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Studies on succession and population dynamics of insect pest complex of oyster mushroom

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Abstract
The present investigation was carried out at mushroom production house, Department of Plant Pathology, College of Agriculture, JNKVV, Jabalpur (M.P.). The activity of pest complex namely Sciarid fly, Phorid fly, Cucujoid beetle, and Staphylinid beetle were recorded at spawn run stage, pin head stage and sporphore stage. Incidence of pest complex observed up to spawn run stage later on population is disappeared except Staphylinid beetle is noticed even at sporophore maturation stage. The relationship between pest population and weather parameters (maximum, minimum temperature, morning and evening relative humidity) were found non-significant during both seasons.

Keywords: pest complex, weather parameters, spawn runs stage

Introduction
Mushrooms are the macro fungi with clear fruiting body and therefore the edible mushrooms recognized as a food source by Food and Agriculture Organization (FAO) due to their nutritional quality. Mushrooms contain a lot of protein than either fruits or vegetables [4]. Oyster mushrooms (Pleurotus spp.), are lignocellulose loving fungus and can be easily recognized in nature due to their peculiar morphology with a peculiar short stem or stipe. Due to simple low-cost cultivation technology, it is the most popular cultivated edible mushroom, consumed for its delicacy, flavour, pleasant consistency besides having nourishing and medicinal value [3]. Cultivation is also independent of weather, and can recycle agricultural by-products as composted substrate which, in turn, often can be used as organic mulch in growing different horticultural crops, as well as vegetables [13]. The oyster mushroom contribution that is estimated to 24.1 per cent of the total world production of commercial mushrooms ranked second to the button mushroom, which shared 37.7 per cent during 1990 [8]. It is the 3rd largest cultivated mushroom in the world and it is popularly grown in China, India, South Korea, Japan, Italy, Taiwan, Thailand and Philippines. India produces annually 10,000 tons of oyster mushroom [2].
Mushrooms are attacked by abundance of pests from spawning to harvest. Since mushrooms are grown mostly in an enclosed environment, the risk of insect pests and diseases spreading rapidly within the crop are high, find very suitable and protected environment for their unhindered multiplication [13]. Sciarid fly, phorid fly, spring tails and mites are important arthropod pests of cultivated mushroom in India [10, 12]. Phorid fly, *Megaselia spp.* was reported for the first time in India on oyster mushroom beds [5]. On their own, phorid flies cause 'fly speck' on mushroom caps that reduces the quality of mushrooms to a cull grade [11]. Prior to 1980, no detailed information on identification, biology, behavior and control of these pests in India was available. After thorough scanning of the literature, the gaps were identified and the present investigation was planned and carried out at mushroom production house, Department of Plant Pathology, College of Agriculture, JNKVV, Jabalpur (M.P.).

Materials and Methods
The materials and methods used during present experimentation are as follows.

Experimental site
The research experiments were conducted in the mushroom production house, Department of Plant Pathology, College of Agriculture, JNKVV Jabalpur.

Meteorological data
The meteorological data on daily temperature (Maximum and Minimum) and relative humidity prevailing in the mushroom cropping hut were recorded and used to study their effect on insect pest population.

Observation on the succession of different insect pest complex on mushroom
Observations on the succession of insect pests on mushroom crop were started from spawning stage of the crop and it was repeated at an interval of 4 days. The observations were taken up to maturity of the crop.
The Poly-bag method of oyster mushroom cultivation was followed with three replications using all recommended standard practices. Spawning was done through mixing method @ 3 per cent on wet straw basis. Spawned substrate was filled in 3 bags @ 1000g dry straw bag^{-1}. Spawning was done after the bags were transferred to the cropping room. Where average temperature of December- January was 25.7 °C maximum and 5.5 °C minimum and above 90 per cent relative humidity in morning and 27.6 per cent relative humidity during evening day^{-1}, respectively prevailed. The observations were taken by the method based on counting the numbers of occurrence of larval, pupal and adult stages of phorids, sciarid flies and other insect pests on oyster mushroom. During spawn run stages, two types of observations were taken, first one was external (without removing polythene bags) observation and another was done internally (removing polythene bags) in which two mushroom beds were observed. Photographs were taken on different stages of different insect specimen on mushroom crop.

Observation on insect pest infestation
To record the infestation of larval stages of mushroom flies, the observation were started right from spawn run stage of the crop. It one observation was taken externally (without removing polythene bags) on the surface of mushroom beds and another observation was taken of inside mushroom beds (removing polythene bags during spawn run stage). On both these conditions, number of larval and pupal stages were counted of mushroom flies were counted. Second phase of observation were taken at pinhead and at sporophores maturation stages. The larval and adult stages of mushroom flies on sporophores were counted.

Correlation with weather parameters
The data were transformed and correlated with different weather parameters by putting formula of [6]. Correlation analysis was carried for analysing the influence of ambient weather parameter *viz*. maximum, minimum, mean temperature and relative humidity on the incidence of mushroom insect pests. The larval population of different mushroom flies observed and applied square root transformation and was correlated with different weather parameter average. The weather parameter average, inside the production house condition were computed by working out the averages of four days condition 3 days preceding to each larval stage counting was taken as basis for the working out of weather parameter averages.

Results and Discussion
The experimental findings on the different aspects of the study entitled "Studies on succession and population dynamics of insect pest complex of oyster mushroom " conducted at mushroom production unit dept. of plant pathology. The observations recorded on various aspects reflect some interesting facts, which are briefly elucidated in the present chapter.

Incidence of major insect pests on oyster mushroom crop
A detailed experimental study was done on the incidence of various insect pests on the oyster mushroom in the duration of *rabi* season December-January 2016-17. The data pertaining to the incidence of different insect pests, attacking oyster mushroom crop are presented in Table 1.
It is obvious from the data and photographs that about four insects species were found causing damage to oyster mushroom in relation to crop phenology from spawn run to sporophore maturation stage *viz.* Sciarid fly *Lycoriella auripilla* Winn., Phorid fly *Megaselia halterata*, Cucujoid beetle *Cyllodes whiteii*, and staphylinid beetle *Scaphisomanigro fasciatus* Champion, were recorded.

Table 1: Succession of insect complex on oyster mushroom, during *rabi* season December-January 2016-17 (Average population of three polythene bags of size 12" x 18" of 150 gauges)

Date of observations	Crop stage	Sciarid			Phorid			Cucujoid Beetle	Staphylinid Beetle
		Maggot	Pupa	Adult	Maggot	Pupa	Adult	Adult	Adult
17-12-16	Spawn run	9.3	4.3	15.3	7	5	5.3	5	3.3
21-12-16	Spawn run	16.7	20.7	22.3	5	9	6.7	7.7	4
25-12-16	Spawn run*	33.7	40.3	0	14.3	18.7	0	3.3	4.7
29-12-16	After spawn run	0	0	24.7	0	0	3.3	0	1.7
2/1/2017	Pinhead	0	0	19.3	0	0	4.7	0	3.3
6/1/2017	Sporophore	2.7	0	14.7	3	0	5.3	0	5.7
10/1/2017	Pinhead	0	0	16	0	0	4	0	2
14-01-17	Sporophore	2.7	0	13	1.7	0	6	0	9.3
18-01-17	Pinhead	0	0	10.3	0	0	3.3	0	4
22-01-17	Sporophore	2	0	15.7	2.7	0	5.3	0	8.3

Note: * Indicates population counted internally

Table 2: Insect pest incidence on oyster mushroom, during *rabi* season December-January 2016-17

Insect pest	Life stage of Insects	Crop stage	No. of insects per bag (Range)	Period of activity	Crop stage of maximum insect population
Sciarid fly	Maggot	Spawn run to sporophore maturation	2.0 - 33.7	3rd week of December to 4th week of January	Spawn run
	Pupa	Spawn run	4.3 - 40.3	3rd week of December to 5th week of December	Spawnrun
	Adult	Spawnrun to sporophore maturation	10.3 - 24.7	3rd week of December to 4th week of January	Pinhead to mature sporophore
Phorid fly	Maggot	Spawnrun to sporophore maturation	1.7 – 14.3	3rd week of December to 4th week of January	Spawnrun
	Pupa	Spawn run	9.0 – 18.7	3rd week of December to 5th week of December	Spawnrun
	Adult	Spawnrun to sporophore maturation	3.3 – 6.7	3rd week of December to 4th week of January	Pinhead to mature sporophore
Beetle	Adult	Spawn run	3.3 – 7.7	3rd week of December to 5th week of December	Spawnrun
Staphylinid	Adult	Spawnrun to sporophore maturation	1.7 – 9.3	3rd week of December to 4th week of January	mature sporophore

Incidence of sciarid flies

It is easy to understand from the Table (1) that 3rd and 4th week of December, maggot, pupa and adult life stages of sciarid fly infested the oyster mushroom crop and their average population was recorded at spawn run stage (observed externally twice and internally once). The findings on population were 9.3 and 16.7 bag^{-1} for maggot, 4.3 and 20.7 bag^{-1} for pupa and 15.3 to 22.3 bag^{-1} for their adult stage at spawn run. While, inside the bag, the population of maggot and pupa were 33.7 and 40.3 bag^{-1}, respectively.

Later on, observations were taken in the 5th week of December, on different life stages of sciarid fly were observed at after spawn run stage, pin head and matured sporophore of the crop. It was revealed that in after spawn run stage the maggot and pupal population disappeared while the adult sciarid fly population was 24.7 bag^{-1}. Similarly, all successive pinhead stages were unfavorable for larval infestation. However, they appeared on gills and stalk of mature sporophore with feeding them at all three successive fruiting bodies *i.e.* 2.7, 2.7 and 2.0 bag^{-1}, respectively. However, pupal population was not observed at this stage of crop while, it is obvious from the data that adult fly was located on the pin head and sporophore stages of the crop.

Incidence of phorid flies

It is crystal clear from the (Table 1) that at spawn run stage, phorid fly appeared on the crop at its all life stages. In 3rd and 4th week of December. the maggot and pupal population were 7.0, 5.0 and 5.0, 9.0 bag^{-1}, respectively at four-day intervals, while observed inside the bag, maggot and pupal population were found 14.3 and 18.7 bag^{-1}, respectively. However, at this level of observation adult fly population could not be seen.

The observation taken at after spawn run stage on the 5th week of December shows that phorid flies at their maggot and pupal stages were not observed, however, the adult phorid flies were observed 3.3 bag^{-1}. Onwards, it is obvious that during pinhead stage of the crop, maggot and pupal stages of phorid flies were not found, but adult flies were observed 4.7, 4.0 and 3.3 bag^{-1}, respectively at pinhead stage. For the same duration, data shows that at all three consecutive fruiting stages the population of maggot and adult flies were 3.0, 1.7 and 2.7 bag^{-1}, 5.3, 6.0 and 5.3 bag^{-1}, respectively.

Incidence of adult cucujoid beetle

It is obvious from the data (Table 1) that the incidence of the adult beetle was noticed during the 3rd week of December at the spawn run stage. It continued to remain the entire spawn run stage *i.e.* up to the 5th week of December. The crop was observed to be completely free from its attack in after spawn run, pinhead and mature sporophore formation stages.

Incidence of Staphylinid beetle

The findings presented in (Table 1) for the incidence of Staphylinid beetle, it is reflected from the data that there was the incidence of Staphylinid on all the stages of mushroom crop i.e. from spawn run to sporophore maturation. During spawn run stage of the crop, the Staphylinid population per bag observed was 3.3 and 4.0. When examined internally it was found to be 4.7 bag^{-1}. The attack was reached to peaks during the sporophore stages as the beetles settle between gills of fruiting bodies. The staphylinid populations during successive sporophore stages were 5.7, 9.3 and 8.3 bag^{-1}.

Correlation of abiotic factors on major insect pests of oyster mushroom

To know the effect of abiotic factors in the mushroom production house condition *viz.* maximum and minimum temperature, morning and evening relative humidity on oyster mushroom flies. The simple correlation studies between different weather factors and mushroom flies by taking larval population were established.

Effect of temperature

The effect of temperature on larval activity was analysed i.e. maximum and minimum temperature during period of study *viz.* December-January, which is depicted in Table 3.

It is evident from the perusal of Table 4 that the statistically positive non-significant correlation was found between phorid maggot population with maximum and minimum temperature whereas for sciarid fly it was found positive non-significant and negative non-significant correlation with maximum and minimum temperature respectively during the experiment.

However, the temperature range during month of December-January, 23 to 16.5 °C as maximum and 7 to 12.25 °C as minimum was prevailing.

Table 3: Correlation between mushroom flies population and abiotic factors of the mushroom production house, during December-January 2016-17.

Date and Month	Crop stage	Sciarid larval population bag^{-1}	Phorid larval population bag^{-1}	Temperature (^{0}C)		Humidity (%)	
				Maximum	Minimum	Morning	Evening
17 Dec.	Spawn run	9.3	7	22.75	11.5	90.5	50.5
21 Dec.	Spawn run	16.7	5	20.25	8.75	90	49
25 Dec.	Spawn run*	33.7	14.3	23	9.5	90	52.25
29 Dec.	After spawn run	0	0	21.75	9.75	91.5	51
02 Dec.	Pinhead	0	0	23	9.75	91.5	51.5
06 Jan.	Sporophore	2.7	3	19.25	11.5	91.25	52.5
10 Jan.	Pinhead	0	0	22	11.75	90.5	52.5
14 Jan.	Sporophore	2.7	1.7	16.5	7	92	54.5
18 Jan.	Pinhead	0	0	20.5	8.25	90.5	52.25
22 Jan.	Sporophore	2	2.7	20.75	12.25	90.5	52

Note: * Indicates population counted internally

Table 4: Coefficient of correlation (r) among mushroom flies' population and abiotic factors

Insect pest	December to January (2016-17)							
	Temperature (^{0}C)				Humidity (%)			
	Maximum		Minimum		Morning		Evening	
	r	byx	r	byx	r	byx	r	byx
Sciarid	0.28 NS	-	-0.14 NS	-	-0.61 NS	-	-0.24 NS	-
Phorid	0.29 NS	-	0.04 NS	-	-0.56 NS	-	-0.16 NS	-

Note: NS=Non-significant

Effect of relative humidity

The distribution of relative humidity for two intervals in a week at production house condition in relation to larval stage of mushroom flies population has been shown in Table 4

It can be seen (Table 4) that there was statistically negative non-significant correlation between larval population of mushroom flies with morning and evening relative humidities during the experiment. There was a close span range of 90 to 92 per cent as morning relative humidity and 49 to 54.5 per cent evening relative humidity was observed during month of December-January.

The observation in relation to fly activity on crop phenology was found similar but the intensity of infestation in *rabi* season *i.e.* December-January sciarid and phorid flies were different. The phorid flies population was slightly decreased in December-January in comparison to sciarid flies. These findings are in corroboration with those of [15]. They reported that the sciarid flies may present on mushroom production sites throughout the year and found numerous during January to March but the phorid flies incidence was comparatively less at this season [5]. also mentioned about the activity of phorid fly. They observed these flies are found numerous in the mushroom hut at spawn run stage only during September-November *i.e.* rainy season and comparatively less during winter seasons and also reported that these flies breed on wild mushrooms at these periods. The incidence of larval life stage of sciarid and phorid flies started from early spawn run stage to sporophore maturation of *rabi* season *i.e.* December-January. The peak population during the experiment was observed in spawn run stage on 5th week of December. The present findings are somewhat corroborative with those of [9, 1, 7, 5]. The peak populations of Staphylinid beetles recorded during the sporophore stages *i.e.* 2nd, 3rd and 4th weeks of January in which the beetle infests the gills of emerged sporophore. Similar statements were reported by [14].

Conclusion

From the observation on mushroom flies activity was found that dipteran flies as major pests which severely infested to oyster mushroom crop with its larval life stage. The spawn running crop growth period are most susceptible and provided congenial microenvironment. The pest activity associated and influenced more by growth stages of the mushroom crop than the prevailing abiotic conditions.

References

1. Scheepmaker JWA, Geels PP, Smits PH, Griensven Van LJLD. Location of immature stages of the mushroom insect pest *Magaselia halterata* in mushroom growing medium. Entomologia Experimentalis-et-Applicata 1997;83(3):323-327.
2. Das G, Sarkar S. Oyster mushroom (*Pleurotus* spp.): Adoption percentage of mushroom trainees of Cooch Behar Krishi Vigyan Kendra-A review. World J Pharm Life Sci 2016;2(1):86-92.
3. Deepalakshmi K, Sankaran M. *Pleurotus ostreatus*: An oyster mushroom with nutritional and medicinal properties. J Biochem Technol 2014;5(2):718-726.
4. Chang ST, Miles PG. Mushrooms: cultivation, nutritional value, medicinal effect, and environmental impact, 2nd ed. Boca Raton, FL: CRC Press 2004, pp. 451.
5. Krishnamoorthay AS, Marimuthu T, Sivaprakasam K, Jayarajan R. Occurrence and damage caused by phorid fly on oyster mushroom. In- Indian mushroom (Eds. M.C. Nair). Kerala Agricultural University, Velloanikkara 1991; pp.240-41.
6. Snedecor GW, Cochran WG. Statistical method. Indian Edition 1968 published by arrangement with the original American publishers. The Iowa state University Press, USA 1968.
7. Brar DS, Sandhu GS. Biology of the Sciarid fly, *Bradysia tritici* (Cog.) (Diptera: Sciaridae) on temperate mushroom in the Punjab, India. Mushroom Science 1989;12(2):831-842.
8. Bahl N. Export potential of mushrooms. Advance in Horticulture (Eds. K. L. Chadha and S.R. Sharma), Malhotra Publishing House, New Delhi 1995;13:585-595.
9. Mohan S, Desney RHL. A new species of suttle fly (Diptera: Phoridae) that is a pest of oyster mushrooms

(Agaricales: Pleurotaceae) in India. Bulletin of Entomological Research 1995;85(4):575-578.
10. Sandhu GS. Management of mushroom insect pests. in: advances in horticulture Mushroom (Chadha, K.L. and Sharma, S.R., Eds.). MPH, New Delhi 1995;13:239-260.
11. David MB, Shelby F, Paul JW. Crop Profile for Mushrooms in Pennsylvania, General Production Information 1999,15-17.
12. Deepthi S, Suharban M, Geetha D, Sudharma K. Pests infesting oyster mushroom in Kerala and the seasonability of their occurrence. Mushroom Research 2004;13:76-81.
13. Quero Cruz R. Manual para comunidades forestales. producción de hongos comestibles (*Pleurotus Ostreatus*) 2007. Oaxaca. (in print)
14. Gahukar RT. Mushroom Pest and Disease Management Using Plant-Derived Products in the Tropics: A Review. International Journal of Vegetable Science 2014;20:78-88.
15. Singh AU, Sharma K. Pests of mushroom. Advanced Crop Science technology 2016;4:213-219.