THE C_4 PATHWAY

- In the arid tapestry of dry tropical regions, a botanical phenomenon known as the C_4 pathway takes center stage, adorned by plants like Sugarcane, Maize, Sorghum, and Amaranthus. Pioneered by the insightful discoveries of botanists Hatch and Slack, this pathway orchestrates a dual carbon fixation dance, crafting the initial product as the four-carbon compound, Oxaloacetic acid (OAA).
- C_4 Plants equipped with the C_4 pathway boast a unique leaf anatomy, a testament to their adaptation to higher temperatures, responsiveness to intense light, and an ingenious avoidance of the wasteful choreography of photorespiration. The hallmark of their leaf structure is the 'Kranz' anatomy—characterized by bundle sheath cells enveloping vascular bundles with copious chloroplasts, absence of grana, impermeable thick walls, and a distinct lack of intercellular spaces.

The Hatch-Slack Cycle

- In the C_4 pathway, the crucial interplay between mesophyll cells and bundle sheath cells unfolds, requiring the orchestrated regeneration of phosphoenolpyruvate (PEP) from C_3 acid. Unlike the C_3 cycle, there is no net gain or loss of NADPH in the C_4 cycle. The energy economy in C_4 plants involves a consumption of 2 ATP per fixed CO_2, leading to a total expenditure of 5 ATP per fixed CO_2 when considering both cycles.

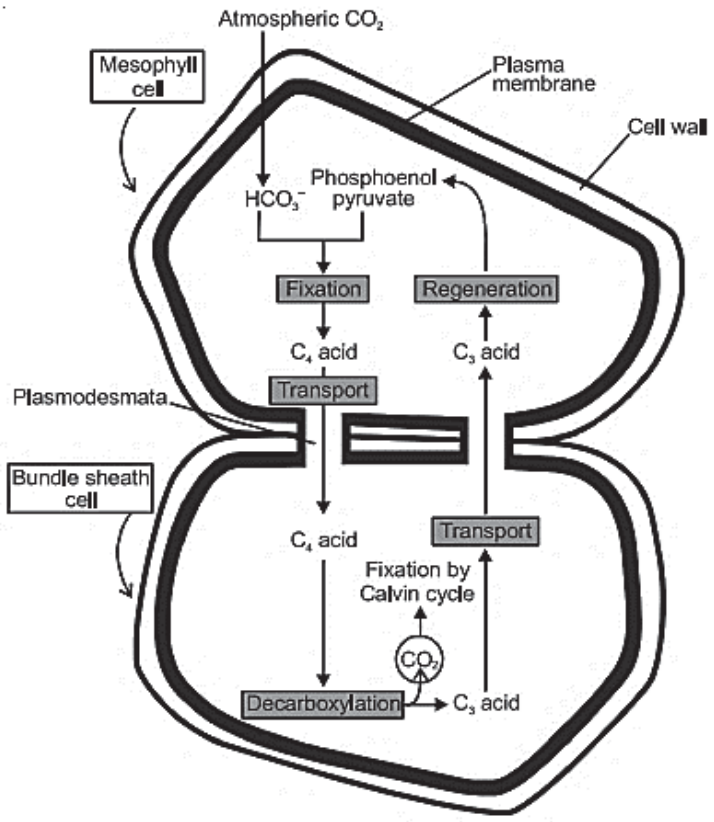

Fig. : Diagrammatic representation of the Hatch and Slack Pathway

- ATP Dynamics in C_4 Plants: A Balancing Act The energy investment in C_4 plants is notably efficient, requiring 2 ATP for the C_4 cycle compared to the 3 ATP demanded by the C_3 cycle per fixed CO_2. The

aggregate cost sums up to 5 ATP per fixed CO_2, showcasing the judicious financial management in the energetic economy of these plants.

Importance of C_4 Plants

- **Salinity Tolerance:** C_4 plants exhibit remarkable tolerance to saline conditions, attributed to the abundance of organic acids, such as malic and oxaloacetic acid, reducing their water potential compared to the soil.
- **Stomatal Resilience:** These plants showcase the remarkable ability to conduct photosynthesis even when stomata are closed, courtesy of the potent CO_2-fixing enzyme, phosphoenolpyruvate carboxylase (PEP case).
- **Water Utilization:** The concentric cell arrangement in C_4 plant leaves optimizes the leaf's surface area in relation to volume, enhancing water utilization efficiency.