



Population density of adult *Hexameris Viswakarma* Dhiman (Nematoda – Mermithidae) in soil under Kusum Tree, *Schleichera oleosa* Lour.

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Abstract:

Population density of a mermithid nematode is described in soil under the host tree of bug, *L. augur* which in turn is a host of this nematode. The *H. viswakarma* occurs in eggs, preparasites, parasites and post parasites and adults stage. Adults remain in soil upto 30cm deep depending upon moisture content of soil, lays eggs during rainy months late June to September. Preparasites emerged from the eggs come on soil surface to parasitize the host bug, *L. augur* nymph to adult stages. Parasitic stage emerge out from the host as post parasite and enters into soil for moulting and to become adult. Density of adult *H. vishwakarma* is recorded maximum in August and September and minimum during late June, July and October as well as during winter and summer months. First rainfall in late June or July stimulates hatching and parasitization of this nematode at $28 \pm 2^{\circ}C$ and 88 to 100% R.H. Distant wise maximum recovery of nematodes from soil is recorded from 6 to 10 meter in soil from tree trunk of *S. oleosa* which is host of *L. augur*, minimum recovery is recorded from the samples taken from 20 meter distance area. Both biotic and abiotic factors influence the population density of adult *H. vishwakarma*.

Key words: - *Hexameris vishwakarma*, *S. oleosa*, *L. augur*, population density, soil.

Introduction

One of the greatest challenges of today is to provide food for an ever-increasing population globally. Low agriculture productivity and inadequate means of food distribution as well as factors responsible for minimum productivity such as poor soil fertility and inadequate pest management practices contribute greatly to this problem. Generally, pests destroy about 35% and 20% in field and after harvesting the crops

respectively. Among these, major contribution is made by insect pests. *Leptocoris augur* (Fabr.) (Heteroptera – coreoidea – Rhopalidae) is a serious pest of Kusum plant, *Schleichera oleosa* Lour (Sapindaceae) which in turn is a host of lac insect. The pest bug *L. augur* is a gregarious feeder and by its desapping habit loss the viability of seeds (Dhiman and Gulati, 1986). It is parasitized by a mermithid nematode *Hexamermis vishwakarma* Dhiman which naturally check the rapid built up of bug population.

Biological control of insect pest is the safest mean of ecofriendly control and parasitism by a mermithid is usually fatal to the host. *H. vishwakarma*, an entomophilic nematode, is a potential biocontrol tool (Dhiman, 1996). This cause 88% mortality of *L. augur* in natural condition during rainy season June to August and cent percent in lab (Dhiman and Kumkum, 2005). Various odds of this mermithid are worked out by Ghayyum (1993), Dhiman and Kumar (1996), Dhiman and Gujral (2000), Dhiman et.al. (2009), Tomar and Dhiman and Kumkum (2006), Tomar and Dhiman (2017). In present paper on endeavour is made to describe the population density of this important bio-control agent in nature.

Material and Methods

Studies are conducted mainly in HRI and Training Center, Saharanpur where main host plants, *S. oleosa* are planted in good number. The parasitoid, *H. vishwakarma* completes life cycle in eggs, preparasite, parasite, post parasite and adult stage. Eggs, post parasitic stages and adults remain in soil whole preparasitic juveniles after hatching from the eggs come out on soil surface after first rain of rainy season and search out host bugs (nymphs and adults) for parasitization. Parasitic stage occurs inside the body of bug in haemocoelomic cavity. Post parasites after entering into soil moult in adult after removing exocuticle. Hence, population density of *H. vishwakarma* is mainly considered of adult stages.

The parasitoid, host bug and seeds of *L. augur* occur in good number during rainy months late June to September. The bug population feed gregariously on the fallen seeds which has also been reported by Dhiman and Gulati, 1986 and Shikha et.al., 2020. At this stage preparasitic nemas easily parasitizes host bug. The seeds of the plant are carried by rain water upto 20 meter distance from the host plant and bug population occur under the tree as well as up to 20 meter away from the tree feeding on seeds. Hence, there is a relationship between seeds of plant, host bug and parasitoid *H. vishwakarma* which finally effect the population density of the aforesaid species of adult nematode.

To observe the density of the adult *H. vishwakarma* different sample areas were marked under the tree canopy as well as some distance away from it and soil samples were examined for recording the presence of adult nemas. Sample size consisted 30x30x30 cm area. Samples were taken at 2, 4, 8, 10, 12 and 20 meter distance from the tree trunk base and these were marked as A,B,C,D,E,F and G, respectively (Fig.1). Five samples were examined randomly from each sample area. Samples were taken and examined monthly and the data are recorded in Table-1. The study was carried out for two consecutive years 2021 and 2022.

For the extraction of this mermithid nematode from various soil sample, the technique used for extracting plant parasitic nematodes i.e., by modified Bearman's funnel technique is not applicable because mermithids are quite long (27cms) and their width is also more in comparison to plant parasitic nemas. Due

to long body, *H. vishwakarma* is easily detectable from the soil by naked eyes. Hence, there were first physically sorted out from soil samples and then Cobb's (1918) wet screening method was followed for the remaining *H. vishwakarma* left in soil sample due to camouflage etc.

Results

The adult *H. vishwakarma* remain in the soil up to 20 cm. Deep during winter months November to February and early summer months up to mid of June till rain comes on. As first rain of the rainy season pours, they migrate towards the upper layer of soil as temp. ($28^{\circ}\text{C} \pm 2^{\circ}\text{C}$) and relative humidity (80 to 100%) becomes favourable. The adults become active and begin oviposition while post parasites moults into adults. Hatching of preparasites, migration on soil surface, penetration into host bug and parasitization all occur during late June to September depending upon the rain fall of the locality.

The density of adults of *H. vishwakarma* is recorded maximum in August and September when the host bug population is also on the peak. During July to September, the adults are found up to 20 meters away from the host bug tree. Parasitization percent increases from July to first week of October due to which host bug population decreases considerably. This results increase in the population density of nematode *H. vishwakarma* in soil, being on peak in July and August and then gradually decreases and goes on lowest level during winter and summer months (Table-1 and Graph-1).

Climatic factors such as low and high temp., aridity of soil, low relative humidity, predators and parasites play significant role in decreasing the population density of adults nemas in soil. *Leptus sp.* of mite, soil micro arthropods, earthworms, fungi and predatory birds are observed main enemies of this nematode species. Due to these, minimum recovery of adults was obtained from sample areas during winter and summer months.

Distant wise, population density was seen maximum in the soil samples taken from six to ten meters distant from the tree trunk base of *S. oleosa* the host of *L. augur*. In these zones maximum seeds and gregariously feeding bugs are found and after emergence from the host, post parasites enter in to the soil for moulting to become adults (Fig. 1).

Minimum recovery has been made from the 'G' sample taken from 20 meters distant area. The possible reason is because the bug population only occur in this zone feeding on the few seeds transported by rain water during July to September.

Further, during rainy months, adult nemas were recovered from the soil surface as well as upto 10 cm deep soil of most of the sample areas due to high moisture content of environment as well as soil. A few post parasitic nematode are also collected from the herbs emerged out from the host under *S. aleosa*. During winter and summer season low recovery was made from 'A' and 'B' samples taken from 2 and 4 meter away from the trunk. This is due to low moisture content which makes the soil hard near tree trunk. However,

density of adults was seen high enough throughout the year in 'C' to 'E' samples areas because soil of these are is found comparatively soft and able to hold enough moisture content necessary for survival (Table-1).

Graph -1 clearly indicates the fluctuation in the population density of *H. vishwakarma* in soil during two consecutive years 2021 and 2022. It depicts that as the temp. and R.H. increases, the bug population also increases which causes the increase in density of this adult mermithid nematodes during rainy season (July to October). This happens due to increased parasitization during these months which causes decrease in the population of host, because the parasitized host bug dies after the emergence of parasitic stage. Thus, cent percent mortality occurs of parasitized bug. The decrease in bug population and R.H. also decrease the density of adult emas during October onwards. As said already, highest density of adults of *H. vishwakarma* was recorded at 6 – 8 meters away from the tree trunk during August and September while low density observed in winter and summer months due to decrease and increase in temp. during these two seasons and low R.H. levels. Although, the bug resides under the host tree *S. aleosa* and adult nematodes in soil in the study area throughout the year.

Fluctuation in the population of adult parasitizes is also influenced by predators, fungus and extremes of climatic factors. However, change in soil moisture and temp. are mainly responsible of population density of parasitoid. The decline in nematode abundance from November to May followed the increase in temp. and was correlated with a very dry period.

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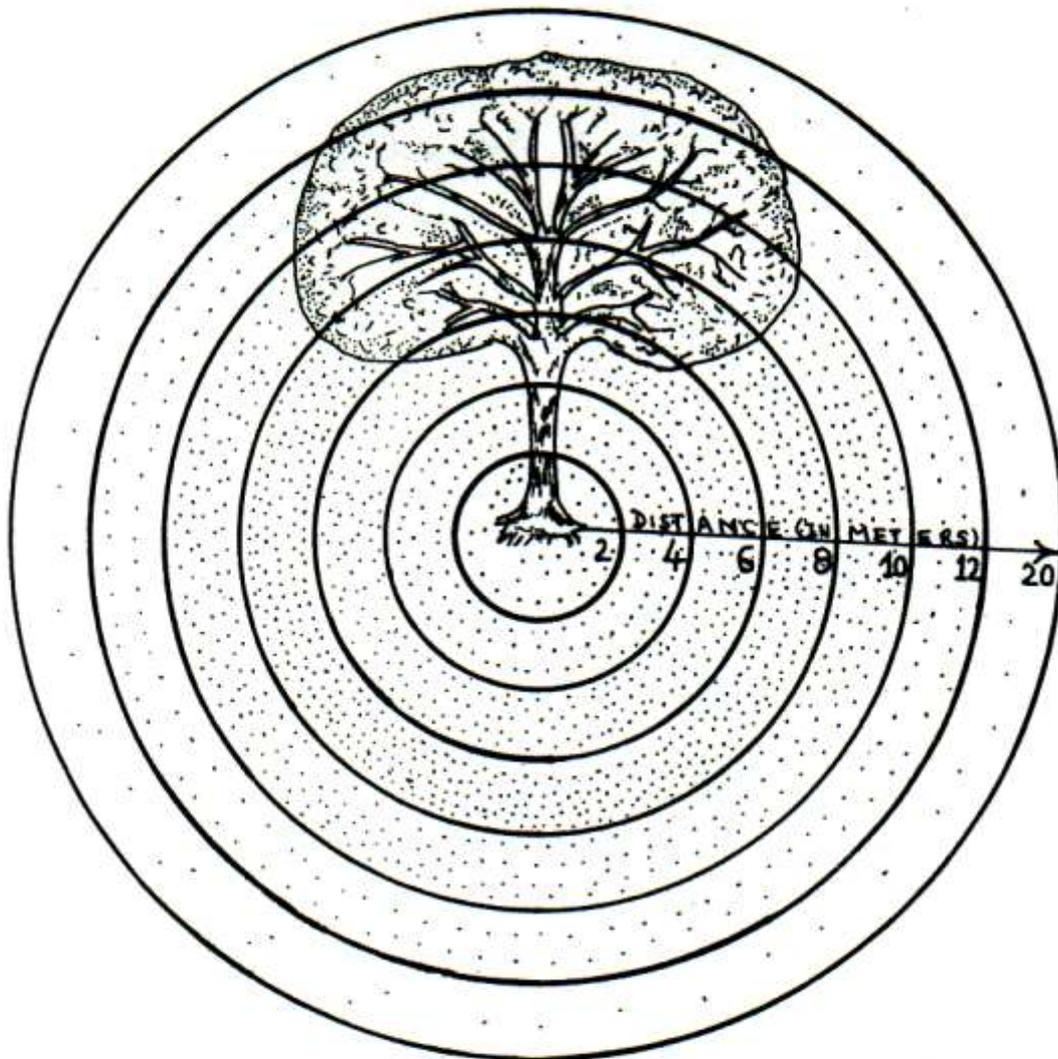


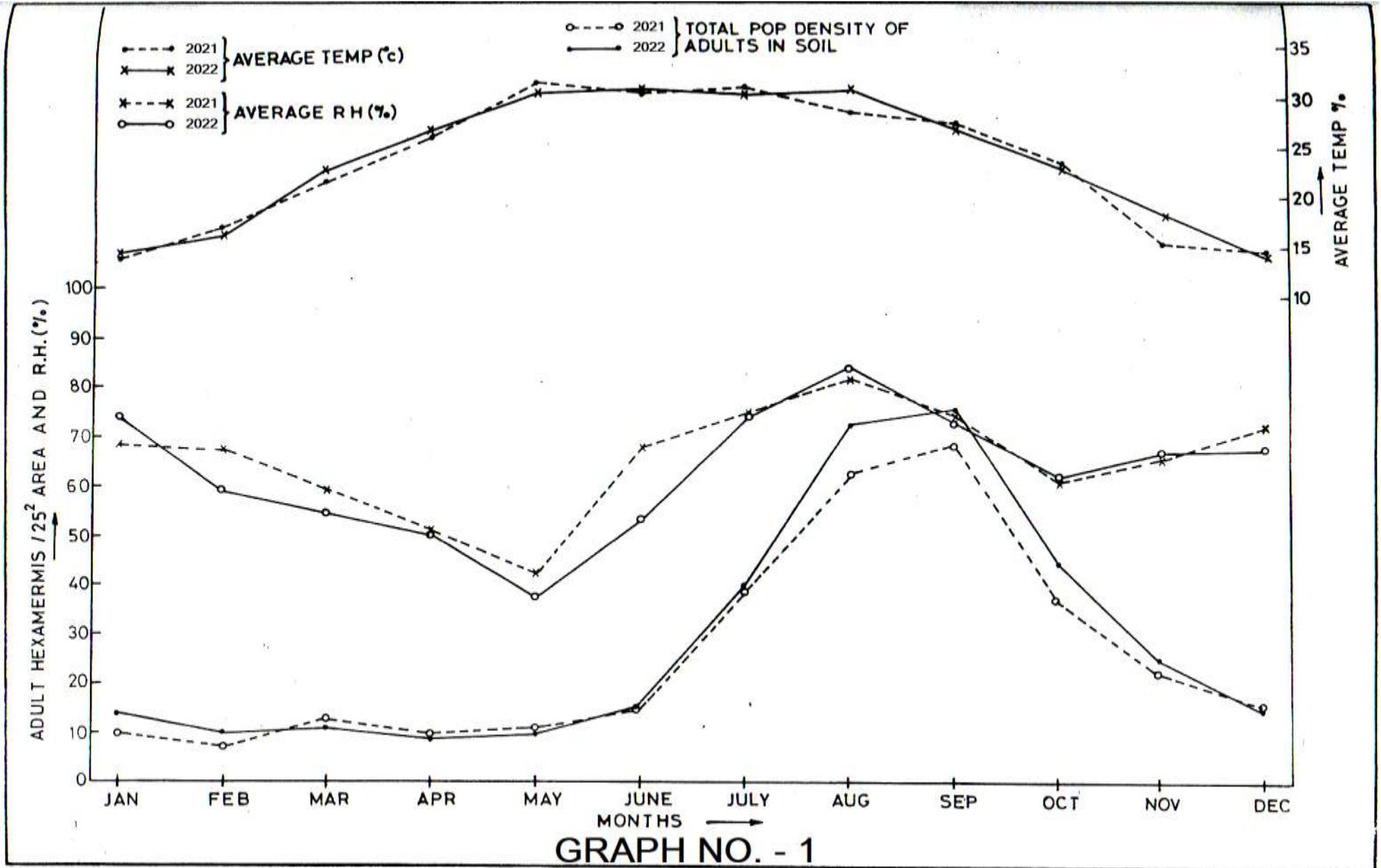
FIG. - 1

TABLE – 1

POPULATION DENSITY OF ADULT HEXAMERMIS. IN SOIL AT STUDY SITE DURING 2022-2023.

Months	Bug population / 25 ² meter		A		B		C		D		E		F		G		Total No. of adults	
	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023	2022	2023
January	60	65	-	-	1	-	2	2	-	7	4	2	2	3	1	-	10	14
February	120	100	-	2	-	1	-	-	1	3	3	3	3	1	-	-	7	10
March	150	130	1	-	2	-	3	2	4	5	2	3	1	1	-	-	13	11
April	125	140	2	-	1	-	2	2	3	3	2	4	-	-	-	-	10	9
May	220	200	-	-	2	1	5	5	2	2	-	2	2	-	-	-	11	10
June	250	350	6	3	3	2	-	3	1	4	3	3	-	1	2	-	15	16
July	300	550	6	7	6	6	4	6	10	7	6	7	2	5	5	2	39	40
August	350	600	8	9	7	9	12	24	12	11	14	12	6	3	4	5	63	73
September	200	450	10	6	5	7	14	15	19	21	12	17	6	4	3	6	69	76
October	100	80	6	6	5	8	9	8	8	10	8	9	1	4	1	-	38	45
November	60	50	-	-	-	2	9	7	7	6	4	6	3	5	-	-	23	26
December	40	20	-	-	-	-	7	4	5	4	4	3	-	4	-	-	16	15
TOTAL			39	33	32	36	67	78	72	83	62	71	26	31	16	13		

Minimum population density of adults – G sample
Maximum population density of adults – D sample
(Average has been taken of 50 observations)



GRAPH NO. - 1