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Research Article

Odor Dispersion and its Response by Moths (Lepidoptera)

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Abstract

Pheromones are chemical substance which are used to attract the insects of same species which are released by insect. These pheromones are artificially made by the using specific chemicals which have same fragrance or odor like natural chemical to attract insect to collect in traps or cages. Odor dispersion depends upon the intensity of source, air temperature and wind speed, dispersion route and absorption by insects distance. Hanging traps distance and ground traps distance also impact on dispersion of odor.

Artificial pheromones was used to traps insects in traps by using "Gyptol". This is infrared spectrum of the purified attractant (termed "gyptol") indicated the presence of a primary hydroxy group, a secondary acetoxyl group, and double bond. This compound is the natural attractant was confirmed by the synthesis of material with activity equivalent to that of the natural attractant. Active space dependency on the behavior threshold, distance from source and dispersion of odor, all these factors are cross ponding to each other.

Keywords: Active Space; Behavior Threshold; Odor Dispersion; Distance from Communication; Rate of Absorption; Rate of Dispersion, Pheromones; Gyptol; Mating Behavior; Odor Flux; Diffusion Coefficient and Concentration

Introduction

Insects are arthropods of class insect, which have a body division into 3 parts [1]. Head, thorax and abdomen, three pairs of legs and two pairs of wings. Insects found around us [2]. They communicate with each other [3] and create a competition among them for survival of shelter, food [4]. They use specific communication chemicals to communicate with each other of same species these chemical is semiochemical [5] and other species of insects in which Pheromones and allelochemicals are most common [6]. Pheromones are those chemicals which are used to communicate between the same species for different purposes in which emergency alarming, mating behavior, calling behavior, to locate food source direction and calling for sex, that's are basically called sex pheromones [7]. To communicate with other species of insects they use allelochemicals that are interspecific chemicals which are released by insects. In insects these chemicals are smelled by antenna, olfactory organs and sensory receptor surface, these all sensory receptors followed by Central Nervous system of insects [8]. Prepared artificially Pheromones are commercially used by the researcher to traps insects for specific purposes [9]. Pheromones have specific molecules which have odor to which insects are attracted toward it and trapped into cage [10]. This odor signals of pheromones dispersion is done through air, by contact chemoreceptor and transport medium [11]. Host insects find odor by odor behavior, odor dispersion and air-born odor [12]. Odor dispersion totally dependents on the distance from the source to receiver body of insects species. Distance plays important role to attract the species to odor dispersion coming from pheromones chemicals source [13]. Increase in the distance from source decline of odor concentration and same like decrease in distance from source increase of odor concentration attraction of insects. Active space is also important for odor dispersion, it's defined as the volume of air inside which the odor concentration is above threshold level [15]. For insect's odor receiving sufficient according to odor behavior. Close source of odor concentration have sufficient high suppressed behavior [16]. If active space distance is maximum then communication dispersion of odor will effect [17]. Odor emission from source and behavior threshold are both dependent on each other, these are measured by dispersion model.

Emission rate of pheromones from source can measured by few species [18]. While behavior threshold is complicated behavior. Different concentration of same odors have different elicit behavior in same species [19]. Rate of odor depends on the ratio of molecules that are coming out from source. Odor signals behavior response by olfactory organs, Central nervous system and sensory receptor surface [20]. Rate latency in insects are specific for insects. It is a time interval between the arrival of stimulus and response which increase or decrease by its concentration [21]. Prolong odor dispersion produce sensory adaption [22]. Plused signals are continuous signals at the lower threshold. Threshold is term of concentration in atmosphere where odor molecules absorption by olfactory sensory organs [23]. Rate of absorption of odor in moving air depends on the odor flux on its concentration [24]. Odor flux concentration also in still air and its absorption according to condition. Flux odor too much lower can be measured by sampling of air. Behavior threshold pheromones estimated by few insects [25]. Size and shape of active space depends on the behavior threshold. Rate of behavior threshold and rate of natural pheromones characteristics of communicated system done by Q/K [26]. Q is amount released of odor molecules and K is behavior threshold. In alarm pheromones, Q/K will be high when odor signals will fade quickly [27] and easily as same as Q/K will be low, when odor signals will not fade quickly in sex pheromones. It will give the low persistent of Q/K [28].

Dispersion of Odor in stop air/wind

In stop or still air odor concentration dispersion done by the molecular diffusion [29]. Odor flux and rate of transportation done by reference product of diffusion, Diffusion coefficient and concentration ingredient [30]. Diffusion coefficient describes as the property of gases in given temperature and its function of molecular weight and intermolecular forces [31]. Lite molecules movement is higher than heavier molecules because these molecules are denser [32]. Pheromones' diffusion coefficient is 0.03-0.07 cm2s-1. Diffusion coefficient is increased by movement of air, by current air and independency of molecules species [33]. Active space size and pheromones concentration by diffusion equation [34].

- Instantaneous puff
- Emission rate of odor flux from source of pheromones
- Source of Deposition on plain trail plain [35].

In Instantaneous puff release alarm pheromones measured by Q, K,D

Q = amount released of odor

K = behavior threshold

D = Diffusion

R=Q/2KπQ

Air dispersion effects the bodies of air dispersion and depend upon the distance from source of release [36].

Odor dispersion in moving air

Odor dispersion will described by Sutton laws, Gussain dispersion model.

Odor dispersion done by wind, turbulent edits and chemical warfare agents [37]. Molecular diffusion of odor dispersion measured by the statistical approaches can be find by particles present in moving air [38]. According to this amount of turbulence, wind speed and macro-viscosity measured by the roughness of surface. Moth of female gypsy moth movement to male by covering the longest distance of 4KM by odor concentration pheromone [39].

Maximum distance of communication and behavior threshold are dependent on each other [40]. Sutton laws describe as the modified the release rate of amount of pheromones deposition or absorption on surface [41]. Wind speed is important for the movement of odor dispersion from source to long way, it's also depends on the odor intensity of dispersion and fused able molecules in air [42]. If air is blowing in speed then dispersion from source is long away and insects have ability to response the stimuli of this odor from long way coming odor. But sometimes insects are unable to response of stimuli due to weakness of signals they fluctuate from way and unable to move source of odor [43]. If odor intensity will be high they will move without any fluctuate of their way. Diffusion coefficient is basically done on neutral atmospheric stability [44]. In neutral stability, air temperature decreases with high ground level 1'C per 100m, this is called adiabatic lapse rate [45]. In clean sunny day, neutral stability, radiation heat uptake from soil and move into air. In denser air air-born odor have a maximum turbulent. In night case is different, radiant heat loss from ground cool air at surface relative to warm air above [46]. But in stable air, turbulence and dispersion rate is minimum. Wind speed is also important factor in dispersion of odor [47]. Size of odor of active space and maximum communication distance decreases with the intensity of wind space. High wind speed movement give large amount of dispersion if its concentration intensity will be strong [48]. This is measured by the standard deviation which shows the speed of wind is directly proportional to the dispersion of odor in long distance [49]. Communication distance increases by the wind speed. Male gypsy moth fanning movement is a best example, its wing fanning movement decreases at high wind speed [50]. In high wind speed, active space size increases and rate of odor release.

Rate of odor released by the synthetic pheromone source is directly proportional from releasing surface. Rate of odor absorb depends on the active space size [51]. Sometime absorption rate efficiency also decreases by wind speed. Wind speed effects response of organism and behavior of organism. For mating and seating on fruits for rest and laying eggs, optimum wind speed is successful.

Air temperature

Active spaces and behavior mechanism based on Air temperature present in surrounding. Air temperature affects the dispersion rate phenomena because its intensity became depressed due to increase in temperature in air. Rate of absorption also affected by air temperature and insects are unable to sense odor from source they dismiss their movement. Calling behavior problems in insects occurs. Mating behavior changes due to odor intensity strength from source, insects are unable to mate. Active size space changes also occur due to air temperature.

Materials and Methods

Artificial pheromones was bought from market to traps insects by using infrared spectrum of the purified attractant (termed "gyptol") indicated the presence of a primary hydroxy group, a secondary acetoxyl group, and a cis double bond. Quantitative catalytic hydrogenation of gyptol confirmed the presence of a single double bond. Oxidation of the natural attractant with periodate- permanganate reagent gave 3-acetoxy-1 -nonanoic acid and a viscous oil, which was further oxidized to pimelic acid. Gyptol was therefore proposed to be 1 O-acetoxy-cis- 7-hexadecen-1-01. That this compound is the natural attractant was confirmed by the synthesis of material with activity equivalent to that of the natural attractant.

Some Pheromones traps are placed on ground and some are hanged at different heights from range (1 meter = 25 meters). Their attraction have seen noticed after 2 days in regular intervals. Collect the data on regular bases.

Statistical analysis of data, moths per trap

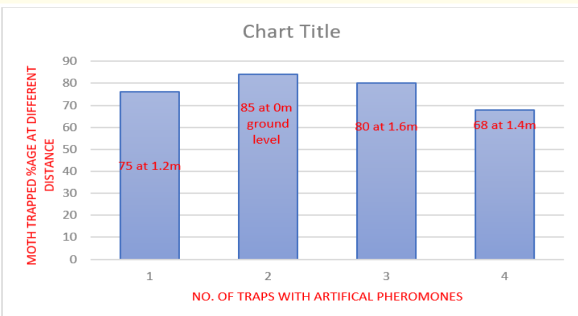

Figure 1

Number of traps = 4

- Trap (one) at height level at 1.2 = meters
- Trap (two) at ground level at 0 = meters
- Trap (three) at height level at 1.6 = meters
- Trap (four) at height level at 1.2 = meters.

Number of Moths in 4 traps

- Trap (one) 75 moth came
- Trap (two) 85 moth came
- Trap (three) 80 moth came
- Trap (four) 68 moth came

Results and Discussions

Pheromone molecules are totally embedded into source body. Molecules are come out from source in form of odor. From surrounding of source too much intensity of odor present, here rate of dispersion, rate of releasing will be too high. Heavy concentration of odor will be near source. When air will blow dispersion of odor will be high from source to surrounding. Odor will move toward ground and in the air.

But more concentration of odor or molecules will be high toward the ground, molecules have denser molecular weight so they will be move downward and lite molecules will be move upward by air circulation. In high speed of air, pheromones concentration will affect. Insect's movement will be high toward the ground, because denser molecules of odor will be settle down to earth. Source of dispersion of pheromones on the surface then movement of dispersion will be high. So insect's movement will be more attractive toward ground.

Conclusion

Gypsy moth movement toward odor is maximum when source are placed at 20 meter away [52]. Moth easily detect the odor and shows their movement because absorption of odor is in horizontal position.

In the experimental case of vertical position, if source of pheromone will be at the 20 meters above then movement of gypsy moth will unable to identify the exact location of source and unable to absorb the odor concentration. Distance reduced and kept at 1.6 meter away vertically [53,54], then its movement toward odor was same like the 20 meter away horizontal position. So trapping of moth in cages, this is best method to keep pheromones at ground or at height of 1.6 meters only. At this point, dispersion of odor, active spaces, rate of absorption, emission rate, behavior threshold, and mating behavior will be at optimum stage.

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