



Manganese and tipburn

Gifty Kodua

Tipburn- inner and outer tipburn

- Transpiration is not even in the entire plant
 - less in young leaves
 - high in old/outer leaves
- Less transpiration leads to less nutrients transport = more inner tipburn
- High transpiration leads to more nutrient transport = more outer tipburn
- Rapid growth
 - less nutrients supplied
- Environmental factors strongly inducing tipburn
 - increased irradiance
 - high light sum
 - light spectral distribution

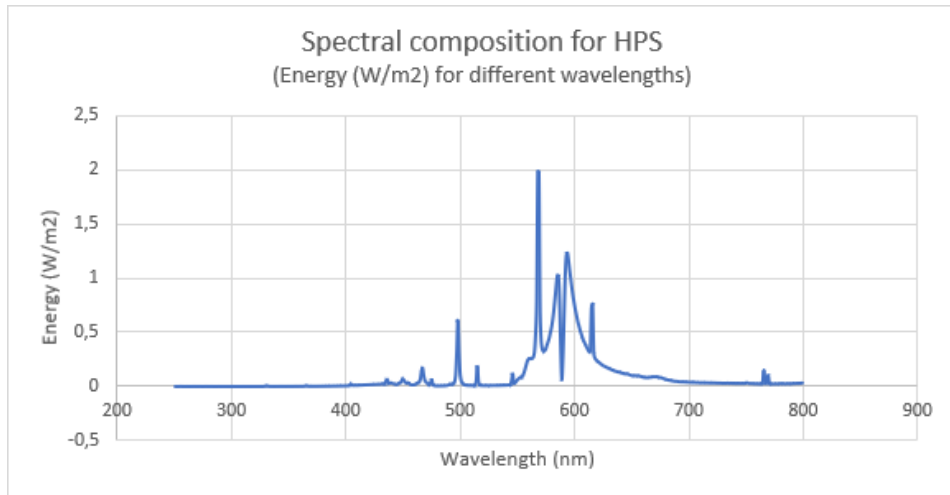
Manganese- Essential and Toxic

- Essential
 - for photosynthesis
 - part of antioxidative enzymes eg Mn-SOD
- Excess
 - Affects photosynthesis
 - increased production of ROS leading to oxidative damage.
 - competition with other nutrients

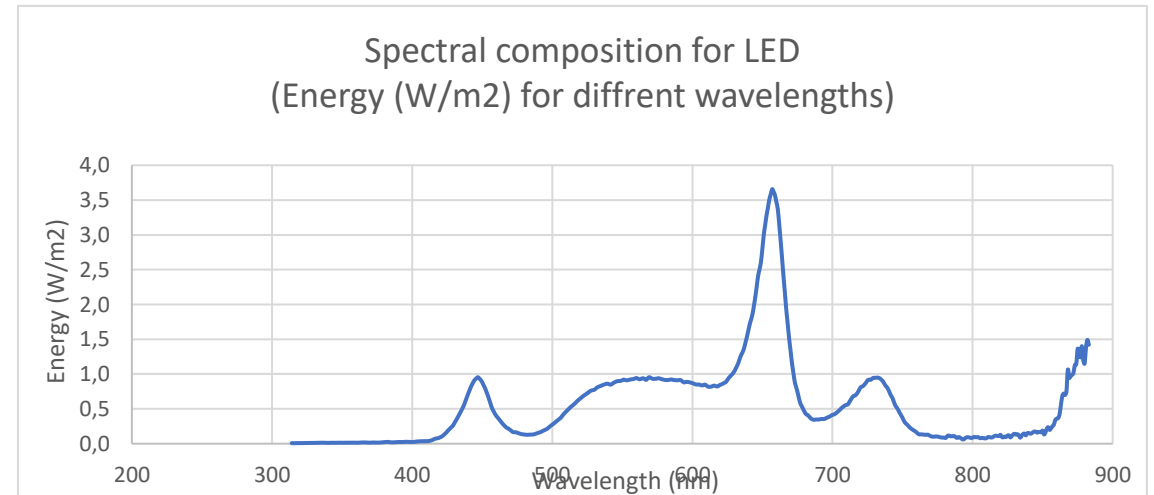
Light spectral distribution and intensity are important

- more infra-red radiation can increase transpiration (HPS)
- more red and blue light can cause stress (LED)
- high irradiance causes rapid growth= less nutrients

HPS



LED



Extra Manganese (111ppm) in the nutrient solution

- Nutrient accumulation
- Growth
- Tipburn



Outer leaf



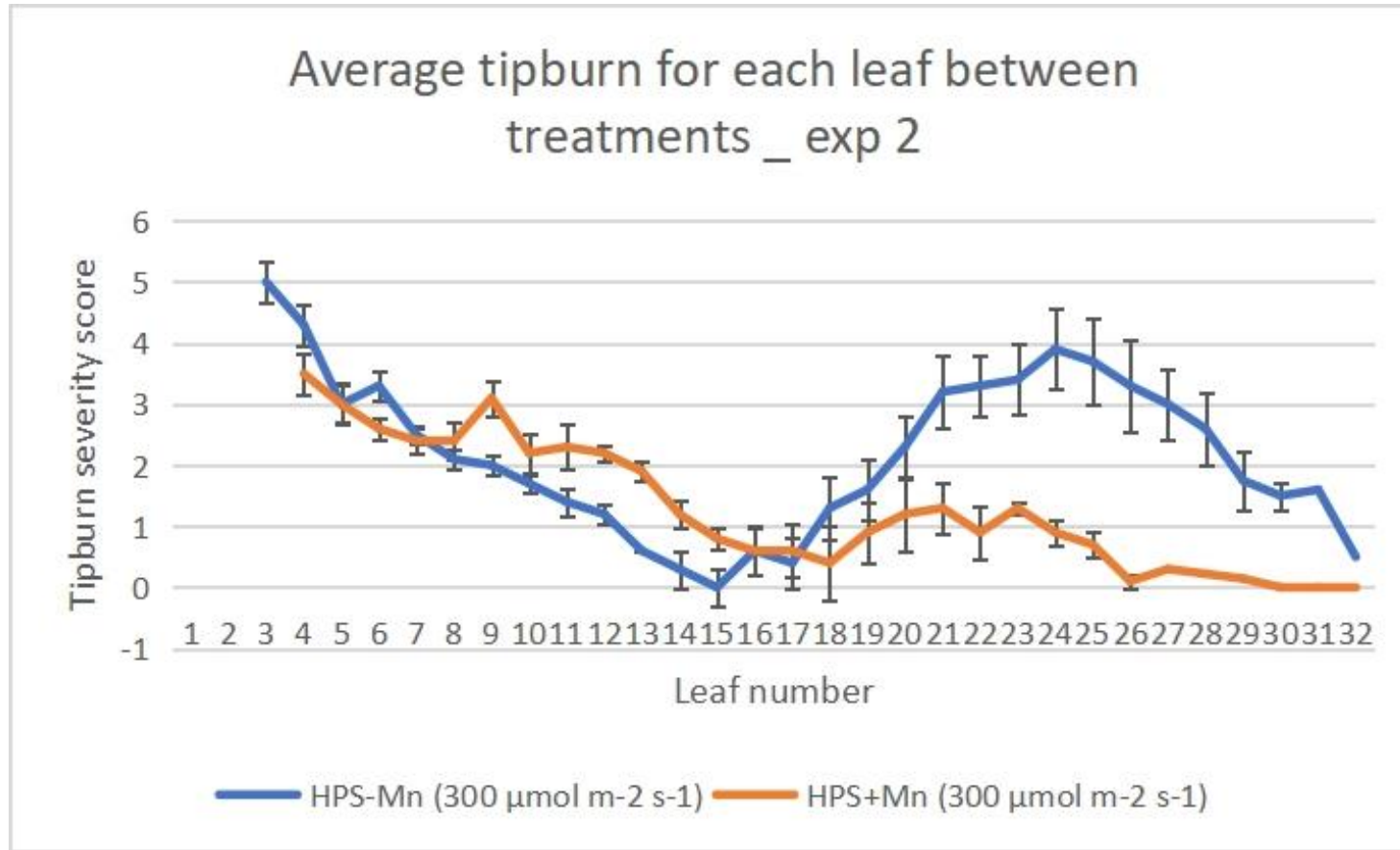
Inner leaves

Manganese (Mn) accumulation from lettuce (mg/kg)

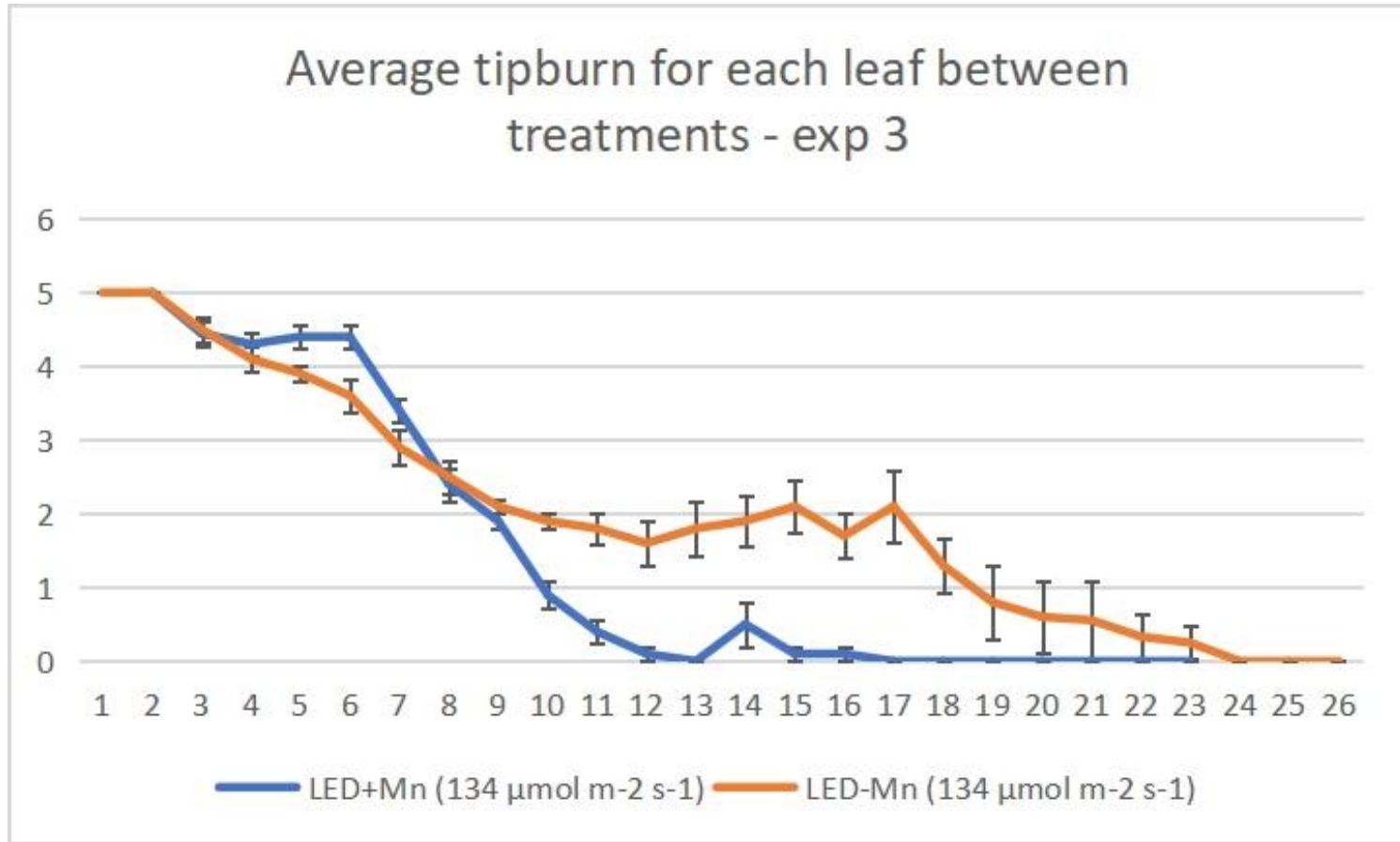
Treatment	Young leaves		Inner part of old leaf		Edge of old leaf	
	+Mn	-Mn	+Mn	-Mn	+Mn	-Mn
HPS- 300 $\mu\text{mol m}^{-2} \text{s}^{-1}$	665.4	14.95	2072	34.27	4421	194.7
HPS- 150 $\mu\text{mol m}^{-2} \text{s}^{-1}$	1504.2		2230.5		8163	
LED- 134 $\mu\text{mol m}^{-2} \text{s}^{-1}$	1054.3	30.54	1830.3	40.71	3706	168.36
LED- 206 $\mu\text{mol m}^{-2} \text{s}^{-1}$	888	41.05	2136	124.9	4096	350.2

- Different in different parts of the leaf (transpiration)
- More at the edges of old leaves of treated plants
- Treated plants grown under HPS accumulated more Mn

Tipburn- Extra manganese vrs without extra manganese (HPS)



Tipburn- low light (LED)

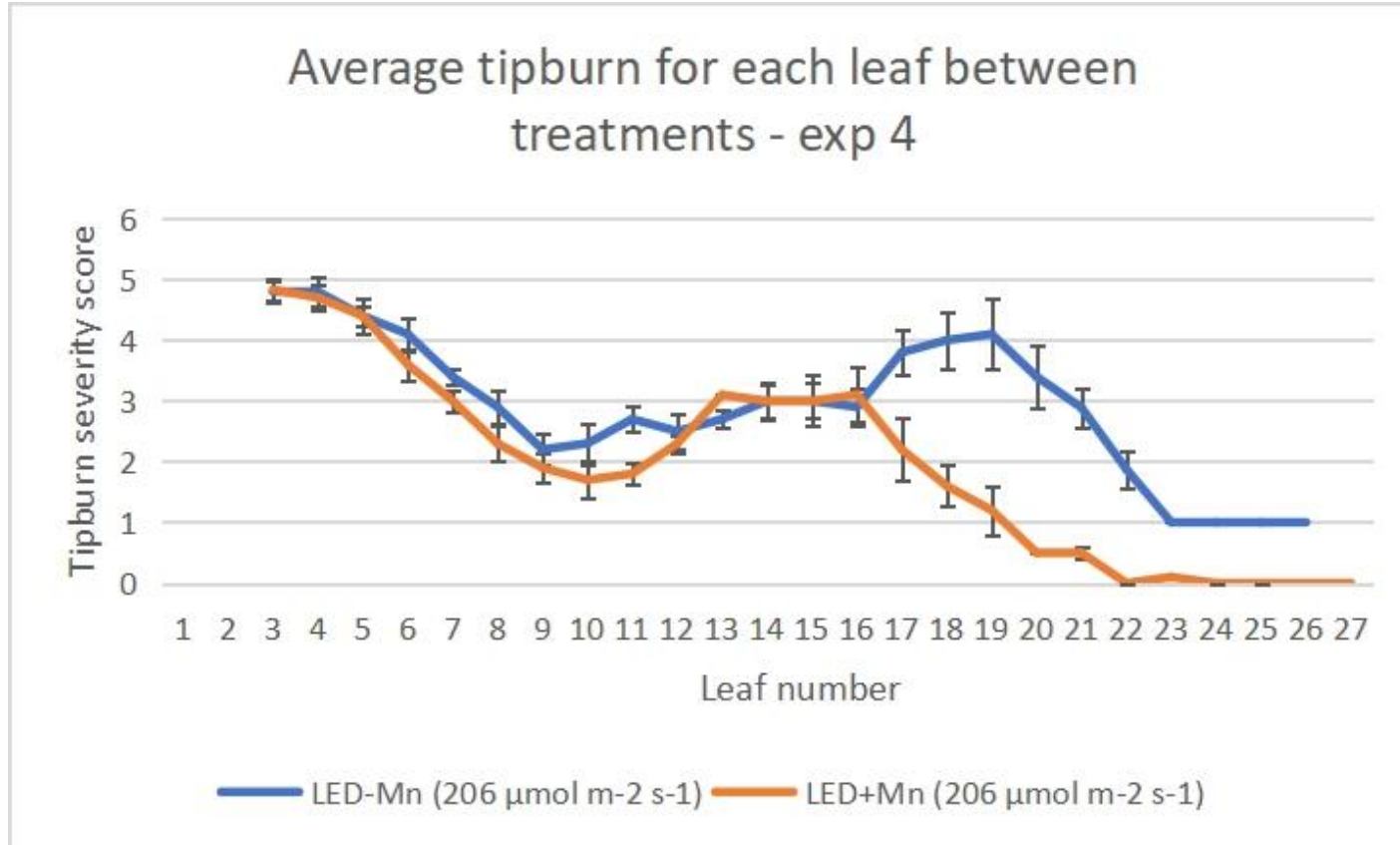


+ Mangan



- Mangan

Tipburn- high light (LED)



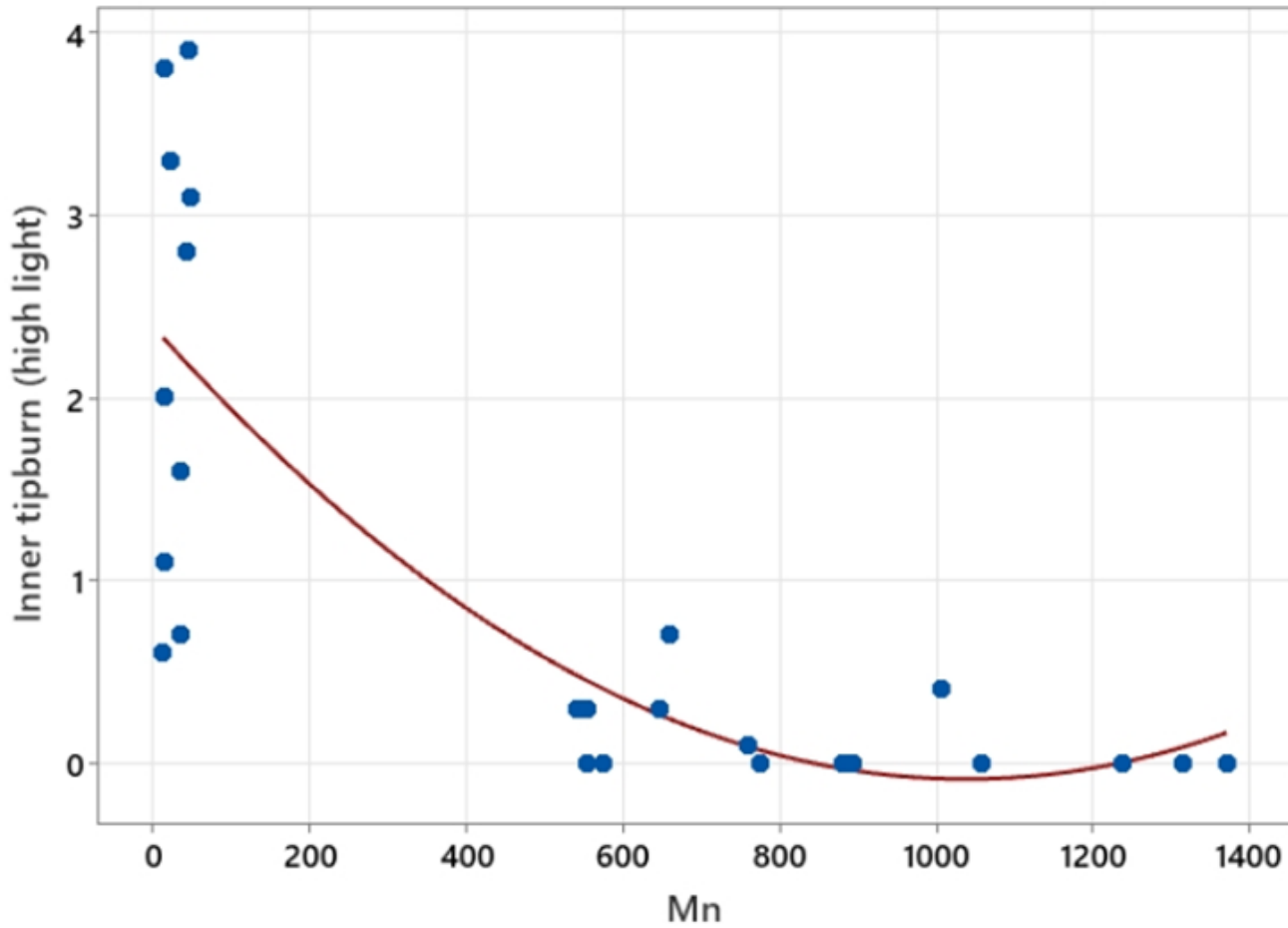
- Mangan



+ Mangan

Fitted Line Plot

$$\text{Inner tipburn (high light)} = 2.386 - 0.004767 \text{ Mn} + 0.000002 \text{ Mn}^2$$



S 0.843898
R-Sq 63.2%
R-Sq(adj) 59.8%

Conclusions

- ❖ The Mn content of inner leaves is much lower than the edge of outer old leaves and follows similar pattern of distribution as Ca
- ❖ Increased Mn content in the nutrient solution led to a higher concentration of this element in all parts of frillice lettuce analyzed.
- ❖ Foliar application of extra Mn did not affect plant growth nor tipburn severity (both inner tipburn and outer tipburn) either in low light or high light with LED.
- ❖ Increased Mn content in the inner leaves led to less inner tipburn.
- ❖ The effect of extra Mn in the nutrient solution on outer tipburn severity was dependent on lamp type and irradiance
 - ❖ Severity was high in plants grown in high irradiance with LED lamps