

Preface

Photosynthesis is the process of converting light energy to chemical energy and storing it in the bonds of sugar. This process occurs in plants and some algae (Kingdom Protista). Plants need only light energy, CO_2 , and H_2O to make sugar. The process of photosynthesis takes place in the chloroplasts, specifically using chlorophyll, the green pigment involved in photosynthesis. Photosynthesis takes place primarily in plant leaves, and little to none occurs in stems, etc. The parts of a typical leaf include the upper and lower epidermis, the mesophyll, the vascular bundle(s) (veins), and the stomates. The upper and lower epidermal cells do not have chloroplasts, thus photosynthesis does not occur there. They serve primarily as protection for the rest of the leaf. The stomates are holes which occur primarily in the lower epidermis and are for air exchange: they let CO_2 in and O_2 out. The vascular bundles or veins in a leaf are part of the plant's transportation system, moving water and nutrients around the plant as needed. The mesophyll cells have chloroplasts and this is where photosynthesis occurs. As you hopefully recall, the parts of a chloroplast include the outer and inner membranes, intermembrane space, stroma, and thylakoids stacked in grana. The chlorophyll is built into the membranes of the thylakoids.

Chlorophyll looks green because it absorbs red and blue light, making these colours unavailable to be seen by our eyes. It is the green light which is NOT absorbed that finally reaches our eyes, making chlorophyll appear green. However, it is the energy from the red and blue light that are absorbed that is, thereby, able to be used to do photosynthesis. The green light we can see is not/cannot be absorbed by the plant, and thus cannot be used to do photosynthesis.

Red light-emitting diodes (LEDs) are a potential light source for growing plants in space flight systems because of their safety, small mass and volume, wavelength specificity, and longevity. Despite these attractive features, red LEDs must satisfy requirements for plant photosynthesis and

photomorphogenesis for successful growth and seed yield. To determine the influence of gallium aluminium arsenide red LEDs on wheat photomorphogenesis, photosynthesis, and seed yield, wheat (*Triticum aestivum* L., cv. 'USU-Super Dwarf') plants were grown under red LEDs and compared to plants grown under daylight fluorescent (white) lamps and red LEDs supplemented with either 1% or 10% blue light from blue fluorescent (BF) lamps. Compared to white light-grown plants, wheat grown under red LEDs alone demonstrated less main culm development during vegetative growth through preanthesis, while showing a longer flag leaf at 40 DAP and greater main culm length at final harvest (70 DAP). As supplemental BF light was increased with red LEDs, shoot dry matter and net leaf photosynthesis rate increased. At final harvest, wheat grown under red LEDs alone displayed fewer sub tillers and a lower seed yield compared to plants grown under white light. Wheat grown under red LEDs+10% BF light had comparable shoot dry matter accumulation and seed yield relative to wheat grown under white light. These results indicate that wheat can complete its life cycle under red LEDs alone, but larger plants and greater amounts of seed are produced in the presence of red LEDs supplemented with a quantity of blue light.

The book is designed primarily to be used as a resource book for new researchers in plant photobiology.

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