Table Grapes

Factors that impacts berry size and berry weight

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Factors that could impact berry size & berry weight

- Environmental Factors:
  - Temperature
  - Sun Light
  - Water Stress
  - Water Quality
  - Soil type
  - Salinity
  - Seasonal Changes
- Plant Characteristics:
  - Cultivar type
  - Plant Genetics
  - Plant Vigour
  - Rootstock
  - Bunch Architecture
  - Reserve Status

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Factors that could impact berry size & berry weight

- Cultural Practices:
  - Water Management
  - Fertilization
  - Crop Load
  - Bunch size
  - Leaf : Fruit ratio
  - Plastic covers
  - Girdling
- Plant Growth Regulators:
  - Hydrogen Cyanimide
  - Auxins
  - Gibberellins
  - Cytokinins
  - Ethephon
  - Abscisic Acid

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Berry growth stages and berry development

- Berry growth stages:
  - Stage1 - Rapid Growth
  - Stage 2 - Lag phase
  - Stage 3 - Ripening and Growth
  - Stage 4 - Senescence

- Berry Development:
  - Cell division
  - Cell elongation
  - Cell volume
  - Sugar content

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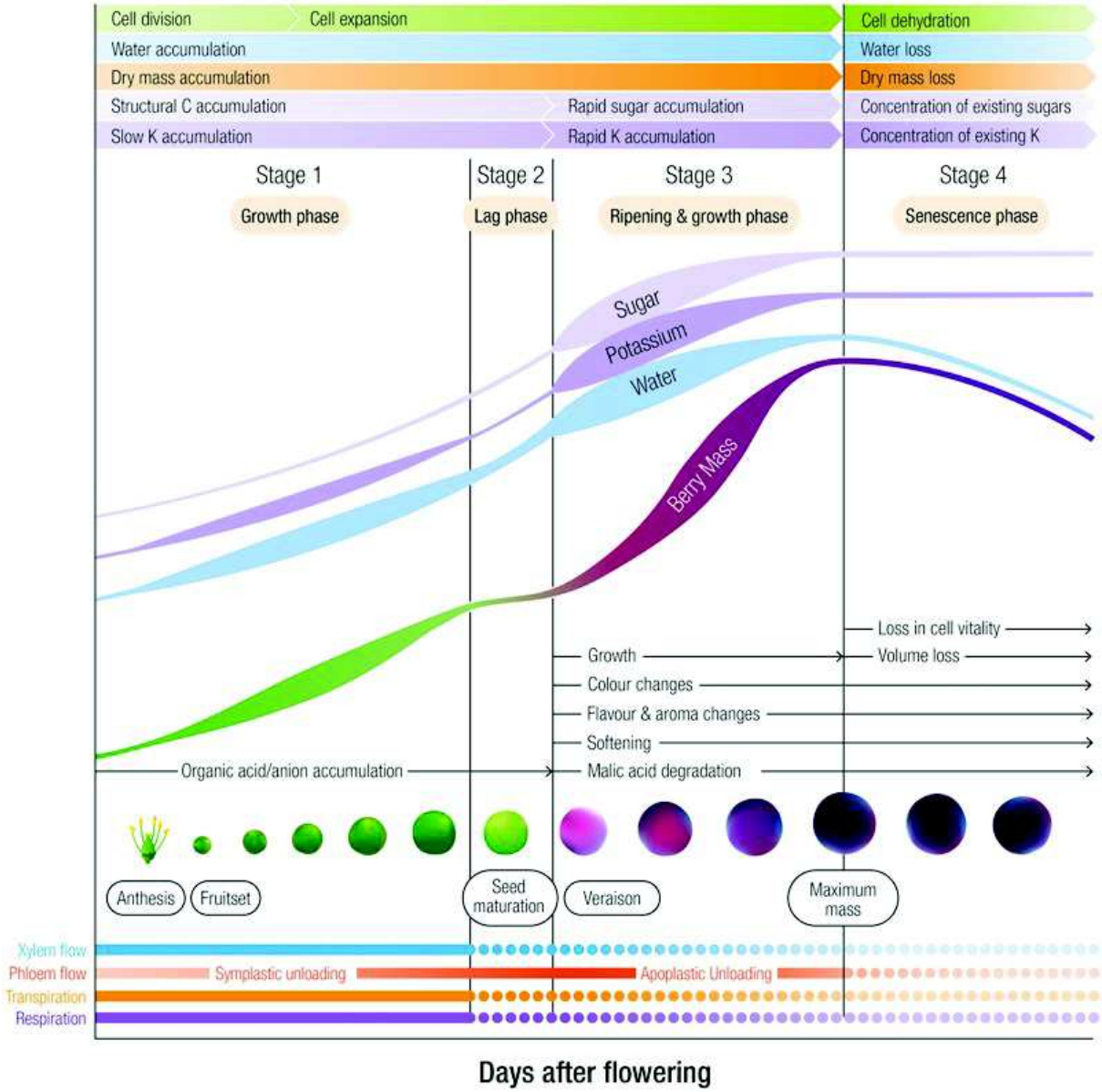
Berry growth stages and berry development



- The number of growth stages depends on environmental conditions, type of cultivar, cultivation practices, solar radiation, temperature and moisture received.

- Seedless cultivars usually do not depict a clear stage two (lag stage), which results in less definite stages in the growth curve.

- Cultivars with no or short lag stage, tend to ripen earlier than those with an clearly observable extended lag phase (Coombe, 1976).

Berry Weight

- The potential size or fresh weight of the berry is controlled by three factors:
  - Number of cells
  - Cell volume
  - Sugar content

- The number of cells in a grape berry is established during the first three weeks after anthesis. No further cell division occurs after this period .

- In fact, the number of times cells divide before anthesis is the primary determinant of the number of cells per berry.

- A field-grown 'Thompson Seedless' berry contains approximately 200,000 cells prior to anthesis and 600,000 cells at harvest. In this example, the total number of cells per berry doubled 17 times prior to anthesis, but less than twice thereafter.

(Coombe, 1976; Dokoozlian, 2000)

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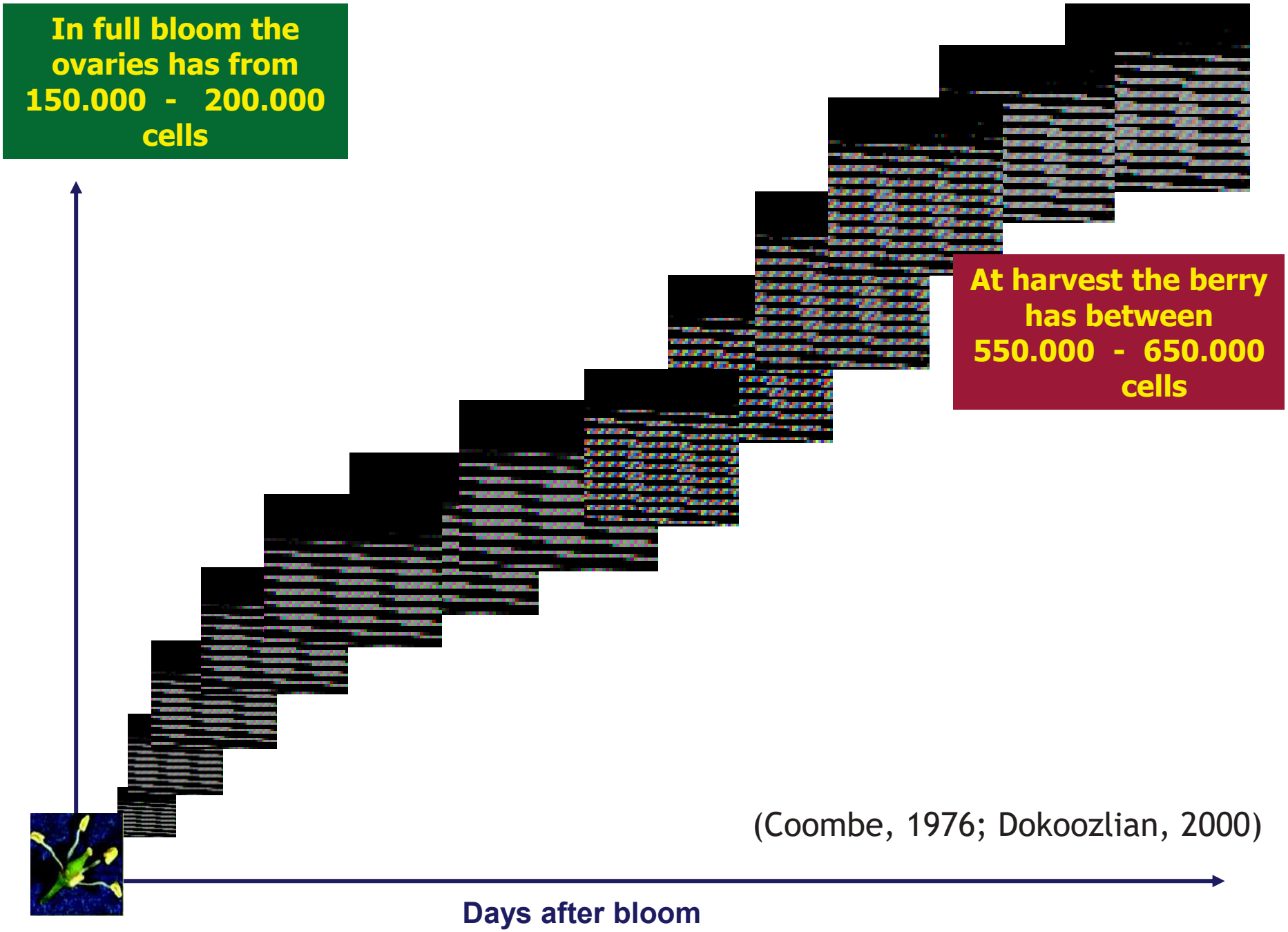
In full bloom the ovaries has from 150.000 - 200.000 cells
At harvest the berry has between 550.000 - 650.000 cells
(Coombe, 1976; Dokoozlian, 2000)
Days after bloom

Cell volume

- Cell volume increases significantly during stage I, remains relatively constant during stage II, and resumes rapid expansion in stage III.
- The concentration of primarily sugars per unit of cell volume also increases sharply during stage III.
- Cell volume increases about 300-fold between anthesis and harvest, and the content of primary sugars per unit of cell volume increases fourfold during the same period.
- It is likely that both the number of cells per berry and the size of those cells are closely related to the final fresh weight of the berry.
- Biophysical factors such as berry cell turgor and cell wall extensibility and plasticity also influence berry growth.
- Stage III growth (expansion) of some grape varieties often stops because it has caused splits or cracks in the berry skin.

Sugars

- The major carbohydrates in grapes are glucose, fructose and sucrose.
- Glucose and fructose usually represents more than 99% of carbohydrates in juice. Fresh weight of mature berries can contain 12% to 27% glucose and fructose (Winkler *et al*., 1974)
- Berry size increases with an increase in sugar content after veraison, and this varies by cultivar.
- The rate at which sugar per berry increase after véraison, is directly proportional to the volume of the berry. One week after sugar accumulation starts, total phenol and anthocyanin content increase significantly, while chlorophyll content decrease entirely during the third stage.

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Temperature

- Temperature affects berry development significantly, as it influences both cell division and enlargement .
- Optimum temperature for berry development is 25˚C day temperature and 20˚C night temperature (Ollat *et al*., 2002).
- The period below a certain minimum temperature has the biggest impact on cell division and berry growth.
- Berry growth during stage I is quite sensitive to temperature, temperatures in excess of 35°C reduce growth rate and size at harvest.

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Sun Light

- Light is also important for optimum berry growth.
- Berries that are subject to heavy shade immediately after berry set are significantly smaller at maturity than berries that have been well exposed to light.
- This suggests that light stimulates cell division or cell expansion in grape berries during stage I.

(Dokoozlian, 2000)

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Water Stress

- Vines undergoing water stress during stage I normally produce smaller berries than non-stressed vines.

- Since the effects of water stress during stage I on berry growth cannot be reversed by subsequent watering, decreased growth probably indicates a reduced number of cells per berry or a permanent reduction in the size or volume of the cells.

- Water stress during phases II and III may also decrease berry weight, but in that case the reduction is related to reduced cell volume or diminished solutes (sugar) in the cells.

- Nutrient deficiencies and other disorders that reduce photosynthesis may also reduce berry growth or slow ripening by decreasing the supply of sugars to the fruit.

(Dokoozlian, 2000)

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Rootstocks

Table (2): Influence of some rootstocks on physical characteristics of berries in Red Globe grapevines in 2008, 2009 and 2010 seasons

Characteristics / Rootstocks	Average berry weight (g)			Average berry size (cm^3)			Average berry length (cm)			Average berry diameter (cm)		
	2008	2009	2010	2008	2009	2010	2008	2009	2010	2008	2009	2010
Dogridge	9.16	9.35	9.51	8.93	9.09	9.23	2.93	2.97	2.98	2.79	2.81	2.84
Salt creek	8.92	9.08	9.29	8.67	8.81	8.99	2.90	2.93	2.95	2.78	2.80	2.83
Freedom	8.35	8.44	8.74	8.09	8.15	8.43	2.88	2.90	2.94	2.75	2.79	2.81
Harmony	8.22	8.35	8.61	7.95	8.04	8.28	2.85	2.88	2.90	2.73	2.74	2.78
Paulsen 1103	8.09	8.24	8.46	7.82	7.92	8.13	2.84	2.85	2.88	2.70	2.74	2.75
Own-rooted vines	7.81	7.98	8.14	7.53	7.64	7.80	2.76	2.78	2.81	2.62	2.64	2.67
new L.S.D. at 0.05 =	**0.91**	**0.97**	**0.86**	**0.95**	**0.98**	**0.91**	**0.06**	**0.08**	**0.07**	**0.05**	**0.06**	**0.05**

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Plant Vigour

At the end, finished fruit is SALT MANAGEMENT

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Firm berries:

N-total: < 0,7 %

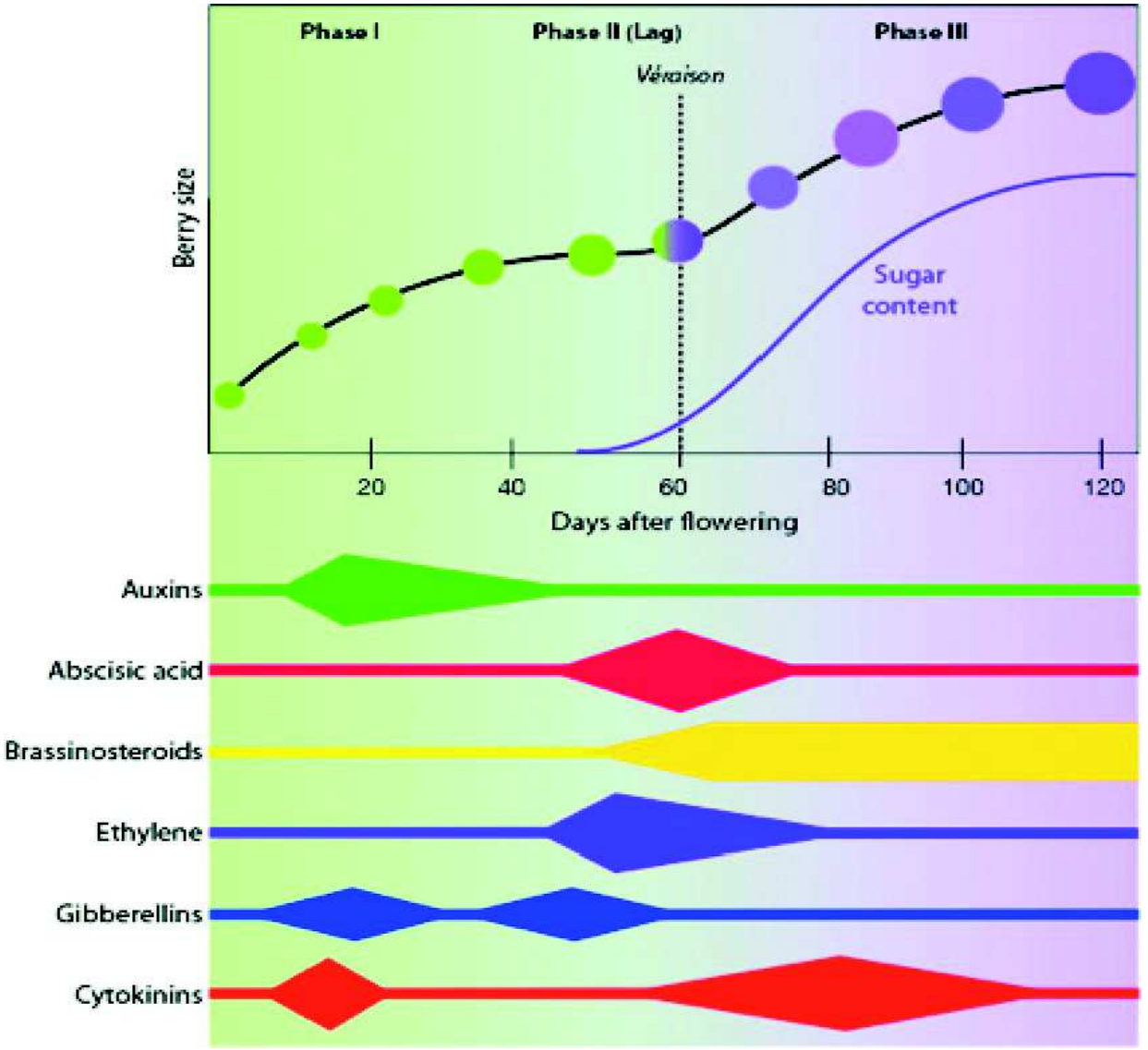
20-23 % dry matter

Soft berries:

N-total: > 1,0 %

10-12 % dry matter

The role of Plant Hormones on berry development



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Effect of girdling and gibberellins on berry weight

Table 1. Effect of GA_3 and Girdling treatments on berry weight, bunch weight, berry diameter, and berry number/bunch of Thompson seedless grape.

Treatments	Berry wt. (g)	Berry diameter (mm)	Bunch wt (g)	Berry no./ bunch
Control	3.55 c*	10.52 b	239.7 c	66.5 a
GA_3	4.01 ab	12.38 a	274.3 a	64.5 a
Girdle	3.86 b	11.53 ab	260.6 b	60.5 a
GA_3 + Girdle	4.14 a	12.30 a	280.9 a	61.8 a
LSD	0.2788	1.4642	13.098	9.5688

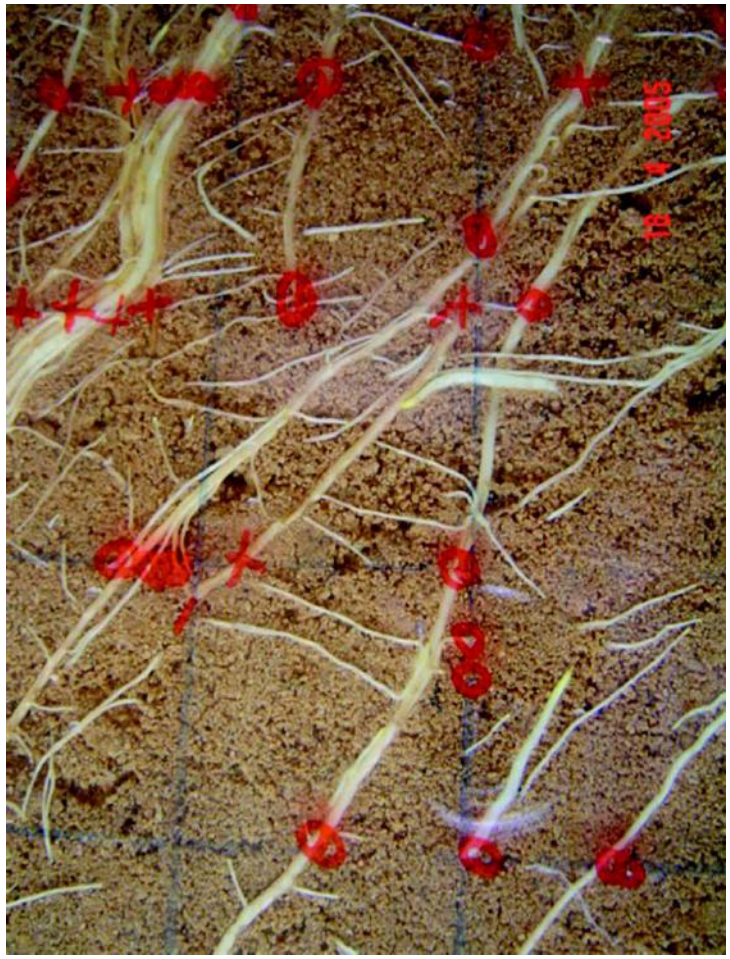
* Values are mean of six replicates

Means within each column having different letters are significantly different at $p \leq 0.05$

TALEB R. ABU-ZAHRA *Pak. J. Bot.*, 42(3): 1755-1760, 2010.

Water Management

- Roots: Winter is the most sensitive period because the mistakes on irrigation are more difficult to solve and to detect.
- Vines are naked and no leaves to help overcome the problem. Important part of the season is decided during this period.
- Full oxygen and the right moisture is the way to secure a good beginning of the season. Bud break quality.
- Don´t over water !



Remember, we have two harvests = the crop and the roots !


Thank You
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