M.Sc. –Botany Semester-II

Paper-VII (Angiosperms: Plant development and R)

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Correlation: A morphogenetic phenomenon

Growth of one part or dimension is related to growth of other parts of plant or its various activities.

These will illustrate how plant forms arise and an integrated organism is produced and will serve as an introduction to the fundamental problem of morphogenesis. Although the structural organization of the vascular plant is comparatively loose, development of the various parts is well coordinated. Control is dependent upon the movement of chemical substances, including both nutrients and hormones. An example of correlation is the growth of shoot and root. The enlargement of aerial part is accompanied by increased demand of water, minerals and mecchanical support those are met by coordinated growth of root system. Correlation have been classified in many ways as environmental, physical,morphological, physiological, genetic and compensatory depending on characters and factors involved.

Correlation is broadly of two types:-

A. Physiological
B. Genetic

A. Physiological Correlation:

Those correlation for which a physiological mechanism metabolic, hormonal or other seems to be operative. It is further categorise in:

1. Nutritional correlation
2. Compensatory correlation
3. Stimulatory correlation
4. Inhibitory correlation
5. Correlation of Position

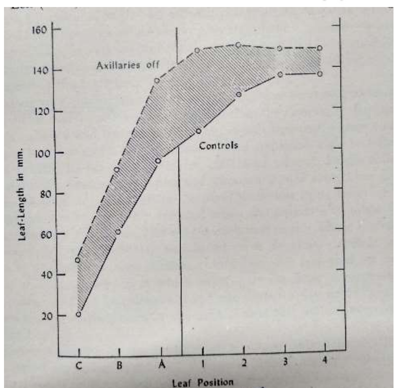
1. Nutritional Correlation:

Simplest type of correlation depends on nutrition. A region that does not produce food must depends for its growth on one that does. Correlation of this type between root and shoot obviously occur. Other example of nutritional correlation is that between a size of a fruit and the amount of leaf area available for the support of its growth. A positive nutritional correlation found between the size of a fruit and of the seeds in it.

2. Compensatory Correlation:

It is a negative correlation between the size and number of parts of a plant. In one of the higher plants, which has many similar growing parts such as leaves, flowers and fruits, the number of these parts may be reduced by accident. In such cases there is often a compensatory increase in the growth of the remaining structures, so that a negative correlation occur between size and numbers of plant parts. The removal of all buds but one in a certain type of Chrysanthemum results in this development of the single flower head, through compensatory growth, to a size very much larger than normal.

Such correlation may perhaps be called Competitive rather than compensatory.



. Compensatory correlation in *Coleus*. Increase in leaf length in 27 days aft of axillary buds and branches, as compared with controls. Leaves at left line had not unfolded from apical bud. (*From Jacobs and Bullwinkel.*)

3. Stimulatory Correlation:

It depends upon the operation of growth factors which affect development, particularly the stimulatory and inhibitory action of auxin and other growth substances. The Stimulatory effect is well shown in the control of root growth. Van der Lek (1925) and others have found that in many cases cuttings on which buds are present will root much better than those without buds. This evidently is due to a root stimulating substance produced by buds which passes down to the base of cutting.

4. Inhibitory correlation:

One part of plant inhibits the growth of another by some other means than competition for food. It involves the action of auxin and related substances. The best known case of such inhibition is the dominance by a terminal bud which prevents the growth of lateral buds below it. Similarly the epicotyl and its buds in seedlings like those of beans, inhibit the growth of buds in the axils of cotyledons.

Nutritional factors may have something to do with the inhibition of cotyledonary buds.

5. **Correlation of position:**

   Many parts of the plant can be shown to have the capacity for much more extensive growth than they normally display. If a leaf is removed and treated as cutting, it will frequently grow to a greater size and live much longer than if it had remained a part of the plant. Single cells, under suitable conditions of isolation and stimulation, will sometimes develop in to whole plants. All parts of the plant tend thus to be **Totipotent.**

   The correlation that these parts display with one another are simply manifestations of the control that this pattern exercises in development.

B. Genetic Correlations:

The physiological Correlations found in plants have surely some genetic basis. The various structures in a growing organic system tend to increase together and thus to be correlated in size. Since growth usually is not uniform, as development proceeds, the relation between the parts of the system or between the dimensions of the organ may change progressively and thus produce differences in form. This relation can be described simply by an equation:

$$Y=bx^k$$

Or $$\log y = \log b + k \log x$$

Where, y = size of one variable in plant

X = size of other variable in plant

b, is value of y when x is of some arbitrary size and k is the ratio of the growth rate of y to that of x. This phenomenon of constant relative growth (*heterauxesis*) has been observed by many biologist but was first widely emphasized by Julian Huxley (1932). He termed this type of growth **heterogony,** a term now replaced in much of the literature by **allometry.**

There are three kind of correlation on the basis of genetic analysis:

1. Correlations of part and whole
2. Correlations between different parts
3. Correlations between dimensions

1. **Correlations of part and whole:**

   Growth correlations between an organ and rest of the body of plants. In beans, for example, Sinnott (1921) has shown that there is a positive correlation between size of leaf and size of entire plant up to a certain plant size. Beyond this the size of additional leaves is no greater even if leaf number and plant size may increase considerably. These facts suggest that organ size may depend on the size of embryonic mass or the shoot meristem and that this may increase up to a certain point only.

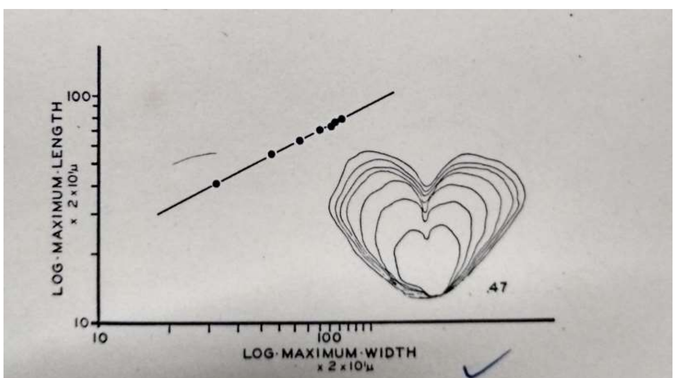
2. **Correlations between different parts:**

In most cases the root is relatively large in the seedling but grows less rapidly than the shoot. One increases at a rate which maintains a constant proportion to that of the other. Some correlations between parts are due to the similar effect of a gene or group of genes on a series of morphologically related organs. Anderson and de Winton (1935) studied the effect of a number of mutant genes, in *Primula sinensis* , on the morphology of the leaf, bract, sepal and petal. In several cases they had a very similar influence on development in all four categories of organs. Such correlations are examples of what is sometimes called **Homeosis.**

3. **Correlations between dimensions:**

Correlation between the various dimensions of an organ or other determinate structure. This relative growth, like that between parts, is under definite control and proceeds in a regular and orderly fashion. Plant embryology in its widest sense is the record of such differential growth by which the complexity of organic form is attained. Dimensional relationships are not constant throughout the plant.

These correlations are not random ones but are simple expressions of that general organized relatedness that is What happens to the whole affects the parts and what happens to a part affects the whole.



Relative growth of length to width in developing fern prothallium. (From
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