

Exercise 22

Aim: To determine the amount of Suspended Particulate Matter (SPM) in air at different sites in a city

Principle: Environmental pollution is the unfavorable alteration of our surroundings wholly or largely as a by-product of man's action through direct or indirect effects of changes in energy patterns, radiation levels, chemical and physical constitutions of environment and abundance of organisms. Substances that cause pollution to the environment are called pollutants. They are the residues of things that man makes, uses and throws away. These residues pollute soil, water and air. The atmosphere in highly populated area is very rich in dust, smoke and SPM all due to vehicular exhausts and industrial emission.

Requirement: A few freshly cut broad leaves, Vaseline, laboratory balance, weights, brush, paper clips and twine thread

Procedure

This experiment is an outdoor activity and may be conducted by assigning 2-3 students into a group.

- (i) Collect a few locally available broad leaves from a nearby tree plant (Canna, Peepal, etc.).
- (ii) Wash the leaves gently in running water to remove any dust settled on their surfaces.
- (iii) Blot dry the surface area of the leaves. To calculate the area of the leaf, trace the outline of the leaf on graph paper (Fig 22.1). Within the traced area calculate the total number of full squares, $1/2$, $1/3$ and $2/3$ squares and individual small squares. Add all the squares to get the total leaf area. Multiply their value with two to obtain total area of both the surfaces.
- (iv) Take 8-10 feet long twine thread and tie five leaves leaving a foot distance in between. Apply an extremely thin layer of vaseline on both surfaces of each leaf. Make a bundle of these leaves and pack



Fig. 22.1 Calculating the area of a leaf on a graph paper

them in polythene bags. Ensure that the outer surface of polythene bag does not have any vaseline sticking on it.

- (v) Make three such bundles of smeared leaves, each bundle containing 5 leaves.
- (vi) Mark bundles as A, B and C and carefully weigh each bundle of leaves along with the polythene bags.
- (vii) Select three spots (X, Y and Z) near by your school. Spots selected should be in a manner that spot 'X' has very heavy vehicular traffic, the spot Y has moderate traffic and spot 'Z' has little or no vehicular traffic. At spot 'X' expose each leaf of bundle 'A' by stretching the attached thread and tie the two ends to two poles or branches of trees preferably at 10 feet height above ground. Keep leaves exposed for about two hours.
- (viii) After exposure at spot 'X', collect the leaves and carefully re-bundle exposed leaves and place them along with the string in the polythene cover 'A'.

Record your findings in the following table:

Site	Leaf bundle sample	Weight of leaves (g)		Weight of suspended particle ($W_2 - W_1$)	Total leaf area (cm^2) of five leaves
		Before exposure (W_1)	After exposure (W_2)		
X	'A'				
Y	'B'				
Z	'C'				

- (ix) Repeat the same process at spot 'Y' and 'Z' exposing leaves of 'B' and 'C' bundles respectively.
- (x) At the end of the experiment, return back to the laboratory. Reweigh each bundle of exposed leaves along with their respective polythene cover.
 - Calculate the amount of suspended particles deposited in mg cm^2 of leaf at each spot.
 - Compare the results of three different spots and interpret.

Since the weight of suspended particles will be in milligrams or even less it is advised to use a very sensitive laboratory balance.

Exercise 23

Aim: To study plant population density by quadrat method

Principle: Density represents the numerical strength of a certain plant species in the community per unit area. The number of individuals of the species in any unit area is its density. The unit area may be as small as 5 square cm to as large as 10 square metre depending on the size and nature of the plant community under study. For herbaceous vegetation a metre square quadrat is normally used. Density which gives an idea of degree of competition is calculated as follows.

$$\text{Density} = \frac{\text{Total number of individual(s) of the species in all the sampling unit (S)}}{\text{Total number of sampling units studied (Q)}}$$

The value thus obtained is then expressed as number of individuals per unit area. When the measured unit area is divided by the number of individuals the average area occupied by each individual is obtained.

Requirement: Cotton/nylon thread (five meters), 4 nails and a hammer

Procedure

- (i) In the selected site of study, make a 1 m X 1 m quadrat with the help of nails and thread. Hammer the nails firmly and make sure that the vegetation is not damaged while laying the quadrat.
- (ii) List the names of the plant species seen in the quadrat (if the name is not known mark these as species A or B etc., and the same species if seen in other quadrats assign the same alphabet).
- (iii) Count the number of individuals of each species present in the quadrat and record the data as shown in the table.
- (iv) Similarly make nine more quadrats randomly in the site of study and record the names and number of individuals of each species.

Observations

Record the total number of species seen in the ten quadrats. This will give an idea about the composition of the vegetation.

There will be difference in the species composition in the quadrats made in shady areas, exposed areas with bright sunlight, dry or wet areas etc.

Table 23.1: Density studies of the given vegetation

Plant Species	Quadrats employed in study & no. of individuals in each quadrat										Total No. of individuals (S)	Total no. of Quadrats studied (Q)	Density (D)
	I	II	III	IV	V	VI	VII	VIII	IX	X			
A	2			5		7		10		3	27	10	27/10 = 2.7
Z	1	2	4	8	3		2				20	10	20/10 = 2.0

Discussion

Plants growing together exhibit mutual relationships among themselves and also with the environment. Such a group of plants in an area represent a community. The number of individuals of a species varies from place to place, making it necessary to take many random sample areas for reliable results. Density values are significant because they show relative importance of each species. With increasing density the competition stress increases and the same is reflected in poor growth and lower reproductive capacity of the species. Data on population density are often very essential in measuring the effects of reseeding, burning, spraying and successional changes.

Discuss the vegetation composition of the area (herbs/shrubs) and comment on the dominant component species.

Questions

1. What factors influence the population density?
2. What is the significance of quadrat method?
3. What conclusion can be drawn if density of a plant species is low?

Exercise 24

Aim: To study plant population frequency by quadrat method

Principle: Frequency is concerned with the degree of uniformity of the occurrence of individuals of a species within a plant community. It is measured by noting the presence of a species in random sample areas (quadrats) which are distributed as widely as possible throughout the area of study. Frequency is the number of sampling units (as %) in which a particular species (A) occurs. The frequency of each species (sp. A or sp. B or sp. X etc) is expressed in percentage and is calculated as follows.

$$\% \text{ Frequency or Frequency Index} = \frac{\text{Number of sampling units (quadrats) in which the species occurs}}{\text{Total number of sampling units (quadrats) employed for the study}}$$

Requirements: Cotton/nylon thread of 5 metres, 4 nails and a hammer

Procedure

- (i) In the selected site of study, make a 1 m X 1 m quadrat with the help of nails and thread. Hammer the nails firmly and make sure that the vegetation is not damaged while laying the quadrat.
- (ii) List the names of the plant species seen in the quadrat (if the name is not known mark these as species A or B etc. and if the same species is seen in other quadrats assign the same alphabet)
- (iii) Similarly lay nine more quadrats randomly in the site of study and record the names of individuals of each species.
- (iv) Calculate the percentage frequency of occurrence using the formula given.

Observations

Record the total number of species seen in the ten quadrats. This will give an idea about the composition of the vegetation.

There will be difference in the species composition in the quadrats made in shady areas, exposed areas with bright sunlight, dry or wet areas etc.

Observe that the frequency of occurrence is not the same for all species.

Table 24.1: Frequency studies for the given vegetation

Plant Species	Number of quadrats employed in the study (Q)										No. of quadrats in which the species is present (N)	Percentage of frequency $F=N/Q \times 100$
	I	II	III	IV	V	VI	VII	VIII	IX	X		
A	✓		✓	✓			✓			✓	5	5/10 100 = 50%
B		✓				✓					1	1/10 100 = 10%
C					✓	✓	✓		✓		4	4/10 100 = 40%

Discussion

Variation in distribution of a species is caused by factors like soil conditions, quantity and dispersal of gemmules, vegetative propagation, grazing, predation, diseases and other biotic activities. Also frequency values differ in different communities. They are influenced by micro-habitat conditions, topography, soil and many other environmental characteristics. Thus unless frequency is not correlated with other characters such as density, frequency alone does not give correct idea of the distribution of a species.

Frequency determinations by means of sample areas are often needed in order to check general impressions about the relative values of species. Many species having low cover or population density also rate low in frequency, but some may have high frequency because of their uniform distribution. Usually if the cover and population density are high, the frequency will be high. The plants with high frequency are wide in distribution.

Questions

1. If frequency of a plant is high, what will be your interpretation?
2. Can many micro-habitat in an area affect frequency of a species? Comment.