Conclusion :-

In conclusion, it appears that C_4 photosynthetic plants have a higher net phts Photosynthetic rate than its C_3 counter parts, even under high temp, high light intensities and low Co_2 concentration. They also produced a unit weight of dry substances with half of the water of C_3 plants. They are thus well adapted to the condition in which they evolved (Hatch et al-1971).

concentration than are C_3 plants. It means they can maintain high rate of photosynthesis when the stomata are nearly closed and plants living in a dry not climate.

2. No Co_2 is lost in photorespiration by C_4 plants either they lack the metabolism of photorespiration or else any Co_2. So, produced is refixed by the mesophyll cells and so can not escaped.
3. The C_4 reaction may be used to store large quantities of C_4 acid which would be used for photosynthesis to control stomatal absure.
4. Hatch et al (1971) believed that C_4 plants are well adapted to grow act low water content higher temp and light internsities.

But the most important point about C_4 photosynthesis is that it is less efficient, ie. it uses more light energy to fix Co_2 than it does C_3 photosynthesis.

Significance of C_4 plants :-

This path is the modefication of calvin-cycle and in advantageous to plant of tropic vegatation. A plant can performs photosynthesis even in presence of very low concentradtion Co_2. Therefore the plant can adopt to grow at low water contents, high temp. and bright light intensity. This cycle is special suited to such plant which grow in dry climate of tropic and sub-tropics.

The photosynthetic rate remain higher due to absence of photo respiration in the plant.

Bassham(1965) proposed a cycle, which slightly differs from calvin cycle in some respect.

Now, we are well aquanted with the fact that in the C_3- cycle carbohydrate is produced, but observing complete calvin cycle, we do not find any specific place for the formation of the carbohydrates. Initially the cycle starts will RUDP and finally RUDP is released, thus completing the cycle. But for every molecule of RUDP, one molecule of Co_2 is fixed. The formation of carbohydrate(glucose) with the fixation of 6molecules of Co_2 can be demonstrated as graphically:-

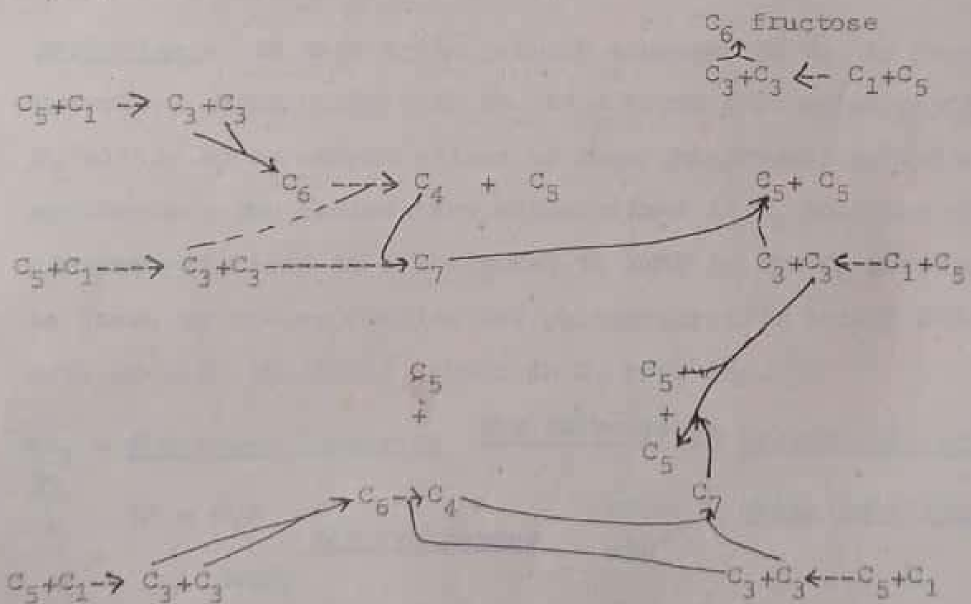


Fig. graphic representation of C_3 Cycle

C_4-cycle (Dicarboxylic acid cycle):-

The cycle of dark phase of photosynthesis in which after Co_2 fixation, first stable 4-carbon compound is formed called C_4 cycle. First of all Kotschak et al(1965),M.D.Hatch and C.R.Slack(1966-70) showed during short term photosynthesis by leaves of sugarcane and found first stable compound C_4 acid produced during the decarboxylation.

Differences between C_3 and C_4 plants.

The main differences are :-

(i) C_4 photosynthetic cells have much reduced or absence of photorespiration.

(ii) C_4 plants have high requirement of ATP for Co_2 assimilation, here only one molecule of Co_2 requires 5 ATP+ 2NADPH$_2$ in contrast to the requirement of 3 ATP+ 2 NADPH$_2$ for C_3 plant.

(III) C_4-plant can perform normal photosynthesis even in low Co_2 concentration and high light intensities. Higher economy of Co_2 fixation is because of rapid initial carboxylation in the formation in the formation of exacids (Laetsch-1974).

(iv) C_4 parts show an accumulation of cation found in excess in soil.

(v) In C_4 plants Co_2 is first accepted by PEP.

(vi) In C_4 plants these are two types of chloroplast,

(vii) C_4 plants not contain enzymes for C_3-cycle.

All C_4 plants perform C_3-cycle but all C_3 plant not perform C_4-cycle, because C_3- plants not contain, such enzymes by which PEP & oxaloacetate are formed.

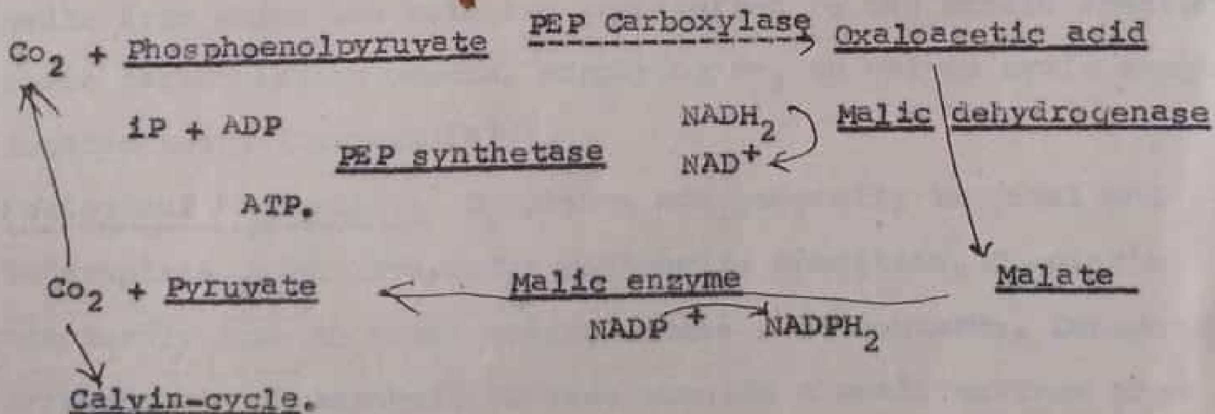
The C_4 plants provides following advantage :

1. They are capable of much higher rates of photosynthesis and because of the high affinity of PEP carboxylase for Co_2 (the strongly exothermic reaction leading to PEP synthesis). They are able to absorb Co_2 strongly from a much lower Co_2

acid (oxaloacetic acid) instead of 3 PGA and hence named as Hatch and Slack pathway.

This cycle mostly occurs in finally Poaceae, Chenopodiaceae, Amarantaceae, Euphorbiaceae, Portulaceae and ~~As~~ Asteraceae, but their have not any taxonomical importance, because several species of one genus carry several cycle. eg- Atriplex rosea C_4 cycle, A. hastate -C_3 cycle, Euphorbia corcollata C_3 cycle, E. maculata -C_4 cycle, where as E. grandidens- Crasulacean acid metabolism pathway. These plants are generally tropical and sub-trophical.

Mechanism :- In this cycle primary acceptor of Co_2 is phosphoenol pyruvate, which unite with Co_2 at a rapid rate which supply in C_4 plants by an enzyme unique of them phosphoenol pyruvate synthetase. The radioactive carbon fixed in C_4 position of C_4 dicarboxylic acid is transferred to RUDP in the C_1 position. As shown by tracer studies and phosphoglyceric acid (3 PGA) is slit of with the fixed carbon in C_1 position.



Kennedy and Laetsch (1974) have shown for the first time that Mollugo verticillate (family-Aizoaceae) possess feature intermediate between C_3 & C_4 plants in leaf anatomy, cell- ultra-structure, photorespiration and primary photosynthetic products.

Chloroplast organisation in C_4-plants:

In C_4 plants leaf structure and chloroplast organisation is unique. Around the vascular bundles are two concentric layers of chloroplasts, an inner sheath of parenchyma, called bundle sheath and outer mesophyll layer. These two usually being separated by a thick wall.

Differences:

(A) Mesophyll chlorpplast in concentric arrangement but bundle sheath chlorophlast are larger.

(B) Mesophyll chåoroplast has well developed grana where as bundle sheath chloroplast has ill developed grana.

(C) In mesophyll peripheral reticullum is well developed where as in bundle sheath, it is ill developed.

(D) In mesophyll cells small starch grains are present where as in bundle sheath well developed starch grains are present.

C_4- dicarbaxylic acid synthesis occurs in mesophyll cells from which the acid are transported to the bundle sheaths where carboxylation occurs, supplying Co_2 to calvin cycle enzymes located there (Downton-1970).

Ecological Adaptation: C_4 plants are generally tropical and subtropical which live under xerophytic condition. C_4-plants are mostly live in areas having excess salt contents. Concentric arrangement of mesophyll tissues provide a small surface area in relation to volum. The geometry reduce transpiring surface and allow better utlization of available water. This geometry helps the plants to survive in higher light intensities. Another peculierity for this is accumulation of actions which are found in excess in soils. These are balanced by organic anions produced separated by paper-chromatography and located on autoradiography, thus confirming the compounds.

C_3 Cyle :-

The cycle of photosynthesis in which first stable compounds after assimilation of radioactive carbon is 3-carbon compound (PGA) is called C_3-cycle. This cycle first of all reported by calvin, Wilson and Bassham (1959) and hence called calvin-cycle.

The graphic representation of calvin cycle is

6 RUMP+6ATP $\xrightarrow{\text{Phospopentokinase}}$ 6RUDP+6ADP.

6 RUDP+6 Co_2 $\xrightarrow{\text{Carboxylase}}$ 6 Keto Acid (unstable).

6 Keto acid $\xrightarrow{\text{Hydrolysis dismatation}}$ 12 PGA.

12 PGA+12NADPH$_2$+ 12 ATP $\xrightarrow[\text{dehydrogenase}]{\text{Triose phosphate}}$ 7 GAP+5DiHP.

3 GAP+3 DiHP $\xrightarrow{\text{Aldolase}}$ 3 fructose 1,6 diphosphate

↓ Phosphatase

3 fructose, 6 phosphate+3 ip.

2 GAP+2 fructose,6 phosphate $\xrightarrow{\text{Transketolase}}$ 2 Erythrose, 4 phosphate + 2 Xyllulose 5 phosphate.

2 DiPH+ 2 Erythrose, 4 phosphate $\xrightarrow{\text{Aldolase}}$ 2 Seduheptulose1, 7diphosphate- $\xrightarrow{\text{Phosphatase}}$ 2 Seduheptulose 7P.

2 GAP+ 2 seduheptulose 7,P $\xrightarrow{\text{Transketolase}}$ 2 ribose-5P+2Xylulose 5,P.

4 Xyllulose, 5P+ 2 ribose,5P $\xrightarrow[\text{Isomerase Epimerase}]{\text{Phosphopento}}$ 6 RuMP

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6 CO_2+18ATP+12NADPH$_2$ ---> $C_6H_{12}O_6$+18 ADP+18 ip+12NADP.

In this way here 18 ATP & 12 NADPH$_2$ carry about 791.4K Calories energy. Where as the synthesis of one molecule of glucose carry of 686 K calories, than 791.4 K Calories are sufficient.

contd.p...3.

X

C_3 and C_4 Plants

The plants performing C_3 and C_4 cycle are called C_3 & C_4 plants respectively. Any discussion regarding C_3 & C_4 plants essentially refers to C_3 and C_4 cycle. C_3 and C_4 cycle are the cycle of darks phase of photosynthesis.

The capture of the photons and conversion of its light energy into chemical energy is the unique process of plants called photosynthesis. (Robert Hill-1937).

Photosynthesis can be revolved into 2 phases :-

(1) Light phase :- Which converts sunlight energy to chemical energy as ATP and $NADPH_2$.

(2) Dark phase :- This chemical energy is used to reduce the carbon into organic compounds.

This reduction of carbon to organic compounds (carbohydrate) is completed in a series of steps each mediated by specific compounds and controlled by specific enzymes, operating in the form of complete cycle of which several cycles have been noted.eg- C_3 cycle, C_4 cycle, C_2 cycle, Crasulacean cycle, Reductive carboxylic acid cycle of which C_3 and C_4 cycle are most important.

The mechanism of these cycles have elucidate with the help of various safosticated techniques and equipments, such as tracer technique chromatography, Autoratiography by several workers working in the different past of the globe.

Technique :- The critical experiments were carried on two unicellular algae.eg *Chlorella pyrenoidosa* and *Scendesmus obliquus*. The algal cells are fed with C-14 (tracer element) and instantaneously killed by methanol. The compounds were

contd.p.2...