17. SOURCE SINK RELATIONSHIP

Source

1. It is the regions of photoassimilates production
2. Export photoassimilates
3. Chlorophyllous tissues
4. Leaves, stipules, fruit wall, young stem, pedicel, awns, peduncle, calyx, bract etc

Sink

1. Regions of photoassimilates consumption
2. Import photoassimilates
3. Growing regions
4. Storage organs – Fruit and Seed

Source strength

1. Source Size x Source activity
2. Differences in CO_2 fixation (Rubisco & PEP Case)
3. Leaf characters – size, thickness, mesophyll size, compaction, vascular bundle
4. Carrying capacity of sieve element (temp., H_2O, nutrients, hormone)

Sink strength

1. Sink size x Sink activity
2. Potential capacity of the sink to accumulate assimilates
3. Competition among different sink

Source sink interaction

1. Source sink equilibrium
2. Small surplus source for stress
3. High source size during sink differentiation
4. Improve strength by activity
5. Synchrony of sink organ development

6. Increased HI is reached – increase DMA
7. Reduce photorespiration in C3 plants

Evans (1983)

Reduced growth of non harvestable organ

Prolonged faster storage

Enhanced competition of storage organ

Enhanced competition of regulatory process

Reduced stem weight and height

Reduced root weight with adequate nutrient and H2O

Improved agronomic support (avoid biotic & abiotic stress)

Hormonal regulation

Developmental plasticity (small surplus source for stress)

Efficient system

1. Quick export of photoassimilates to avoid end product inhibition
2. Efficient root system
3. More photosynthetic rate
4. Optimum LAI (4 to 6)
5. High photosynthetic rate & high DMA

Blackman's law of limiting factor

1. A process is controlled by several factors
2. The phase of the process is limited by slowest factor
3. Compensation mechanism working under canopy level

Dry matter accumulation (DMA)

G x E interaction; nutrients; CO2 fixation rate (path way); photorespiration; vascular network; LAI & LAD; source-sink limiting condition; root-shoot balance

HI

Ye = Yb x h

/ HI = {Yield $_{(Eco)}$/ Yield $_{(Biol)}$} x 100

Improve Harvest index (HI)

Increase biomass production (DMA)

Synchronized development of reproductive organ

Reproductively determinate

High source strength at the time of sink differentiation

Reduced growth of non harvestable organ

Reduced leaf growth at reproductive stage with high LAD

Optimum LAI and early peak LAI

More prolonged and faster storage, enhanced competitiveness among of the storage organ

High photosynthetic rate

Improved HI by increased size and number of sink organ

Decline in duration of Vegetative growth and increased duration of Reproductive growth.

Limitations

Source: wheat, rice, pulses, oilseeds

Sink: bajra, ragi

Transport: sorghum, maize (green leaf at harvest; senescence of phloem Parenchyma)

Sink limitation:

Late anthesis (Long Vegetative phase)

Indeterminate (Vegetative & Reproductive growth)

Vegetative growth at Reproductive phase

Less sink number and size

Hormonal imbalance

Any Stress

Multi-sink demand (nodules supply 25 – 75 % of N demand)

Source limitation:

Low canopy photosynthesis

Low optimum LAI

Slow peak LAI (lag vegetative growth)

Low LAD at filling

Early leaf senescence

Stress – nutrients, water

Plant Growth Regulators (PGRs)

ABA inhibit sucrose uptake in source (Loading)

Auxin promotes source uptake

Starch accumulation in chloroplast inhibit photosynthesis

ABA in leaves causes closer of stomata (Inhibit CO_2 fixation)

Cytokinin delays senescence of source and sink

Cytokinin in sink increases photoassimilates import

Ethylene induces senescence process.