44.2E: Abiotic Factors Influencing Plant Growth

The two most important abiotic factors affecting plant primary productivity in an ecosystem are temperature and moisture.

Learning Objectives

- Identify the abiotic factors that affect plant growth

Key Points

- Primary production, on which almost all of life on earth is dependent, occurs through either photosynthesis or chemosynthesis.
- Annual biomass production, used to estimate net primary productivity by plants in an area, is directly influenced by an environment’s abiotic factors, which include temperature and moisture.
- Warm and wet climates have the greatest amount of plant biomass because they offer conditions in which photosynthesis, plant growth, and the resulting net primary productivity are highest.

Key Terms

- **biomass**: the total mass of all living things within a specific area, habitat, etc.
- **eco-region**: a region, smaller than an ecozone, that contains a distinct biodiversity of flora and fauna
- **chemosynthesis**: the production of carbohydrates and other compounds using the oxidation of chemical nutrients as a source of energy rather than sunlight; it is limited to certain bacteria and fungi
Abiotic Factors Influencing Plant Growth

Temperature and moisture are important influences on plant production (primary productivity) and the amount of organic matter available as food (net primary productivity). Primary production is the synthesis of organic compounds from atmospheric or aqueous carbon dioxide. It principally occurs through the process of photosynthesis, which uses light as its source of energy, but it also occurs through chemosynthesis, which uses the oxidation or reduction of chemical compounds as its source of energy. Almost all life on earth is directly or indirectly reliant on primary production. The organisms responsible for primary production, known as primary producers or autotrophs, form the base of the food chain. In terrestrial eco-regions, these are mainly plants, while in aquatic eco-regions, they are mainly algae.

Net primary productivity is an estimation of all of the organic matter available as food. It is calculated as the total amount of carbon fixed per year minus the amount that is oxidized during cellular respiration. In terrestrial environments, net primary productivity is estimated by measuring the aboveground biomass per unit area, which is the total mass of living plants, excluding roots. This means that a large percentage of plant biomass which exists underground is not included in this measurement. Net primary productivity is an important variable when considering differences in biomes. Very productive biomes have a high level of aboveground biomass.

Annual biomass production is directly related to the abiotic components of the environment. Environments with the greatest amount of biomass have conditions in which photosynthesis, plant growth, and the resulting net primary productivity are optimized. The climate of these areas is warm and wet. Photosynthesis can proceed at a high rate, enzymes can work most efficiently, and stomata can remain open without the risk of excessive transpiration. Together, these factors lead to the maximal amount of carbon dioxide (CO₂) moving into the plant, resulting in high biomass production. The aboveground biomass produces several important resources for other living things, including habitat and food. Conversely, dry and cold environments have lower photosynthetic rates and, therefore, less biomass. The animal communities living there will also be affected by the decrease in available food.

Figure 1: Primary productivity and biomass production: The magnitude and distribution of global primary production varies between biomes. However, warm and wet climates have the greatest amount of annual biomass production.

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