STUDY MATERIAL FOR P G IIND SEMESTER

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LIEBIG'S LAW OF LIMITING FACTOR

All living animals within their residing ecosystem have a range of tolerance for every environmental factors like temperature , light , humidity , water etc. Any environmental factor that by its presence, absence, amount (increase or decrease) influence the metabolic activities and overall growth of organisms and populations also. If an environmental factor exceeds the maximum tolerable level or it goes below the minimum tolerance in an given area, it becomes a limiting factor preventing the distribution of the particular organism or population in that particular ecosystem. In another word, any factor that tends to slow down potential growth in an ecosystem is a limiting factor

J. LIEBIG (1840) was the first to explain this limiting factor in large. He discovered that the crop yield was frequently limited by such nutrients which are utilized in low concentration. He found that the crop yield is not affected by nutrients, water Co_2,etc as they are most abundant in environment but by some raw materials like Boron needed in minute quantity but it remain in very low in soil. This concept is described as Liebig's law of minimum. According to this law the growth is dependent on the amount of foodstuff that is present in minimum quantity. The scientific application of "law of minimum" are extended to ecosystem models or population. The organism or plant growth depends on many factors (organic or inorganic /abiotic or biotic factors). At any given time, these factors are available in different levels and one among all different factors are present in minimum levels, thus limiting than others factors.

Recently, this law is applicable on natural resources management. For example, Phosphorous or other resources recycling is required for the non-renewable resources, limited in supply without any alternative or substitutes.

This law is now incorporated with a law of limiting factors originated by a plant physiologist F.F. Blackman (1905).Blackman while studying the factors affecting the rate of photosynthesis discovered that rate of photosynthesis is governed by the levels of the factors that is operating at a limiting intensity. Later work on limiting factor added two subsidiary principles to this concept. These are—A constraint that the Liebig's law is strictly applicable only under steady-state conditions i.e., when inflows balance outflows of energy and materials. For example, CO_2 was the major limited factor in a lake/pond and the productivity was in equilibrium with the rate of supply of CO_2 coming from the decay of organic matters. It is assumed that the light , nitrogen ,phosphorous etc. were available in

excess in ths steady state equilibrium. If more CO_2 is added by any means in water bodies the rate of production would change and be dependent upon others factors as well .While the rate is changing, there is no steady state and no minimum constituents. The rate of production would change rapidly as various constituents were used up until some constituents perhaps CO_2 again, became limiting and the water body system would once be operating at the rate controlled by the law of minimum.

The second important principle is factor interaction. Higher concentration of some substances other than the minimum one may modify the rate of utilisation of the latter. Sometimes organism are able to substitute at least partly , a chemically closely related substances for one that is deficient in environment, molluscs are able to substitute this for calcium to partial extent in their shells. Some plants require less zinc when growing in the shade than when growing in full sunlight ;therefore a given amount of zinc in the soil would be less limiting to plants in shade than under the same conditions in sunlight. The law of minimum has been restated by Taylor (1934) in broad ecological terms. The functioning of an organism is controlled or limited by that essential environmental factor or combination of factors present in the least favourable amount. The factors may not be continuously effective but only at some critical period during the year orperhaps only during some critical year in a climatic cycle.

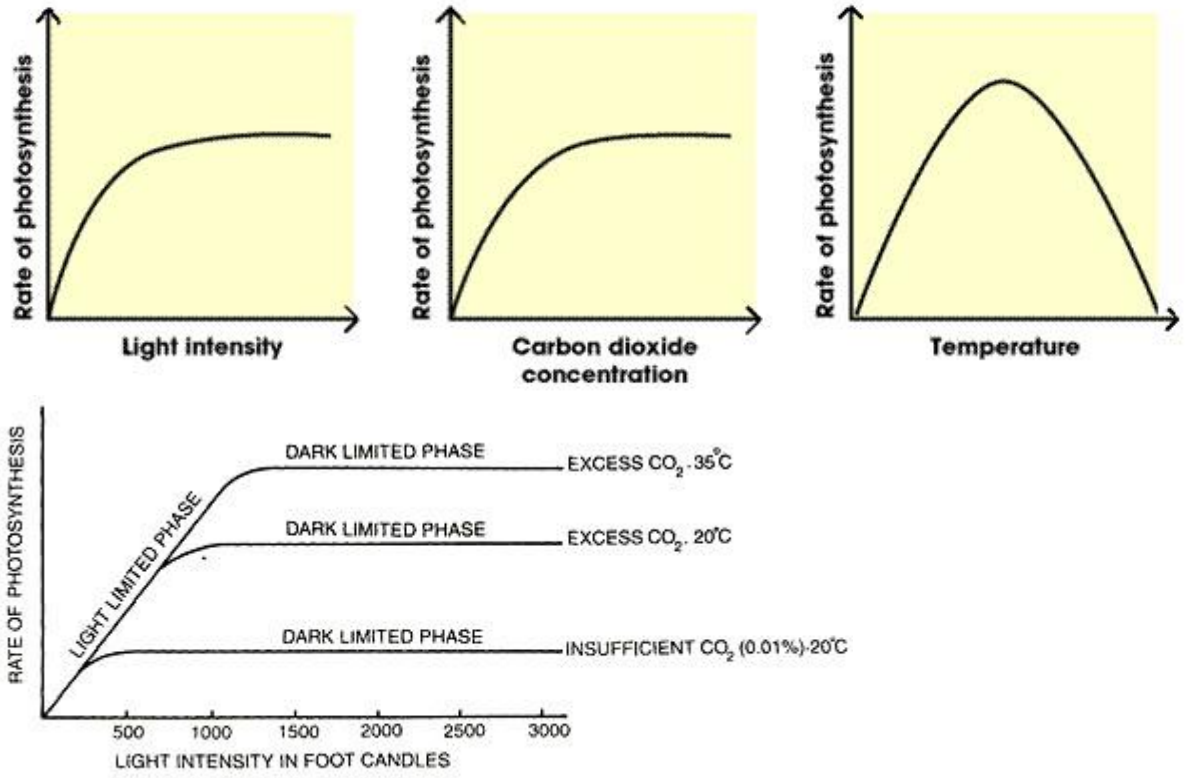

Fig. 13.28. Blackman's law of limiting factors.