

Lecture 26

Modification of the light environment

Fruit and veg crops try to maximize light interception

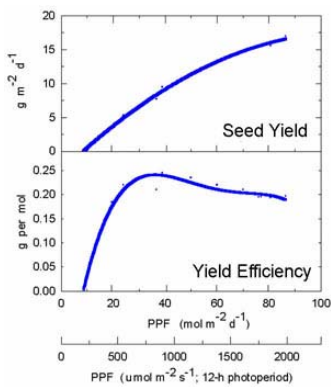
Ornamentals? Many are shade-loving species

in both cases the photosynthetic photon flux is very important.

star anise- shade adapted, then grown under 100% or 45% ambient PPF.

light level (%)	A_{max}	Chl_{tot}
100	0.51	47.0 ug/cm ²
45	8.39	85.1

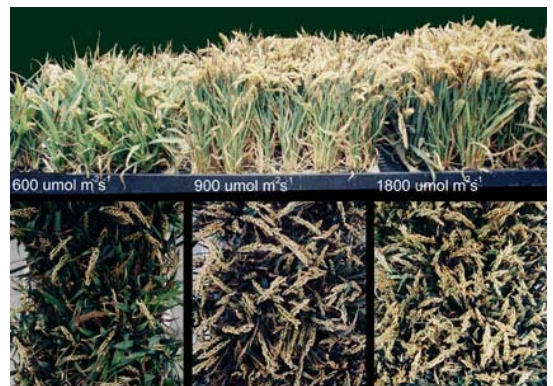
severe photobleaching



More is not always better.

Here in SuperDwarf rice the higher the PPF the more yield there is.

However, the efficiency goes down. In other words, there is less production per PPF unit.



Choice of Location

Light duration and intensity depends on climatic or geographic regions (latitude) and season

Weather; frequently cloudy or sunny – season?

Therefore, even greenhouse production of crops in the winter may be challenged by photoperiod etc.

Species where floral bud initiation is photoperiod dependent require special considerations to the light environment

You can't achieve sufficient SD in tropics for SD plants to flower.

Other factors

light interception dependent upon plant density and size, canopy shape, plant distribution, row orientation

Reflected from ground? Mostly wasted.

So, as planting density increases the efficiency of light interception increases.

This is limited by two factors– canopy overlap and far-red reflection

Apple trees

at different densities the output per acre changes

as density increases the yield per ha increase

BUT fruit color decreases significantly.

High density plantings require smaller trees that limit shading in the lower canopy.

Other ways to limit tree size

Genetics – select dwarf varieties

Rootstocks

Chemical growth control

Physical growth control – pruning/training. Pruning controls height and increases light penetration into inner canopy. Summer pruning is used in apple, peach, nectarine to increase light penetration, photosynthesis, fruit color. Pruning is done after shoot extension growth and before fruit harvest.

Canopy Shape

Trees with taller sides intercept more light than trees with angles

Taller trees intercept more light than shorter trees

The distribution of the intercepted light is important, and angled surfaces give a better distribution.

Plant Distribution and Spacing

Competition for light is delayed with equidistant plantings.

Row Orientation

North-South or East-West?

Fruit trees

NS rows have 30-50% greater yield than E-W rows.

In summer, the best light balance comes from NS orientation.

Light interception remains constant through season

Row Orientation (cont'd)

EW rows have inefficient mid-summer interception because of high sun angle. Sunlight spends most time irradiating the top of the canopy.

In winter E-W rows become very efficient because of low sun angle.

In annual crops EW rows are best in winter, NS rows better in summer.

The same parameters translate to ornamentals and greenhouse propagation.

DECREASING LIGHT..

Some crops and many ornamentals are shade adapted, so they require growth under special conditions.

Physiologically, to maintain maximal vegetative growth the plants should be well shaded.

Also required for plants that need pigment level developmentally inhibited (cauliflower).

Blanching is the loss of chlorophyll by excluding light. Many cauliflower cultivars require outer leaves to be pulled over head and tied 2-3 d before harvest to limit pigmentation.

New cultivars have leaves that shade the head.

DECREASING LIGHT..

In Japan, apples are grown in bags to produce translucent fruit that are valuable as gifts.

Propagation of cuttings also is dependent on light and shading can be useful. Why?

Supplementing LIGHT..

In some cases it is useful to increase fluence rate and/or photoperiod. This is very critical in the ornamental and flower industries, especially where LD plants need to flower in the winter.

SPECTRA OF GREENHOUSE LAMPS is critical.

