CONTROLLING ANTHRACNOSE IN AVOCADO BY ENHANCING NATURAL FRUIT RESISTANCE: THE ROLE OF ROOTSTOCKS AND NUTRITION

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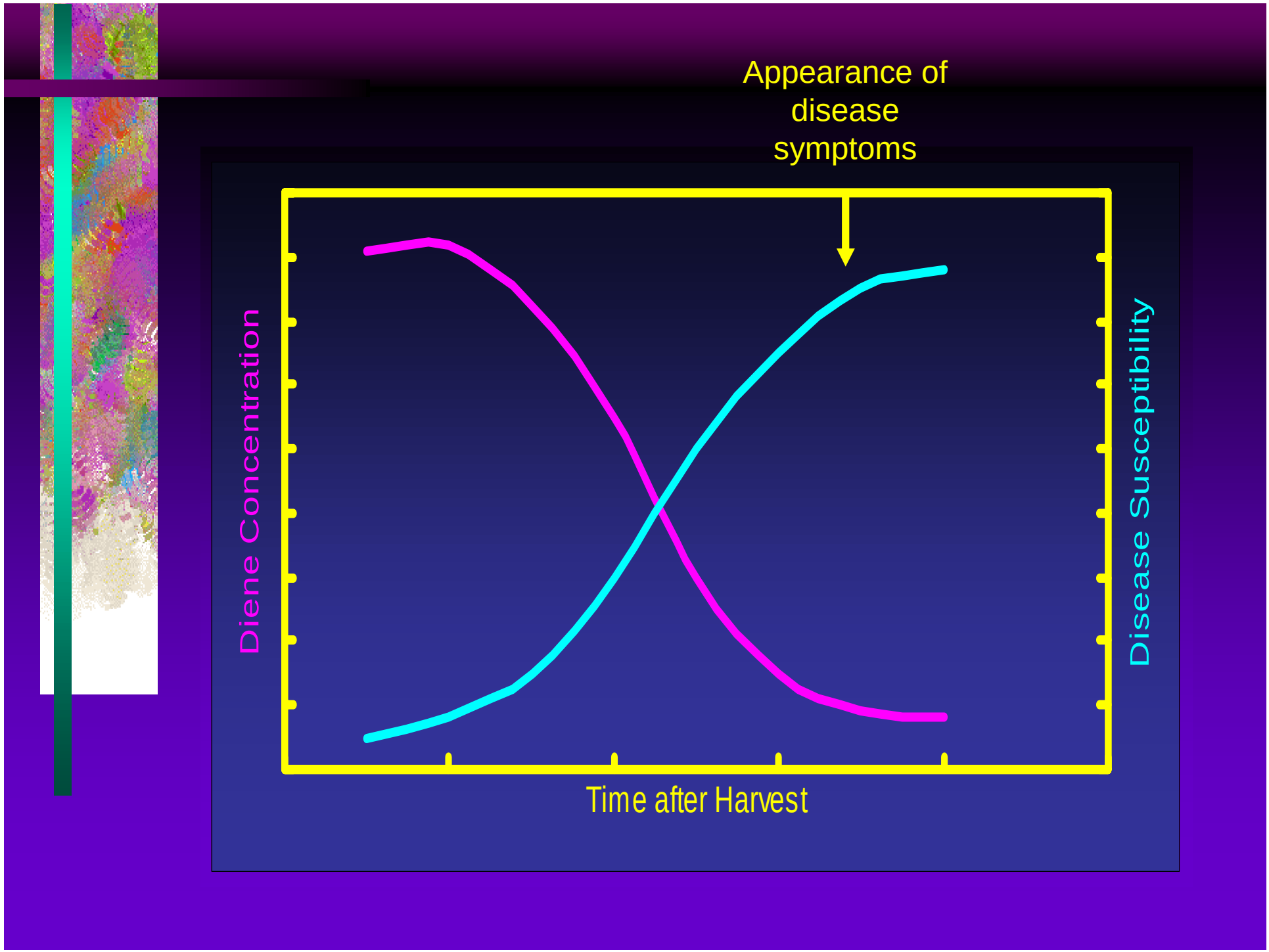
Natural Resistance

- Plants have natural defence mechanisms in place to combat disease
- Plants can defend themselves
  - physically (eg., strengthen cell walls by cross-linking, depositing lignin, callose and suberin)
  - biochemically (eg., phytoalexins, specific antifungal compounds, PR-proteins such as chintinases and beta-1, 3-glucanases)

Defences may be preformed or inducible


Appearance of disease symptoms
Diene Concentration
Disease Susceptibility
Time after Harvest

Systemic Acquired Resistance (SAR)

- induced by a local necrotizing pathogen infection
- long lasting response
- broad spectrum, acts against viruses, bacteria, fungi and nematodes
- resistance is not 100%
- multiple inductions can enhance resistance

SAR Triggered:

- Biologically
  - avirulent strains of the same species
  - different non-pathogenic species
  - plant and microbe extracts
- Chemically
  - salicylic acid (SA)
  - Bion ® /INA/BTH
  - phosphonates
  - Messenger®
- Physically
  - heat shock (eg., 40 sec at 50^{o}C)
  - UV-C light
  - High CO_2
  - rubbing

Benefits of SAR

- residue free
- non-toxic to the environment
- very low risk of pathogen resistance developing
- long-term sustainable control

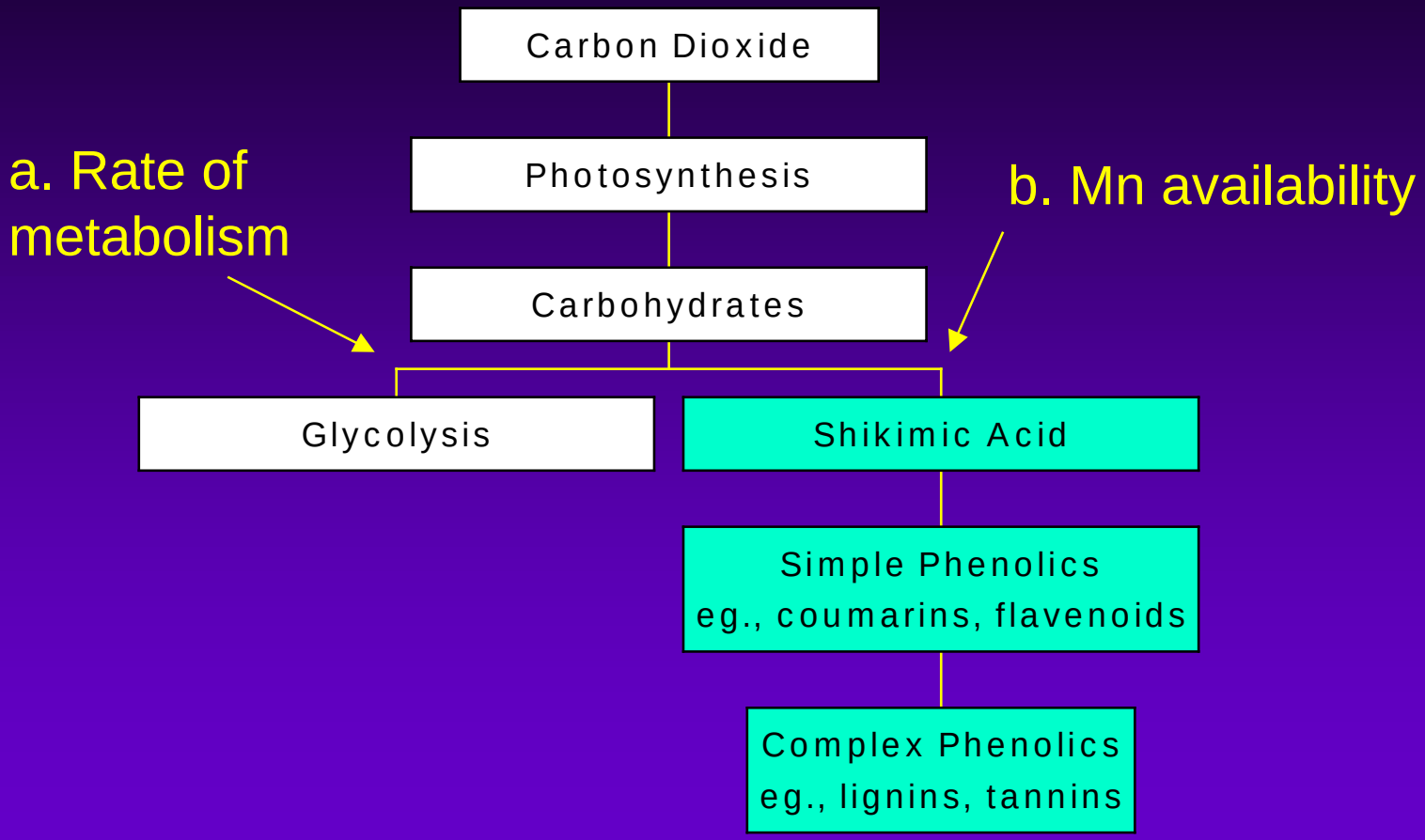
Plant Resistance Depends on:

- Plant part
- Plant age
- Environmental factors eg., temperature, light, moisture
- Cultural factors eg., nutrition, rootstock

Nutrients Can Affect Disease Susceptibility by:

1. Influencing the production of defence compounds via the Shikimic Acid pathway (N, Mn)
    a. directly by altering rate of metabolism
    b. indirectly by altering Mn availability

Defence Products via Shikimic Acid Pathway



Nutrients Can Affect Disease Susceptibility by:

2. Restricting access to cell walls and middle lamella by fungal pectolytic enzymes (Ca)

3. Preventing or delaying ‘attack’ signal to fungus (Ca)

4. Inhibiting fungal enzymes (Mn)

‘Duke 6’ ‘Velvick’

Rootstock Effects - Young 'Hass' Trees

Rootstock	Shelf life(d)	% Anthracnose		% Mark.
		sev.	inc.	fruit
Velvick	7.0[a]	7.7[b]	61.9[b]	66.1[a]
Duke 6	6.7[b]	41.8[a]	93.2[a]	13.6[b]

Rootstock Effects - Older 'Hass' Trees

Rootstock	Shelf life(d)	% Anthracnose sev.	% Anthracnose inc.	% Mark. fruit
Velvick	9.1[a]	15.6[b]	50.0[b]	64.5[a]
Duke 6	8.9[a]	39.5[a]	77.0[a]	33.6[b]

Rootstock Effects - Young 'Hass' Trees

Rootstock	Diene (mg/g FW leaf)
Velvick	2.45[a]
Duke 6	1.74[b]

Rootstock Effects - Older 'Hass' Trees

Rootstock	Diene (mg/g FW leaf)
Velvick	3.30[a]
Duke 6	2.57[b]

Rootstock Effects - Nursery Stock Trees

Rootstock	Diene (mg/g FW leaf)
Velvick	1.01[a]
Duke 6	0.08[b]

Rootstock Effects - Young 'Hass' Trees

Rootstock	N (% DW)	N/Ca ratio
Velvick	2.3[b]	0.9[b]
Duke 6	2.5[a]	1.1[a]

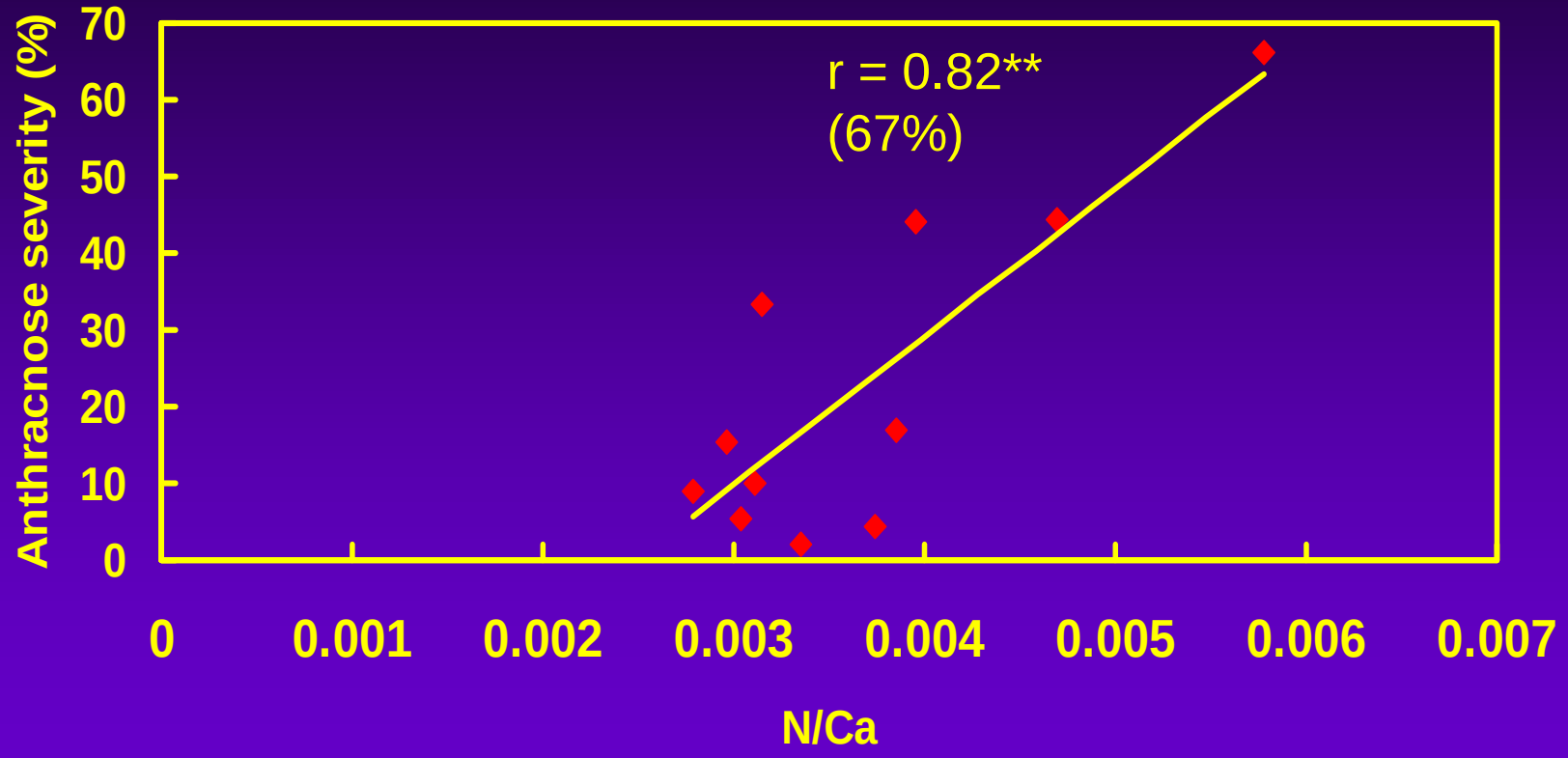
Rootstock x Nitrogen Study

‘Hass’ trees on ‘Duke 6’ and ‘Velvick’ rootstocks were treated with 3 different nitrogen fertiliser levels:

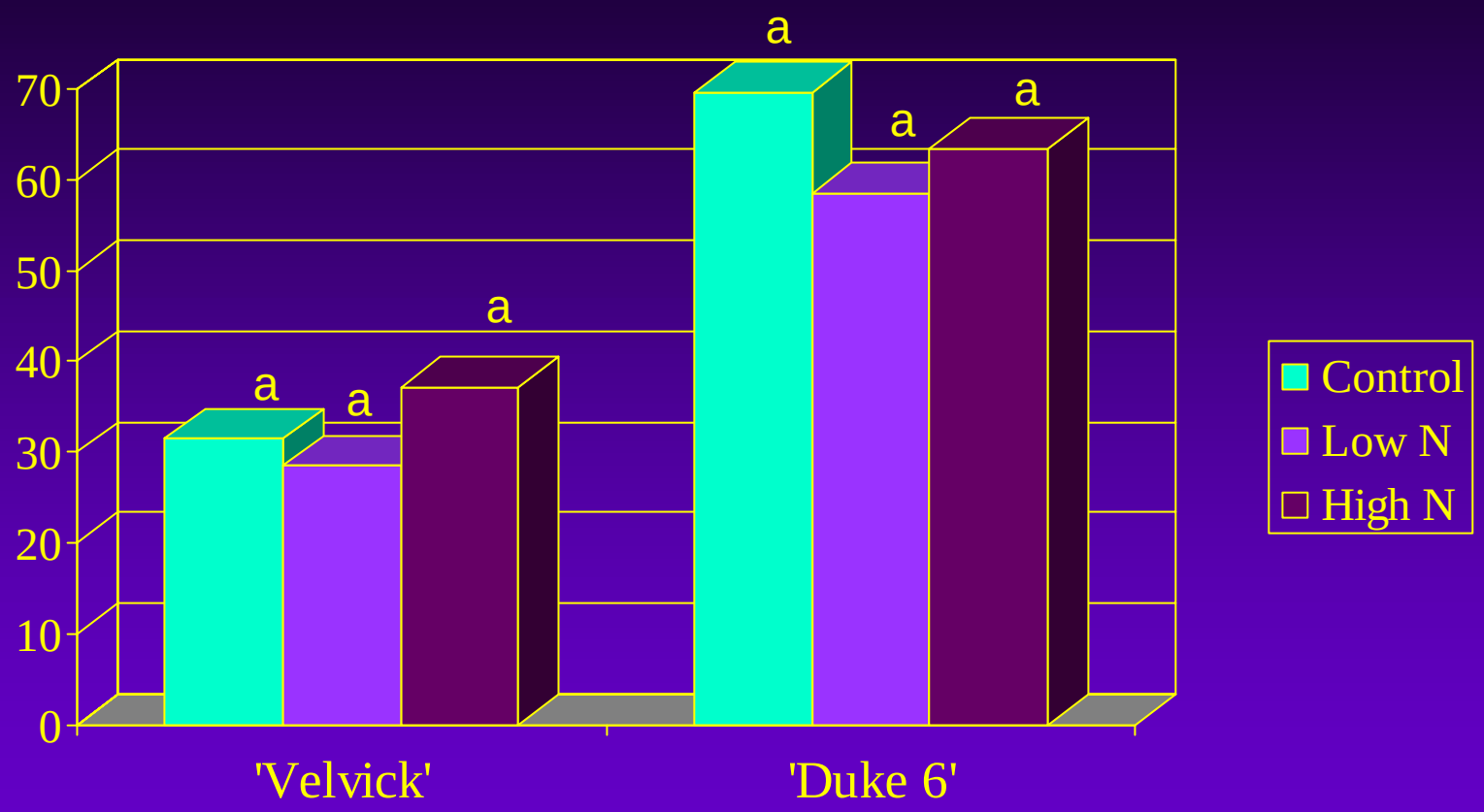
1. Control - standard rate (133 g NH^{4+}-N/tree/month)
2. Low N - no nitrogen fertiliser applied
3. High N - double rate (266 g NH^{4+}-N/tree/month)

Applied from flowering until harvest

Rootstock Effects - Young 'Hass' Trees



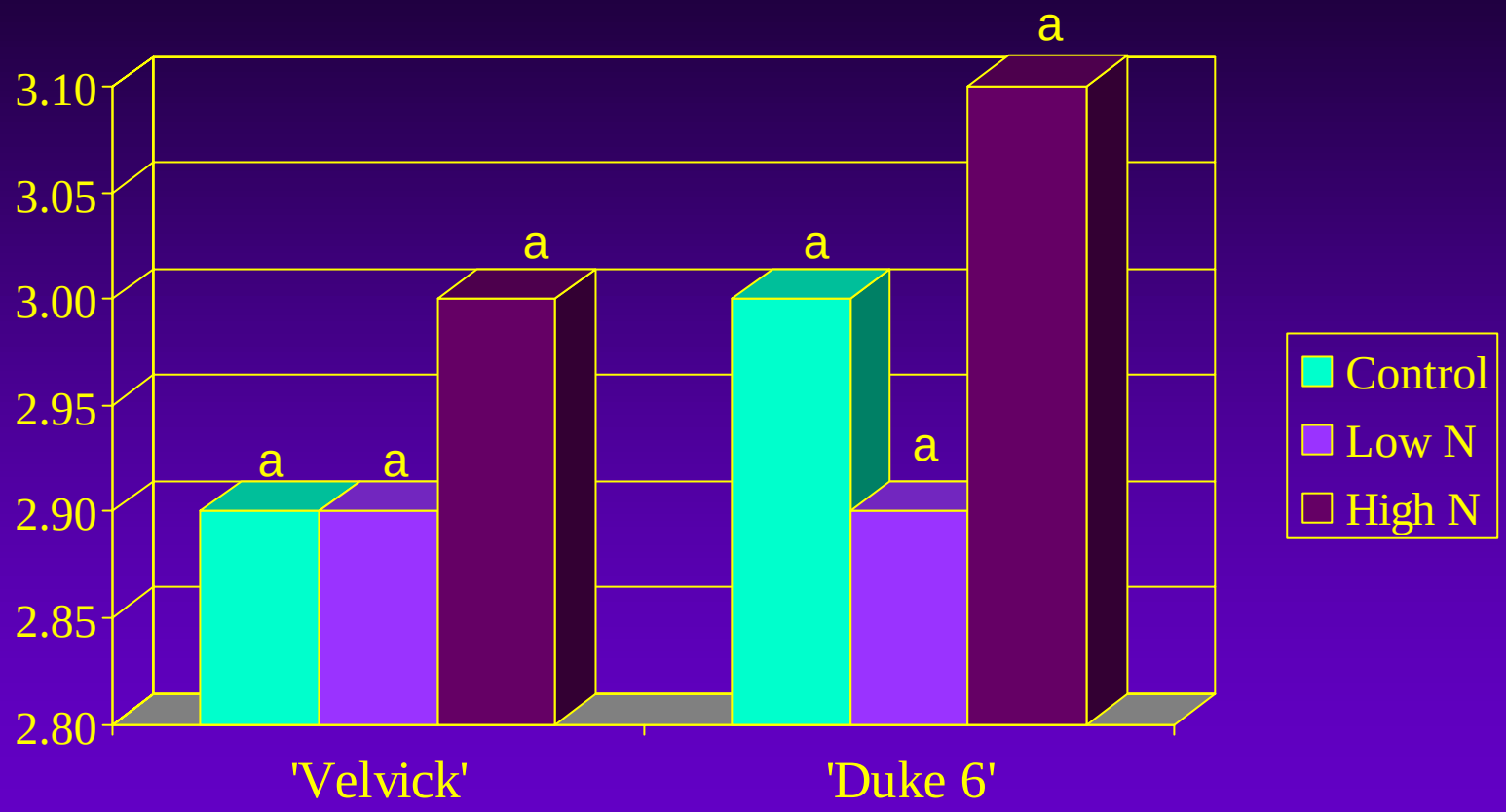
Anthracnose Severity (%)



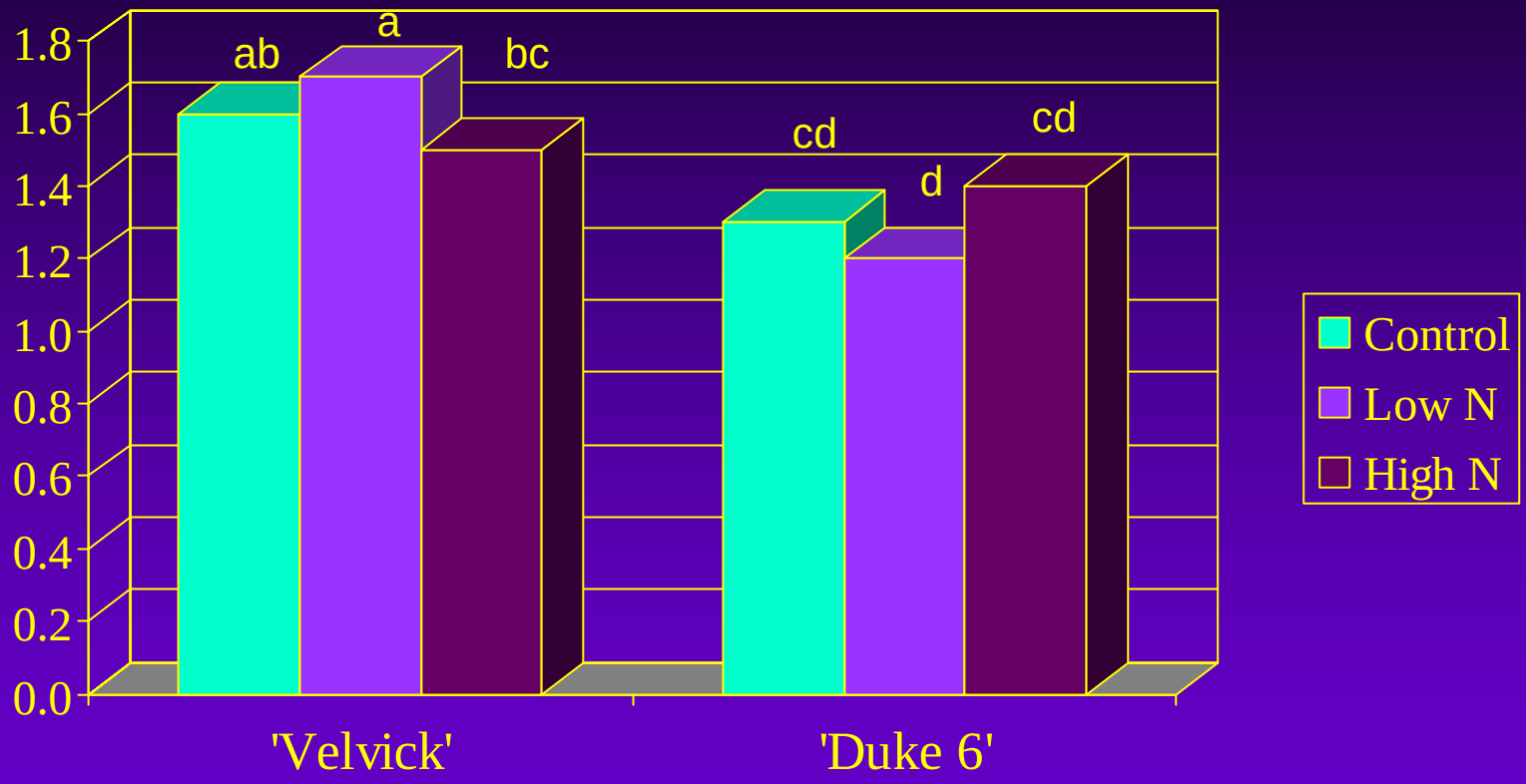
Rootstock Effects

Rootstock	Shelf life (d)	% Anthracnose sev.	% Anthracnose inc.	% Mark. fruit
Velvick	9.3[a]	32.4[b]	64.0[b]	46.9[a]
Duke 6	8.7[b]	63.9[a]	90.0[a]	16.4[b]

Leaf N Concentration ($\%_{DW}$)



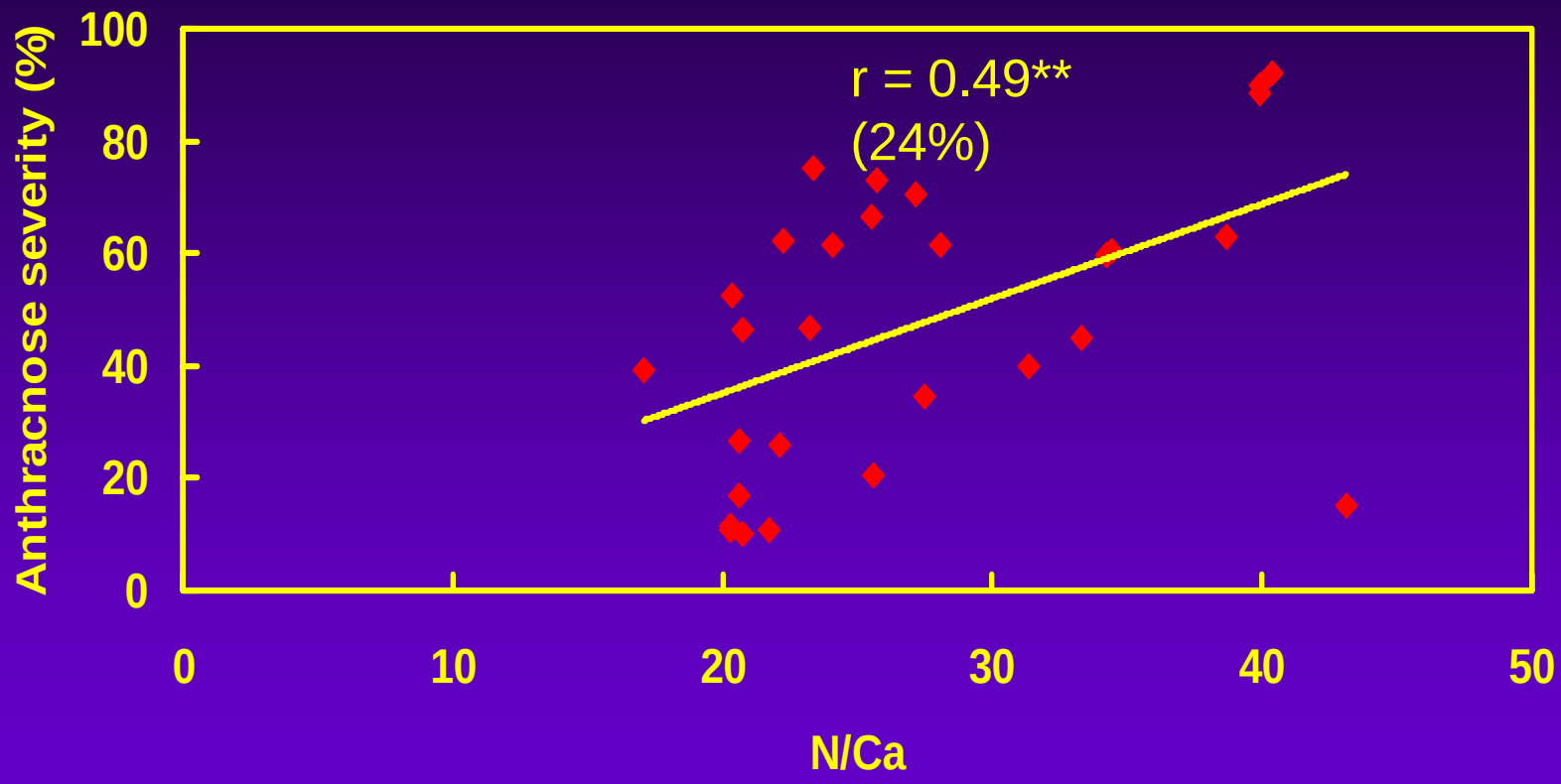
Leaf Ca Concentration ($\%_{DW}$)



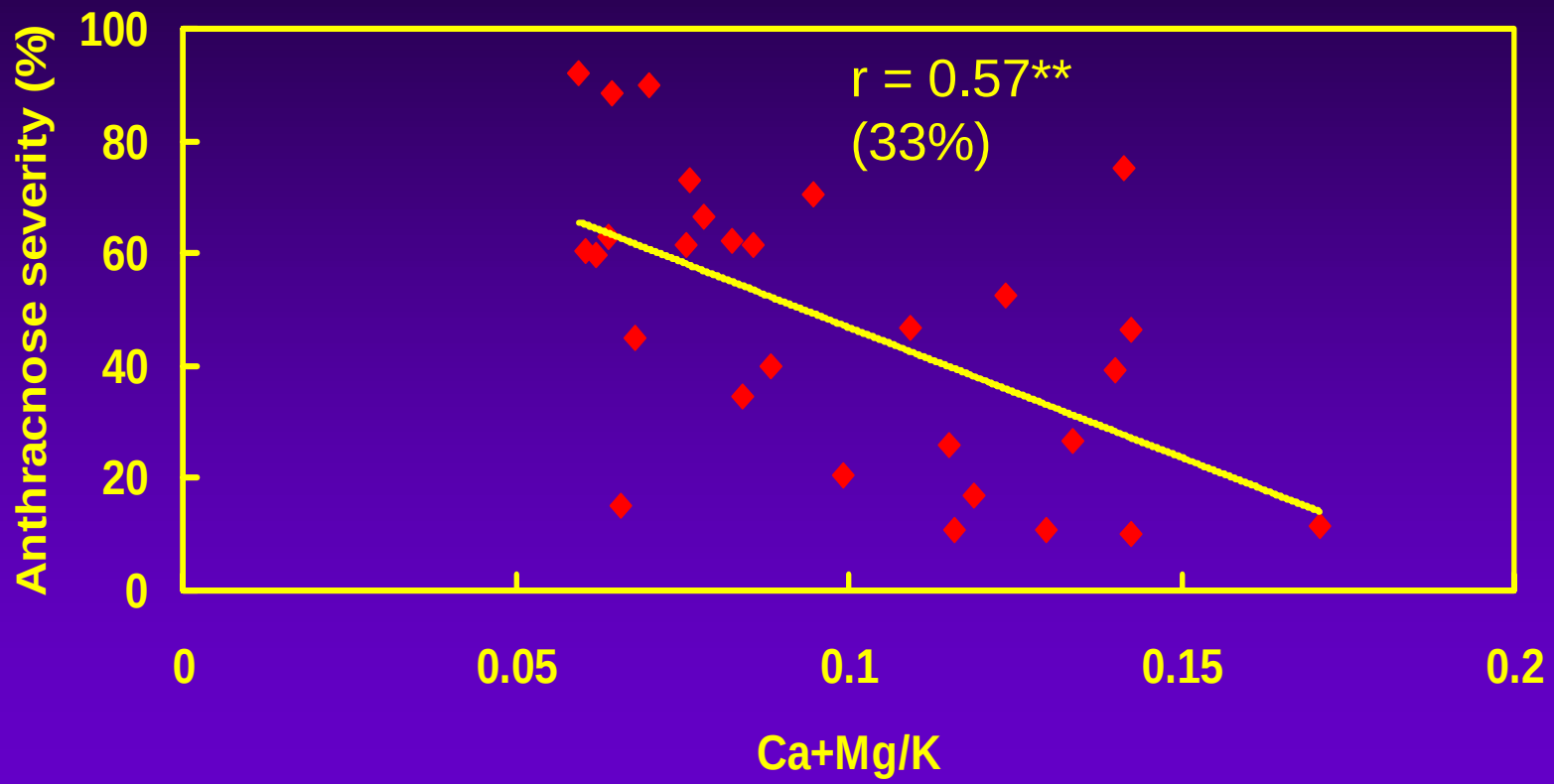
Rootstock Effects on Leaf Minerals ($\%_{DW}$)

Rootstock	N	Ca	Mg	K
Velvick	2.9^{b}	1.6^{a}	0.4^{a}	0.5^{b}
Duke 6	3.0^{a}	1.3^{b}	0.3^{b}	0.7^{a}

Rootstock Effects



Rootstock Effects



Conclusions

- Rootstock influences postharvest anthracnose susceptibility by influencing the accumulation of mineral nutrients and antifungal diene compounds in the scion tissue.
- Rootstock discovery will provide a new long-term sustainable disease control strategy that is less reliant on chemical control.

Future Research

- Assess nitrogen effect after two consecutive seasons of fertiliser applications.
- Evaluate the effect of N form (ie. ammonium vs nitrate) on anthracnose susceptibility, mineral nutrient and diene accumulation.
- Evaluate foliar applications of plant activators (eg., Bion®, Messenger®) to boost antifungals.

Acknowledgments

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