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Effect of Environmental Factors for Vegetable Production

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INTRODUCTION

Different abiotic environmental factors viz., light, temperature, water and soil greatly influence plant growth and geographic distribution. These factors determine the suitability of a crop for a particular location, cropping pattern, management practices, and levels of inputs needed. When a crop is grown in the most favorable environmental circumstances, it performs best and costs the least to produce. It's critical to understand how these environmental conditions affect plant growth and development in order to maximize crop yield.

Effects of light

The intensity of the light varies depending on altitude, latitude, and season, as well as other elements like clouds, dust, smoke, and fog. Any crop requires sunlight to thrive. Dry matter production generally rises in lockstep with the amount of light available. The intensity of incoming light and the duration of the day determine the amount of sunlight received by plants in a given place. The light requirements of various plants vary. The duration of the day changes with season and latitude due to the tilt of the earth's axis and its rotation around the sun. Photosynthesis and photomorphogenesis are two physiological processes that plants use light for. Both occur at the same time in the plant and interact with one another. Three principal characteristics of light are quantity (intensity) which affects photosynthesis, quality (wavelength) which affects photomorphogenesis and duration which affects photoperiodism.

Light quantity: refers to the intensity or concentration of sunshine, which fluctuates according to the season. A plant's potential to make plant food through photosynthesis improves with the amount of sunshine it receives (up to a point). Shade-cloth can be used to reduce the amount of light in a garden or greenhouse. It can be boosted by placing white or reflective material around plants or using extra lighting.

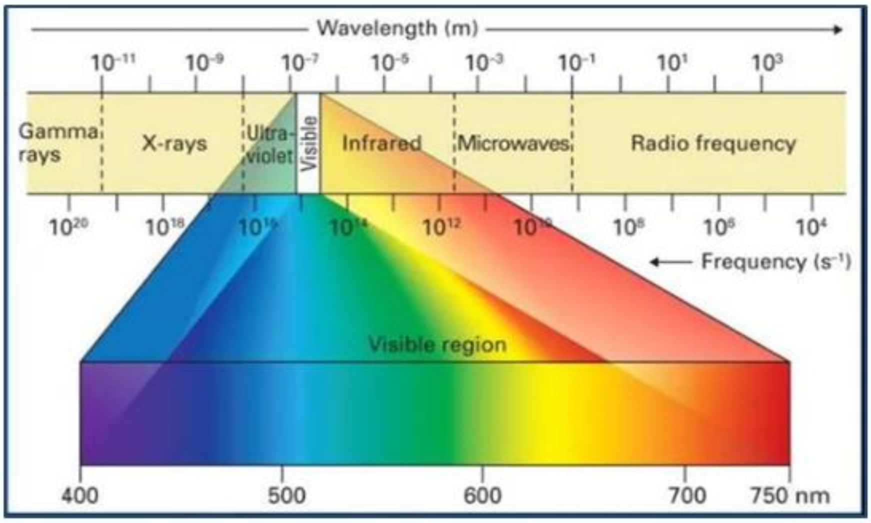
The plant community can be divided into four groups, though not precisely, *viz*.

a. Shade plants: These plants thrive in 30-50% of full sun but weaken in full sun. These plants require low light intensity of 500 to 1000 foot candles (fi-c), e.g., some ornamental house plants like philodendron, dieffenbachia, begonia, ferns, etc.

b. Partial shade and sun plants: These plants will produce an edible crop when grown in a shady location, however, these plants need at least 50-80% of full sun condition. These plants require moderately high light intensity of 1000-3000 ft-c. e.g., cacao, coffee, tea, vanilla, black pepper etc.

c. Sun plants: The plants which thrive in full sun but grow poorly in shade. These plants require high light intensity of 3000-8000 ft-c. e.g., most of the vegetable crops like tomato, brinjal, chilli, all cucurbits, peas and beans, sweet potato, all root crops, etc.,

d. Slight shade and direct sun tolerant plants: These plants thrive well over wide range of light intensity of 2000-8000 ft-c. e.g., vegetable crops like cabbage, potato, etc.



Light quality: is the colour or wavelength that reaches the plant's surface. Plant development is most influenced by red and blue light. Because most plants reflect green light and absorb relatively little, green light is the least effective for plants. Plants respond to red and orange light by producing hormones that promote flowering and budding, but they can't thrive without blue light. Red light promotes flowering and foliage growth, but too much of it can make a plant spindly. It also increases seed growth and causes germination, while far-red light suppresses germination. Many plant responses, such as stomata opening and phototropism, are regulated by blue light. If there is no sunlight available, metal halide grow lights release more light in the blue spectrum and are the best source of indoor lighting for plant growth. Blue light is thought to have a crucial role in the creation of chlorophyll and the development of chloroplasts.

Light duration or photoperiod: refers to the amount of time that a plant is exposed to sunlight. Based on response to light period, plants may be classified into:

a. Day neutral: No preferential photoperiod for flowering. e.g., tomato, pepper, eggplant, cucurbitaceous vegetable crops, cowpea, okra, French bean, amaranth, etc.

b. Long day (short night): Require 12-14 hours of light for flowering. e.g., Potato, onion, lettuce, cabbage, cauliflower, radish, spinach, beet, turnip, carrot, etc.

c. Short day (long night): Require 8-10 hours of light for flowering. e.g., Sweet potato, Indian spinach, hyacinth bean, cluster bean, winged bean, etc.

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In cucurbits, day length and intensity of light, in combination with temperature, are known to alter sex expression. The number of staminate flowers in cucumber tends to grow when there is a lot of light. Reduced light, on the other hand, increases the amount of pistillate flowers. To produce good development and high sugar content in their fruit, crops like watermelon, cantaloupe, and honeydew melons require high light intensity and warm temperatures. In tomato, high light intensity combined with high temperature is detrimental to fruit set. At high temperatures, shade reduces light intensity and so enhances fruit set. In capsicum, short day conditions (9-10 hours light) accelerated plant growth and boosted production by 21-24 percent, while also enhancing quality. The fresh weight of entire fruit increase by 50% when sun radiation was reduced by 50%. In potato, due to improved photosynthesis, higher light intensity and duration result in higher tuber output and quality, but tubers must remain covered under the soil to avoid sun blistering and greening. In root crops, in radish, reported that plants exposed to low light intensities grew the most shoots, but the fresh weight of the total plant, leaves, stems, and roots rose as the light intensity increased. In addition, radish root yield and quality increase when light intensity increases. In bulb crops, lower temperatures and a shorter photoperiod are required for vegetative growth, but higher temperatures and a longer photoperiod are required for bulb formation. Garlic bulb development is aided by long days and hot temperatures. In leafy vegetables, such as spinach, long days and warm weather are highly conducive for speedy bolting. While *A. caudatus*, *A. cruentus*, and *A. edulis* are short-day Amaranthus species, *A. hypochondriacus* is said to be day-neutral.

Effects of temperature

Photosynthesis, water and nutrient absorption, transpiration, respiration, and enzyme activity are all affected by temperature. Germination, blooming, and sex expression, pollen viability, fruit set, maturation and senescence rates, yield, quality, harvest duration, and shelf life are all influenced by this component. The temperature needs of various plants vary. Most plants can only function in a small temperature range. Plants' biological activity is limited on the lower end by the freezing point of water (0°C) and on the top end by protein denaturation (50°C). Plants can only grow and live within these temperature limits if enough time is provided for efficient growth during the seasonal cycle. The ideal temperature range varies depending on the crop. Most vegetable crops' growth slows when temperatures rise above 35°C, and the thermal death point for most crops, including vegetable crops, is about 50°C.

Table 1: Temperature Requirement for Different Crops

Crops	Temperature range
Tomato	21-24oC
Capsicum	17-23oC
Cucumber	18-24oC
Brinjal	21-27oC
Chilli	20-30oC
Knol-khol	15-25oC

The vegetable crops can be grouped according to the temperature requirement for optimum growth-

1. Hot: Night/Day temperature range for growth optimum range 25-27°C (day/night average). e.g., Okra, watermelon, muskmelon, chilli, sweet potato, yam, cassava, amaranth, winged bean, cluster bean, etc.

2. Warm: Night/Day temperature range for growth 12-35°C; optimum range 20-25°C (day/night average). e.g., Tomato, sweet pepper, brinjal, lima bean, French bean, hyacinth bean, cowpea, sweet corn, palak, New Zealand spinach, cucumber, pumpkin, pointed gourd, bottle gourd, bitter gourd, ridge gourd, snake gourd, summer squash, drumstick, Indian spinach, portulaca, elephant foot yam, etc.

3. Cool-hot: Night/Day temperature range for growth 7-30°C; optimum range 20-25°C (day/night average). e.g., Onion, leek, garlic, shallot, chicory, chives, salisfy, pakchoi, globe artichoke, taro, early cauliflower, Asiatic carrot and radish.

4. Cool-warm: Night/Day temperature range for growth 7-25°C; optimum range 18-25°C (day/night average). e.g., Pea, broad bean, mid and late cauliflower, Chinese cabbage, cabbage, broccoli, Brussel's sprouts, kale, knolkhol, turnip, European or oriental radish and carrot, beet, rutabaga, horse radish, parsnip, potato, parsley, fennel, dill, Swiss chard, spinach, lettuce, celery, celeriac, asparagus, garden cress, mustard, etc.

Effects of water

Winter vegetables require a lot of water to grow. Hydrophytes are plants that have adapted to living in water or in soil saturated with water, and they can be grown according to their native environments in terms of water supply. To enable air exchange, hydrophytes contain wide interconnected intercellular gas-filled gaps in their root and shoot tissues. Mesophytes are the most frequent terrestrial plants that can grow in neither a wet nor a dry environment for lengthy periods of time. Their water requirements vary depending on the length of their root systems and other plant characteristics. Xerophytes are plants that can withstand drought for lengthy periods of time. Reduced permeability to prevent water loss, swelling tissues to store water, and deep and widespread root systems to obtain water are all common xerophyte characteristics. The amount of absorbed water necessary to produce one unit of dry matter is stated in units of absorbed water, and vegetable crops are divided into four types.

1. **High water requirement:** Palak, Amaranthus, Lettuce, Celery, Other leafy greens, Sweet pepper, Cabbage, Cauliflower, Asparagus, Broccoli.
2. **Moderate water requirement:** Onion (bulb), Cucumber, Chilli, Brinjal, Tomato, Carrot, Potato.
3. **Low water requirement:** Pea, French bean, Cowpea, Broad bean, Clusterbean, Winged bean, Hyacinth bean.
4. **Very low water requirement:** Watermelon, Muskmelon, Pumpkin, Wax gourd.

Effect of Wind

Carbon dioxide (CO2) must be replenished near the plant leaf surface, which necessitates a little sway of the wind. Unless there is any ventilation or air infiltration inside the poly house, CO2 might be rapidly depleted at the leaf surface. Horizontal airflow fans can help with air movement and distribution in the poly home. The horizontal movement of air in a poly house, on the other hand, occurs naturally.

CONCLUSION

The environment has a significant impact on vegetable production. Though fertilizer has a significant impact on vegetable production to some extent, environmental elements such as light, temperature, humidity, drought, and flooding are to blame for variations in vegetable yield. For optimal vegetable yield, producers must be aware of the effects of environmental conditions and disseminate information about them.