with the growth of Echinochloa stagnina (Retz.) P.Beauv. Paddy is normally cultivated in Manipur from July to November.

A separate field of 50m^2 was marked in the study site, within which thrips samples were collected by sweeping at random from 5 micro plots each with the size of 1m^2. Population assessment was carried out consecutively for two years [2010 & 2011] during the cropping period. On the other hand, thrips density on E. stagnina was assessed on the grasses growing at the bunds of the paddy field by the conventional sweeping technique and the specimens were sampled for 10 sweeps at an interval of 15 days. The collected specimens were processed for permanent slide preservation and identified with the aid of available taxonomic key [9-11]. Thrips specimens were examined under the Olympus Trinocular research microscope at different magnifications in order to know their surface details. The data pertaining to thrips diversity were processed along with their climatic factors.

RESULT

During the survey, 8 species of grass thrips were observed on the paddy and E. stagnina. As some species of thrips were common to both, it became inquisitive to know their population trend on the grass as well as paddy foliage. Keeping this objective in mind, thrips population was assessed on a comparative basis, wherein the grasses growing adjacent to the paddy field were kept as the target site for population assessment besides the paddy foliage. The enumeration of thrips species revealed the occurrence of five species of terebrantians of the family Thripidae and three tubuliferans of the family Phlaeothripidae on grasses, while two species each of the suborders were found on paddy seedlings (Table 1). Among them, Stenchaetothrips biformis was considered as a dominant species, followed by Anaphothrips sudanensis, Haplothrips ceylonicus and H.gangalbaueri both on paddy (Oryza sativa variety priya – a local cultivar) and grass ecosystem, wherein the grass species Echinochloa stagnina was more dominant over other grass species. Therefore, for all practical purpose, E. stagnina has been taken in to account.

The tubuliferan - Plicothrips apicalis, and the remaining three terebrantians *viz.*, Phibalothrips peringueyi, Helionothrips parvus and Frankliniella schultzei were found only on E. stagnina. Table 2 provides mean number of thrips/m^2 on the graminaceous plants, based on two years of field observations along with the climatic factors. The significant observation noticed here is that the above said four species infest both the crop and weed and thrips density has been found more on the weed than the crop. For instance, average density of thrips on paddy was 16.2 thrips/m^2, whereas on E.stagnina, it was 26.6 thrips/m^2 especially that grew on the bund

Table 1
Thrips density and composition on grass and paddy

Thrips species %		*% Composition of thrips**	
		Grass	*Paddy*
(i)	Stenchaetothrips biformis (Bagnall, 1913)	42	62
(ii)	Anaphothrips sudanensis Trybom, 1911	20	18
(iii)	Haplothrips ceylonicus Schmutz, 1913	12	12
(iv)	H. gangalbaueri Schmutz, 1913	12	8
(v)	Plicothrips apicalis (Bagnall, 1915)	7	–
(vi)	Phibalothrips peringueyi (Faure, 1925)	3	–
(vii)	Helionothrips parvus Bhatti, 1968	2	–
(viii)	Frankliniella schultzei (Trybom, 1910)	2	–

*Each value is mean of 20 observations in two seasons (2010-2011)

Table 2
Thrips density on Paddy and Grass along with climatic factors

	*Mean thrips density/m²**					
Period of study	*Paddy*	*Grass*	*Temp. Max(°C)*	*Temp. Min (°C)*	*R.H. (%)*	*Rainfall (mm)*
July, 10	15	28	29	22.7	88.1	296.1
Aug, 10	23	30	29.6	22.6	89.5	103.6
Sept, 10	11	20	28.6	21.6	90.5	262.3
Oct, 10	15	32	27.6	18.5	89.8	195
Nov, 10	10	20	25.3	12.7	86.9	12.6
July, 11	12	28	30.7	22	85	298.8
Aug, 11	18	30	30.4	21.8	85.2	278.4
Sept, 11	22	28	30.3	21.4	79.7	146.6
Oct, 11	19	30	28.7	17.8	74.4	49.3
Nov, 11	17	20	27	9.2	66.9	1.3

*Mean density of thrips in two seasons during 2010 & 2011

region of the paddy field. As the paddy is cultivated from July to November, only five months data during the cropping period was taken in to consideration. It is not only the diversity of thrips, but their density was also more on the grasses than the paddy. Since the species packing was more on E. stagnina, which in turn paved way for the inflow of species into the crop.

Thrips population on paddy ranged from 10 to 23, while on E. stagnina it was 20 to 32 thrips/m^2 during the period of sampling. Although both the plots were free from pesticide application, perhaps the other routine agronomic practices might have kept thrips density under check on paddy. Thrips population on paddy and the grass showed significant difference when subjected to students *t* test (Table-3.). Correlation analysis of thrips density [on grass] with climatic factors also yielded positive relation. It implied that the climatic factors such as temperature, humidity and rainfall favoured the population build up of thrips (Table-3.). On the other hand, thrips density on paddy showed negative relation with humidity and rainfall (r = –0.30 & –0.23), indicating the possible control of thrips by these factors. Although positive relation was obtained with humidity and rainfall along with thrips on E. stagnina, the data gave a weak correlation (r = 0.22 and 0.34). In both paddy and grass, the data clearly revealed that temperature was positively correlated with thrips density (r = 0.45 and 0. 59) reflecting the fact that the minimum temperature of 20 – 22p C and maximum temperature of 28 – 30p C appeared to be conducive for the growth and maintenance of thrips population.

DISCUSSION

A wide variety of grasses (weeds) multiply at a fast rate in the well-fertilized soils in and around the cultivated fields, competing with crops for nutrients, light, and space besides acting as reservoirs of several pest species [12]. Uvarov as early as 1964 emphasized that pest fauna of both the crop and weed tend to exhibit similarity in terms of diversity. Lewis [13] &Taylor [14] attributed this feature due to their inter-plant migratory tendency. Movement of pest species from the wild vegetation to the crop land during different season makes the pest species to complete their development and breeding cycle. Similar aspect of inter plant movement of thrips between paddy and grass has been observed in the present study, wherein the paddy thrips – Stenchaetothrips biformis makes shuttle between the grass and paddy and this process promotes continuous build up of thrips population. The present study also supports the observations made by Koppa [15] who has noticed

Table 3
Correlation analysis of thrips along with climatic factors.

Thirps density on	
Oryza sativa	*Echinochloa stagnina*
Mean thrips density Vs Maximum temperature	
a = 25.86; b = 0.17; r = 0.45	a = 23.05; b = 0.21; r = 0.59
Mean thrips density Vs Minimum temperature	
a = 15.25; b = 0.23; r = 0.22	a = 3.52; b = 0.58; r = 0.59
Mean thrips density Vs Relative humidity	
a = 92.15; b = –0.52; r = –0.30	a = 73.85; b = 0.36; r = 0.22
Mean thrips density Vs Rainfall	
a = 263.95; b = -6.14; r = -0.23	a = 65.84; b = 0.65; r = 0.34

Thrips density on paddy and E. stagnina was subjected to Students 't' test;Calculated t value = 5.36* Table value= 3.169 *Significant at 1% levelSince the calculated "t" value is greater than table value, it is inferred that thrips population is significantly different between paddy and grass.

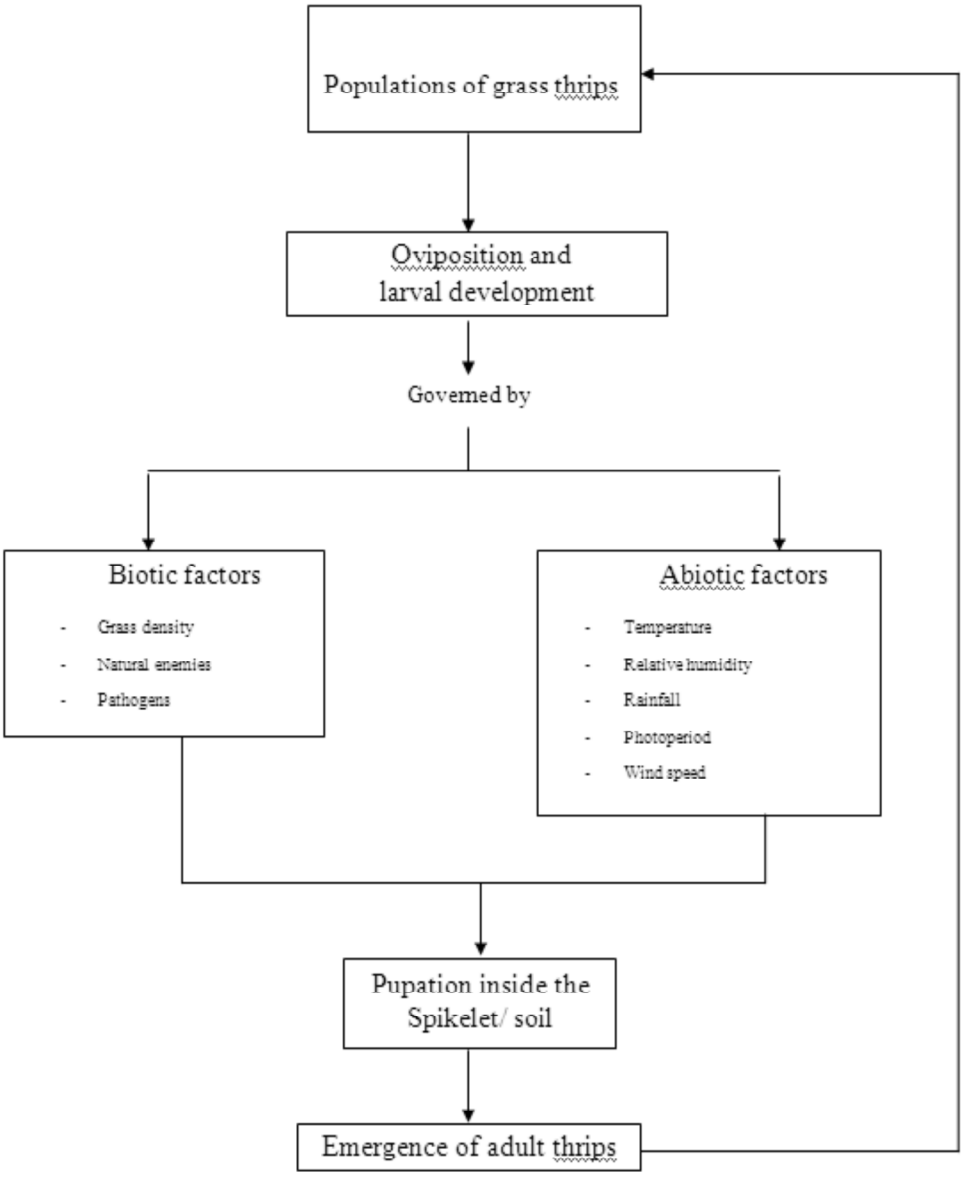

Figure 1: Factors governing the population of grass thrips

the interaction between grasses and cereal crops in terms of population fluctuation of Limothrips denticornis. In view of the perennial nature of the meadows, there is a good build-up of thrips population in these grasses, which move to cereals from meadows and then return in autumn, accentuating the fluctuation in the size of thrips population. Considerable movement of thrips has also been noticed between soybean crop and grasses [16] and also among the cereal crops cultivated adjacent to grassy meadows [17]. Examples highlighted above clearly revealed the role of grasses in supporting the survival of thrips population especially during the off-seasons of the crop.

Weeds are very common in the agro-ecosystem and many pest species colonize on the weeds; eventually migrate especially when the phenological events of crops and weed synchronize each other. The comparative work on pest density between the crop and grassland carried out by Bey-Bienko [18] indicated that the insect density as well as diversity was almost double in the virgin grassland than the wheat fields which in turn paved way for the inflow of species into crop.

Observations of the present study are in tune with the above wherein the density of thrips in protected grassland has been found appreciably more than that of paddy. Uvarov [19] stated that grasses

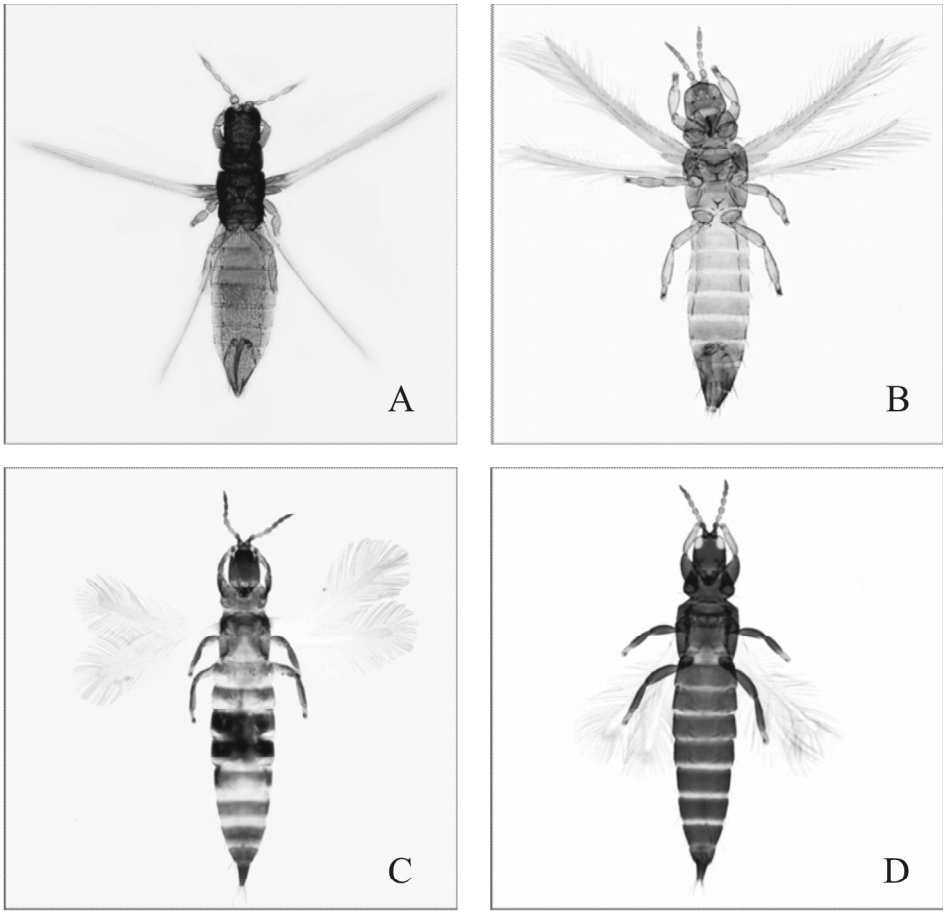

Figure 2: Some of the grass inhabiting thrips
A. Phibalothrips peringueyi, B. Stenchaetothrips biformis, C. Plicothrips apicalis, D. Haplothrips ceylonicus

and weeds could enable not only the insect's inflow continuously into the crop but also provide opportunities for some selective species to become better adapted in that ecosystem. Analyzing all the parameters in the context of population dynamics of thrips, it can be summarized in the following manner. The populations of grassthrips are governed by both biotic and abiotic factors. The biotic component includes grass density as well as natural enemies. Thrips population was found more only when the grass density was high. Certain bugs (anthocoridae) predate upon grassthrips; a few eulophid and trichgrammatid parasites attack thrips larvae and specific fungal pathogens infect both the larval and pupal stages of thrips [20], thus exerting control over thrips density. Therefore, the above said factors are considered under the density dependent factors. On the other hand, temperature exhibited significant positive correlation thus promoting their density, while RH and rainfall showed either weak positive correlation or negative relation with thrips. Generally, the grass provides shelter during the early growth phase of thrips. Once the larva attains second instar, it undergoes pupation inside the spikelet/ inflorescence or within the soil. On pupation, the adult emerges successfully and occupies yet another fresh host-grass and oviposits within the inflorescence, paving way for next generation. Thus the cycle continues leading to perpetuation of thrips generation (Fig. 1)

ACKNOWLEDGEMENT

The authors thank the DST, New Delhi for the financial support and thank the Head, Department of Life Sciences for providing necessary facilities.

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