DISTRIBUTION OF SPITTLEBUG NYMPH

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Abstract:

Distribution pattern of spittlebug nymph, Ptyelus nebulus (Fabricius) (Homoptera, Aphrophoridae) was studied in the months of rainfall, June, July and August by using different statistical measures. All the estimators confirm that nymphs of spittlebug were aggregated in distribution. The cause of aggregation was also calculated by using formula of Arbous and Kerrich (1951) and it indicates that clumping of nymphs was due to environmental factors.

Keywords: Aggregation, Distribution, Environmental factors, Nymph, Ptyelus nebulus.

1. INTRODUCTION

Spittle bugs Ptyelus nebulus (Fabricius) are widely distributed in different parts of West Bengal. The bugs hide their nymphs in mass of white spittle like broth. The spatial distribution patterns of species are important because it is the inherent characteristics of the species concerned and the habitat under which it lives. It is essential for understanding of population dynamics of a species. The present paper reports on the spatial distribution pattern of spittle bug nymphs using different statistical measurements.

2. MATERIALS AND METHODS

Site Description The study was conducted at Suri (87o34' E, 23o54' N). Spittle bug nymphs are distributed in the open grass fields with a few small bushes here and there. Nymphs are very common in the months of rainfall i.e. from June to September when there are over growth of grasses. Height of the grasses ranged from 20-30 cm. There were 800 to 1000 grasses per square meter of soil surface. Sampling Method Samples were taken for eight days from June 20 to August 28, 2011. On each sampling date 16 samples were taken at random using a folding quadrate of one square meter. Description Pattern Aggregation has been measured most widely by using K in the expression:

$$S2 = m + Km2$$

Derived from the negative binomial distribution (Bliss and Owen, 1958) where S2 is the variance and m is the mean. In this method the degree of aggregation is determined from the value of K, which in case of extreme aggregation approaches zero.

The mean crowding (m*) is defined by Lloyd (1967) as the mean

number of other individuals per individual per quadrate. It relates to the mean population density (m) and the variance (S2) of the population in the following way:

$$m* = m + (\delta /m - 1)$$

The ratio of mean crowding to mean density m*/m, is called patchiness by

Lloyd, which is identical with Morisita's (1971) dispersion index I*A and Kuno's (1968) index CA

$$m*/m= (m2+\delta2-m) =1+CA= I*A$$

The m*/m provides a relative measure of aggregation. It equals unity in random and greater and smaller than unity in aggregated and regular distributions respectively.

Iwao (1968) suggested a linear regression equation of m* on the m in the form

$$m*=\alpha+\beta m$$

Hence the intercept α called the index of basic contagion, and the slope β named as the population density contagiousness coefficient, indicates the distribution pattern, $\beta=1$ when the basic components are distributed randomly,

$\beta>1$ in aggregated distribution and $0\geq\beta<1$ when they are distributed regularly.

A X2 test for small samples (Elliot1973) was used to compare two distributions with the Poisson series, where

$$X2=S2 (n-1)/x$$

Southwood (1966) further showed that the index dispersion can be measured in the

following way:

$$\text{Index of dispersion}=X2/ (n-1)$$

The value approximate to unity in random distribution, a value of zero for regularly distributed and a value greater than one imply aggregation. Bliss (1958) showed that K is not always independent of m. If the mean and variance of a series of samples are plotted, they tend to increase together to obey as power law. This relationship has been shown by Taylor (1961), a commonly known as Taylor's power law and is expressed by, S2=aXb . Where a and b are constants , a is largely a sampling factor where b appears to be true index of aggregation, when the population are regular in distribution b tends to zero, in a random distribution b is equal to one and in an aggregated distribution b will be greater than one.

3. RELATED WORK

In the present study it is difficult to determine which estimator is the best to use. All the estimators confirm that nymphs of spittlebug were aggregated in dispersion during these three months. The aggregation may be due to either to active aggregation by the insects or to some heterogeneity of the environment at large (microclimate, food plant, natural enemies). Potential predation on twolined spittlebug, Prosapia bicincta (Say) eggs, nymphs and adults was investigated in the laboratory by entomophagous arthropods commonly found in turfgrass. Eggs were most vulnerable to attack from predators. Nymphs are protected in the spittlemass from predation, but are susceptible to attack when, mechanically removed from their spittlemass. P. bicincta adults were also killed by arthropod predators evaluated in the study. The functional response of the tiger beetle, Megacephala carolina carolina L. to varying prey densities of P. bicincta, and fourth instar fall armyworm, Spodoptera frugiperda (J.E. Smith) larvae in single-prey and two-prey systems was assessed in the laboratory. Like most insect predators, M.

Months	K value	Mean crowding(m*)/mean density(m)	Index of dispersion	X^2**
June 20	0.34	1.34	1.95	29.31
June 30	0.57	1.57	2.35	35.26
July 8	0.40	1.40	2.07	31.01
July 18	0.37	1.37	2.01	30.18
July 29	0.35	1.35	1.99	29.86
August 7	0.26	1.26	1.65	24.80
Aug. 18	0.41	1.41	2.08	31.14
Aug. 28	0.35	1.33	1.89	27.37

**n=16 in each date, $X^{20.001\&0.05}$=30.58&24.99
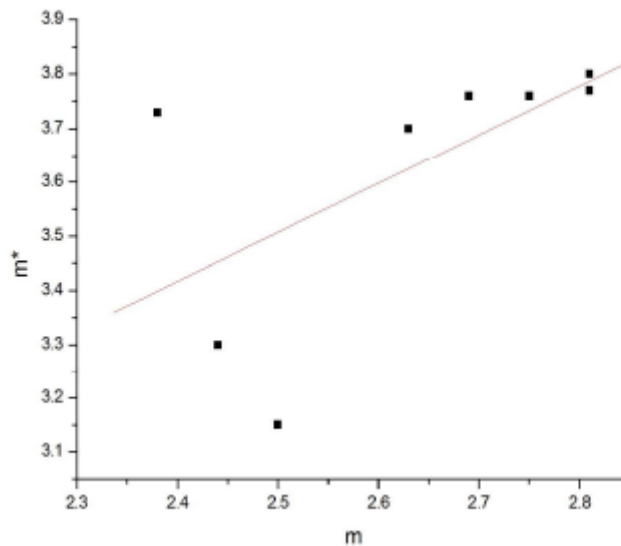
Table.1. Static Measurment

Fig.1.Density

carolina carolina demonstrated a type II functional response in both situations. An alternate management strategy for P. bicincta, with low-risk selective insecticides against nymphs and adults was evaluated in the field. Rearing techniques have been greatly improved (McWilliam and Cook 1975, Lapointe et al. 1989). Mc William and Cook (1975) placed TLS eggs in the advanced egg spot stage in vermiculite substrate of pots of pearl millet, Pennisteum americanum (L.) K. Schum., close to the crown of the plants. Each 15.2 cm pot was infested with about thirty- five eggs. A 16 h photoperiod was maintained to prevent diapause.

Hatching occurred about two days later. Approximately one-week post hatch, spittlemasses were observed, and adults emerged in about seven weeks. Adults were removed after emergence, and placed on different pots of millet for the 10-day pre-oviposition period. They were then transferred to oviposition cages constructed from cardboard ice cream containers, cut down to 10.2 cm, with cellophane tops and mesh bottoms secured by lid rims.

4. ANALYSIS

Blackwith(1958) has suggested that if mean size of a clump is calculated using Arbous & Kerrich's (1951) formula and this is found to be less than 2, then the aggregation would seem to be due to some environmental effect and not to an active process. Aggregation of two or more insects could be caused by either factor. The mean number of individuals in the aggregation is calculated by

$$\gamma = x/2K.v$$

Using this formula the values of γ in all the sampling days ranged from 1.12 to 1.28 (Table 2) i.e. less than 2 which indicate that clumping nymphs is due to environmental factors.
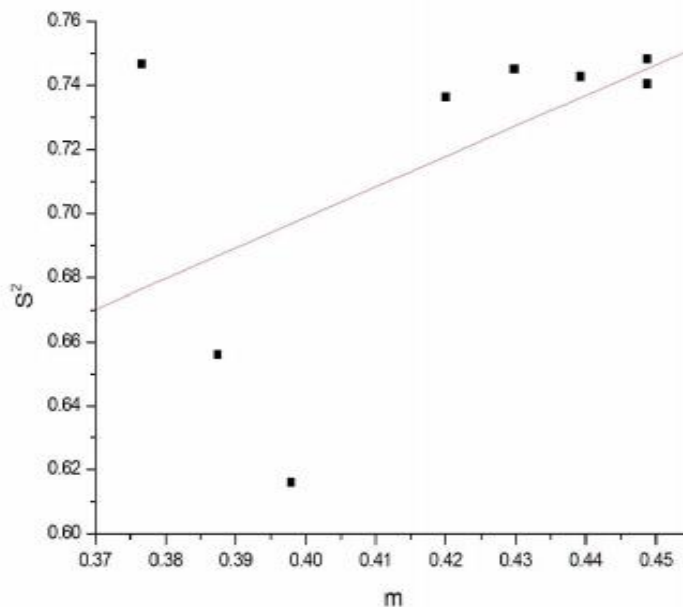

Fig.2.Output

Taylor (1961) criticizes the K method for calculating the degree of aggregation because K is not always independent of m and he suggested that an index of population structure should be the same at different population densities unless some actual change in behaviour is involved. Iwao pointed out that b of Taylor's power law does not provide a reliable means of measuring aggregation because it cannot distinguish whether the distribution is composed of individuals or colonies and because it leads to the unrealistic conclusion that the distribution will invariably change from a contagious through random, to regular patter if b>1 as is observed in many cases.

CONCLUSION

The regression of m* on m technique is widely recognized in many species of insects and their immature stages (Kuno 1963, 68; Hokyo 1972 Iwao 1976). The slope beta of the m* -m regression becomes higher when habitat conditions are heterogeneous as indicated by a simple model of Iwao & Kuno (1971). If the magnitude of environmental heterogeneity can be measured in some way, this may explain the reason why β is greater than unity in most of the observed patterns in the nature.

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