

Effect of reciprocal grafting on growth and development of two contrasting potato cultivars differing in nitrogen efficiency

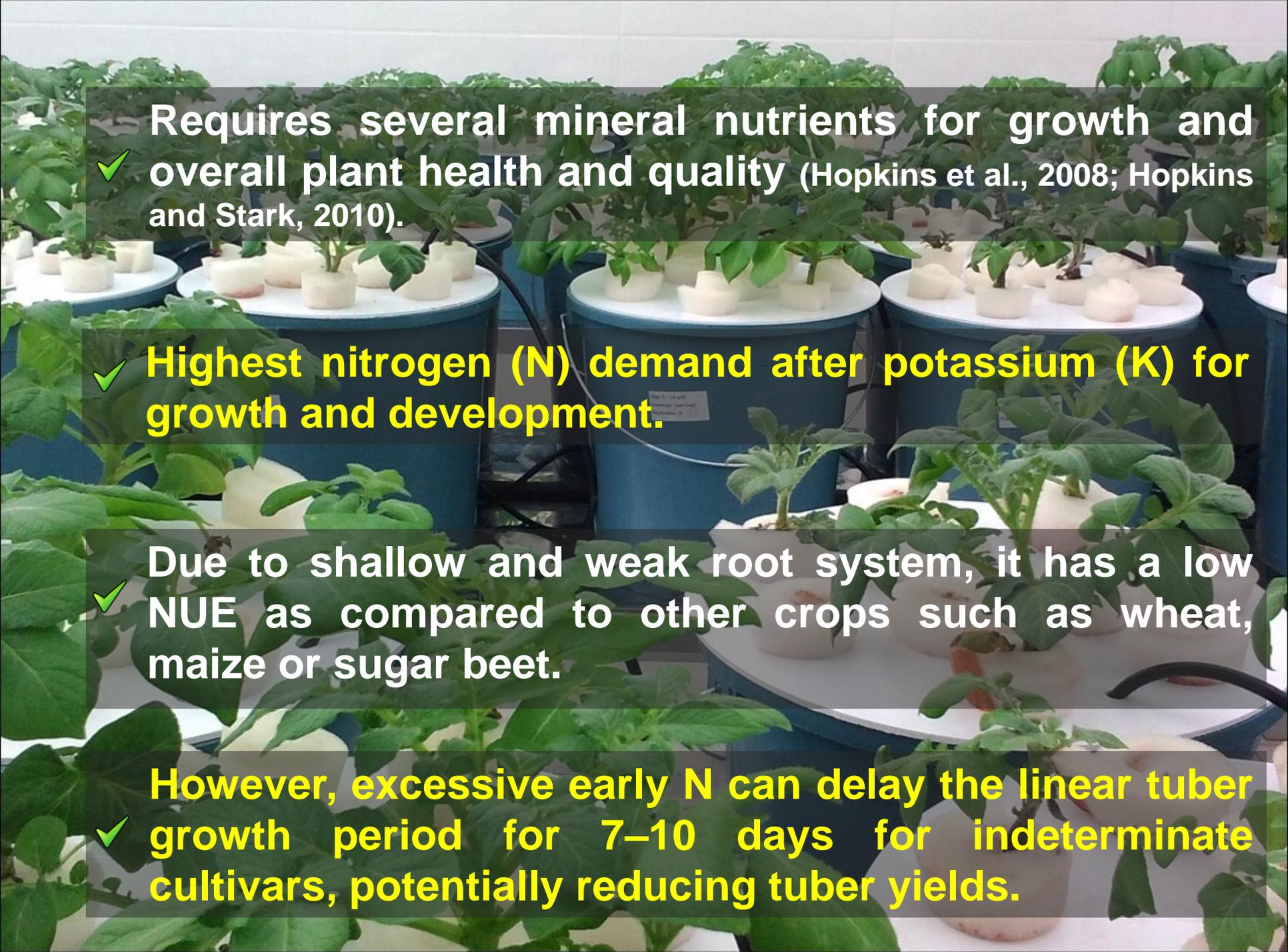
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Introduction

- Solanaceae family
- 1st cultivated potatoes from central Andes of Peru and Bolivia 6000 - 10000 years ago
- Most commonly grown root crop, provides the primary source of calories from starch in many developing countries
- One of six major crops providing 80% of human caloric intake worldwide
- 4th crop in production worldwide after wheat, rice and maize



✓ Requires several mineral nutrients for growth and overall plant health and quality (Hopkins et al., 2008; Hopkins and Stark, 2010).

✓ Highest nitrogen (N) demand after potassium (K) for growth and development.

✓ Due to shallow and weak root system, it has a low NUE as compared to other crops such as wheat, maize or sugar beet.

✓ However, excessive early N can delay the linear tuber growth period for 7–10 days for indeterminate cultivars, potentially reducing tuber yields.

History of Grafting

- Grafting in vegetables was initiated in Japan and Korea in the late 1920s with watermelon grafted onto bottle gourd for control of *Fusarium* wilt (Ashita, 1927).
- At present, grafting is used in
 - watermelon
 - tomato
 - eggplant
 - melon
 - cucumber
 - pepper



Why Grafting?

✓ Improvement of water use efficiency (Cohen and Naor, 2002)

✓ Increase in yield and fruit development (Lee, 1994)

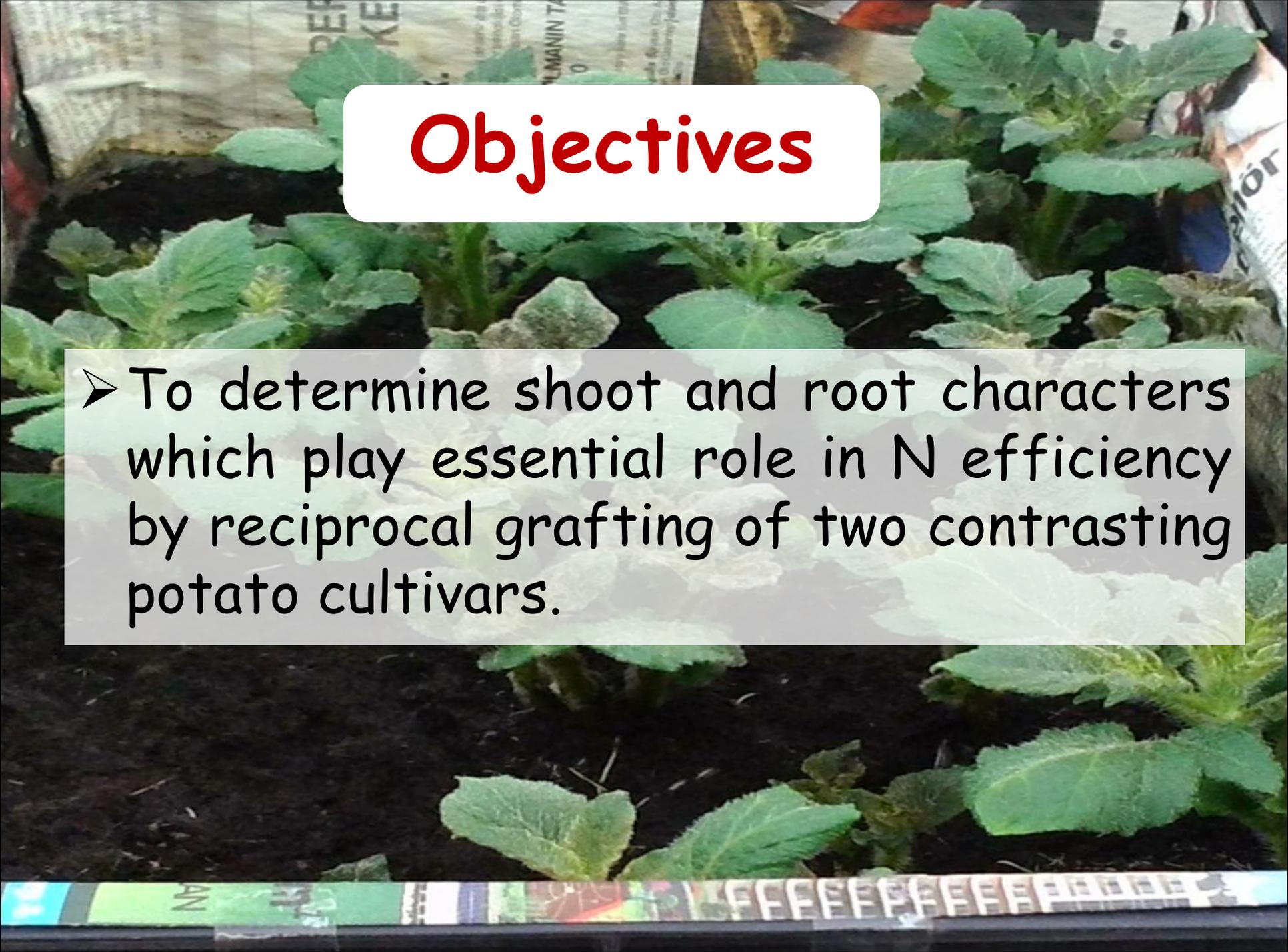
✓ Higher leaf water potential and leaf stomatal conductance (Weng, 2000)

✓ Strong, vigorous root system (Leoni et al., 1990)

✓ Enhancement of drought tolerance (Estan et al., 1995)

✓ Higher root length and root hairs (White, 1963)

✓ Increase in water and mineral uptake (Bersi, 2002)

The background of the slide is a photograph of potato plants growing in a field. The plants are green and appear to be in the early stages of growth. The soil is dark and rich. In the background, there are some bags of fertilizer or soil, with some text visible, including "PE", "KE", "UMANIN TA", and "0". A white text box with rounded corners is centered in the upper part of the image, containing the word "Objectives" in red. A semi-transparent grey box is overlaid on the lower part of the image, containing a bullet point in black text.

Objectives

- To determine shoot and root characters which play essential role in N efficiency by reciprocal grafting of two contrasting potato cultivars.

Materials and Methods

- **Controlled climate chamber pot experiment (August, 2014)**
 - **8 L pots with continuously aerated nutrient solution**
- **Experimental Design**
 - **Completely Randomized Block Design (CRBD)**
- **Replication**
 - **Three replication (two plants per pot)**



- **2 Potato (*S. tuberosum*) Cultivars**
 - **Agria (N-inefficient)**
 - **Van Gogh (N-efficient)**



- **Reciprocal Grafting**
 - **Agria/ Van Gogh**
 - **Van Gogh/ Agria**

- **2 Nitrogen Doses**
 - **High N (3.0 mM N)**
 - **Low N (0.5 mM N)**



- **Each week renovale of nutrient solution**

- **Measurements during the experiment**

- Weekly photosynthesis

- Weekly leaf chlorophyll (SPAD) content



- **Measurements at final harvest**

- Leaf area (cm²/plant),

- Stem length (cm/ plant),

- Shoot fresh and dry weight (g/plant),

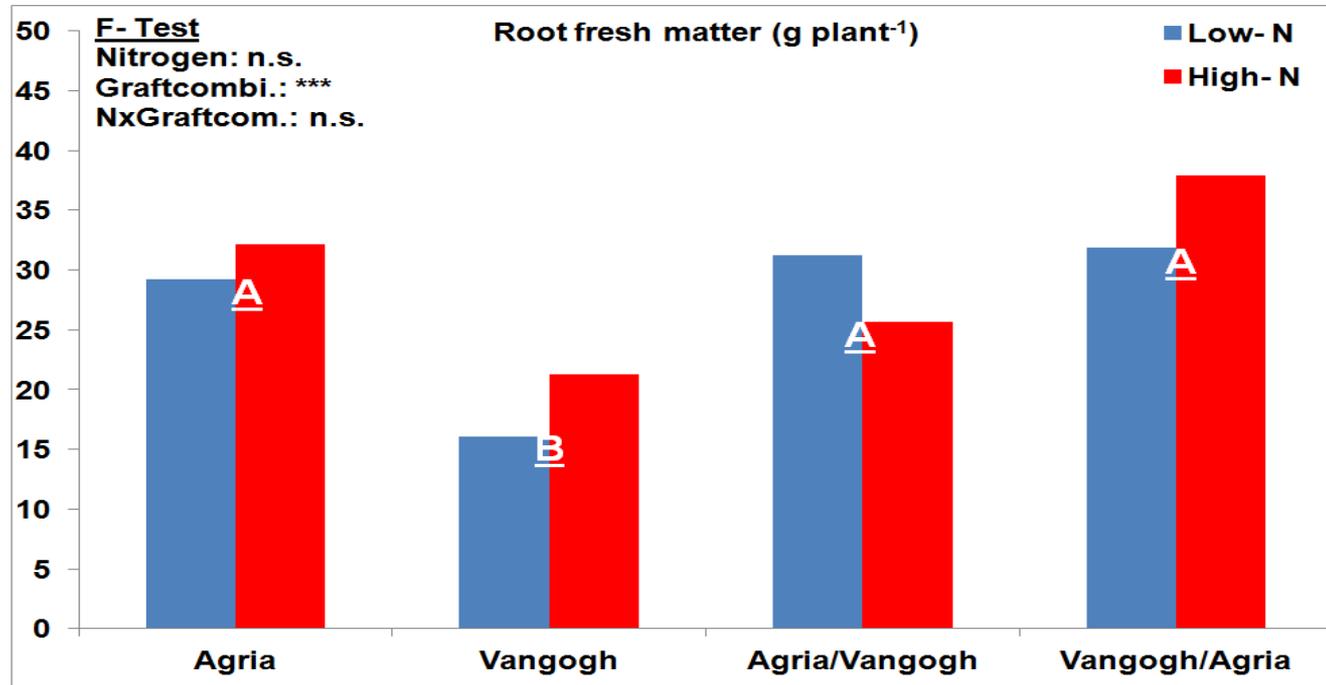
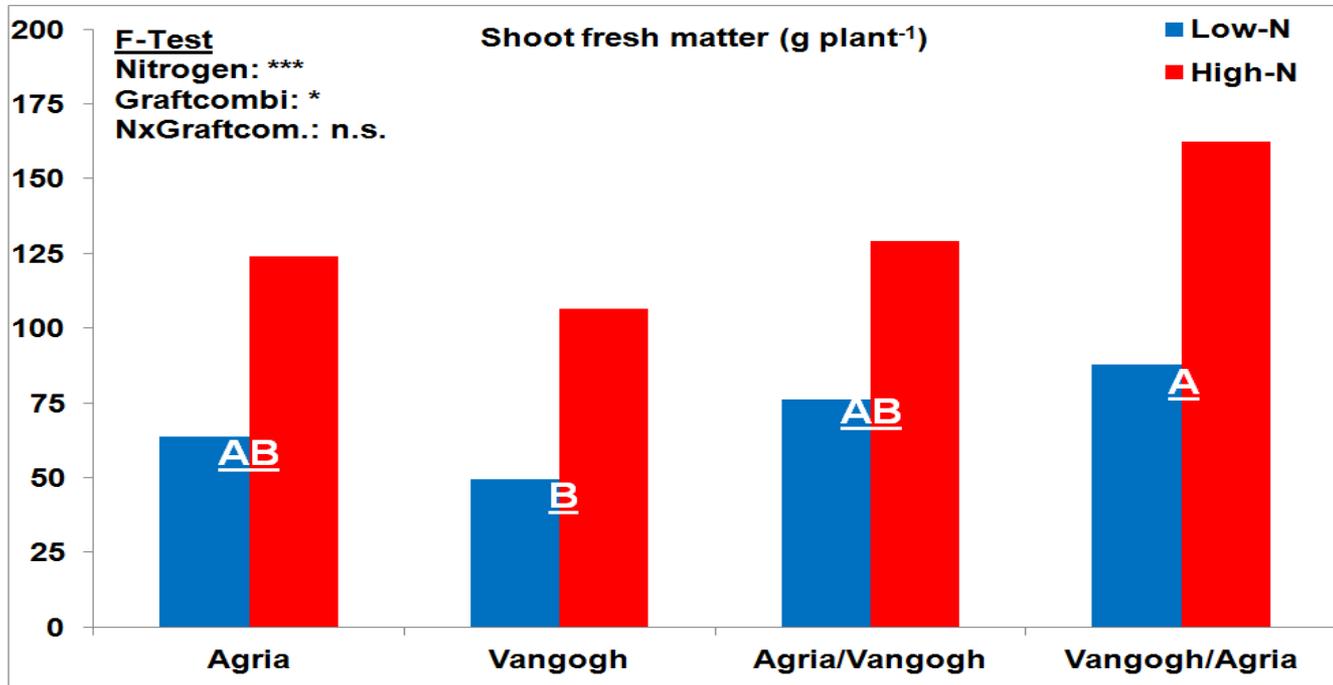


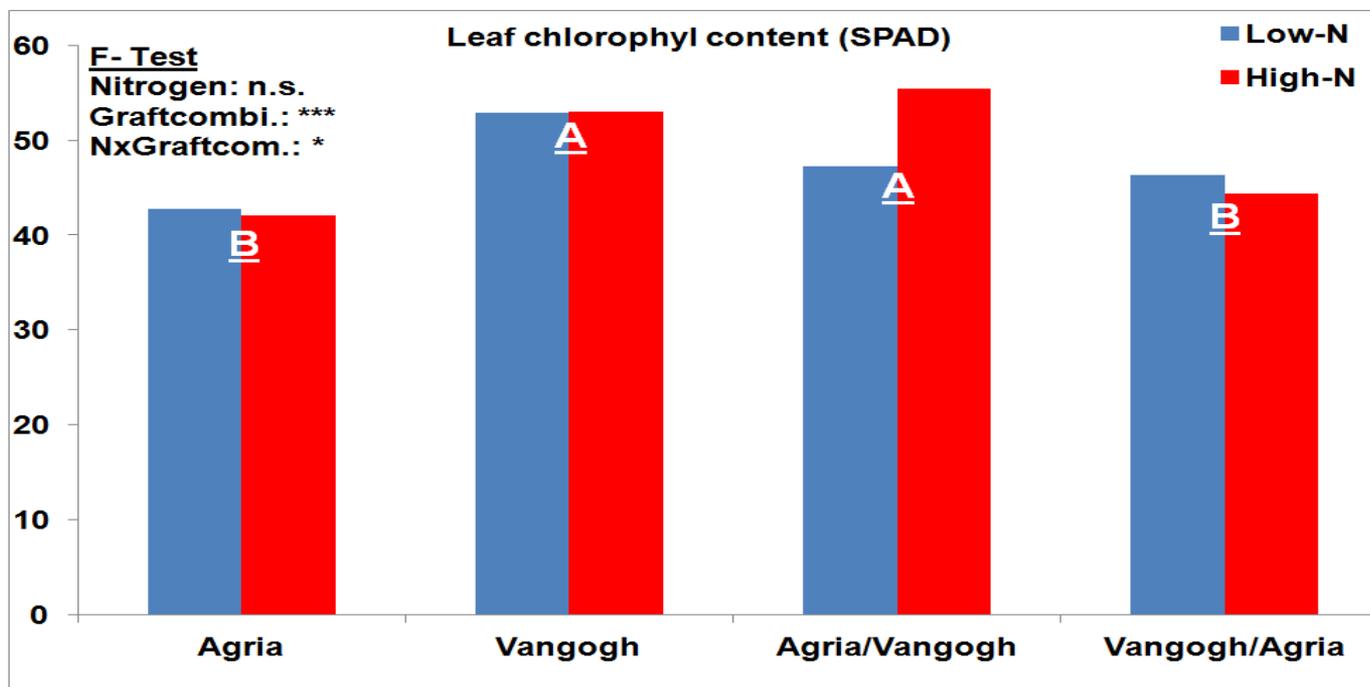
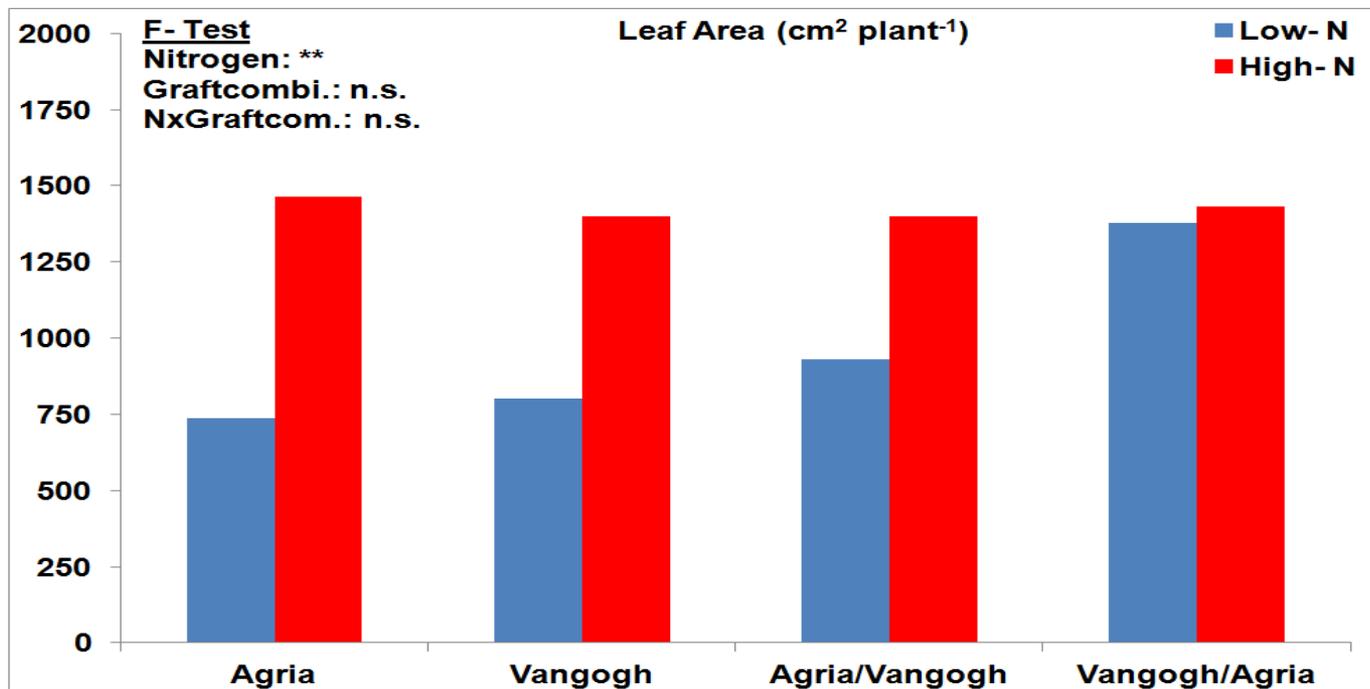
□ Total root fresh and dry weight (g/plant),

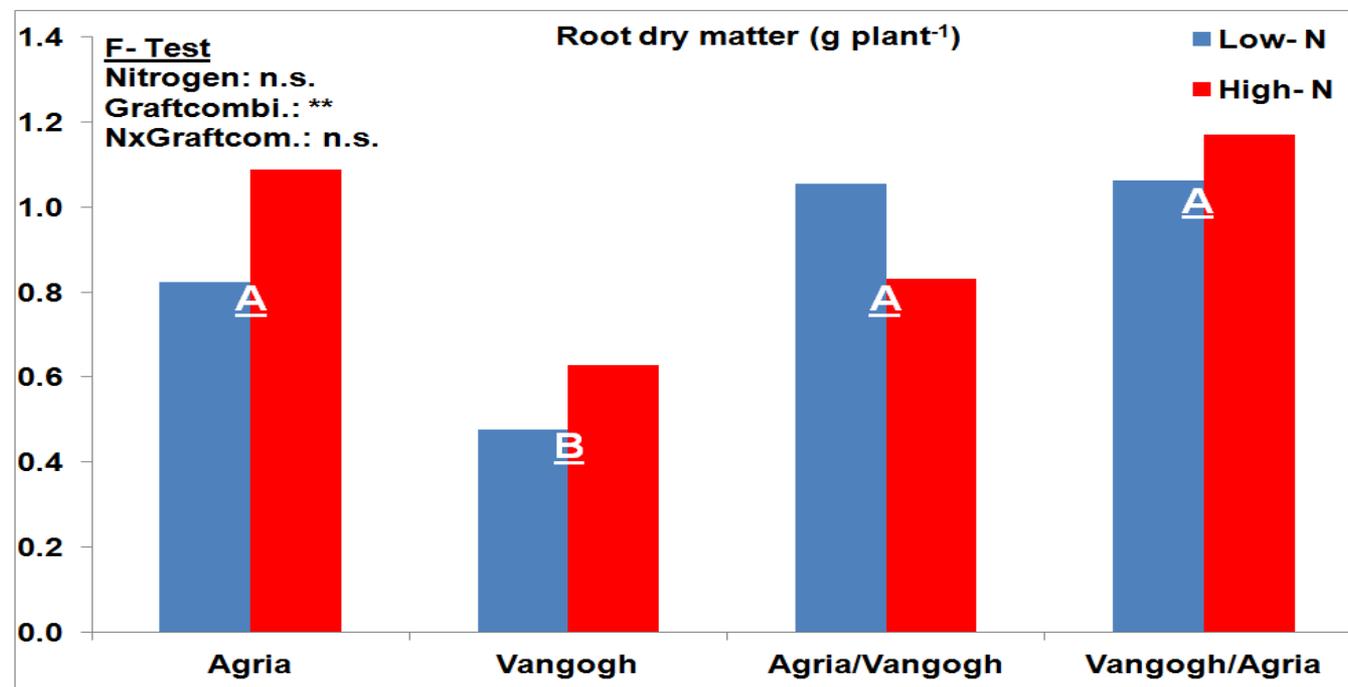
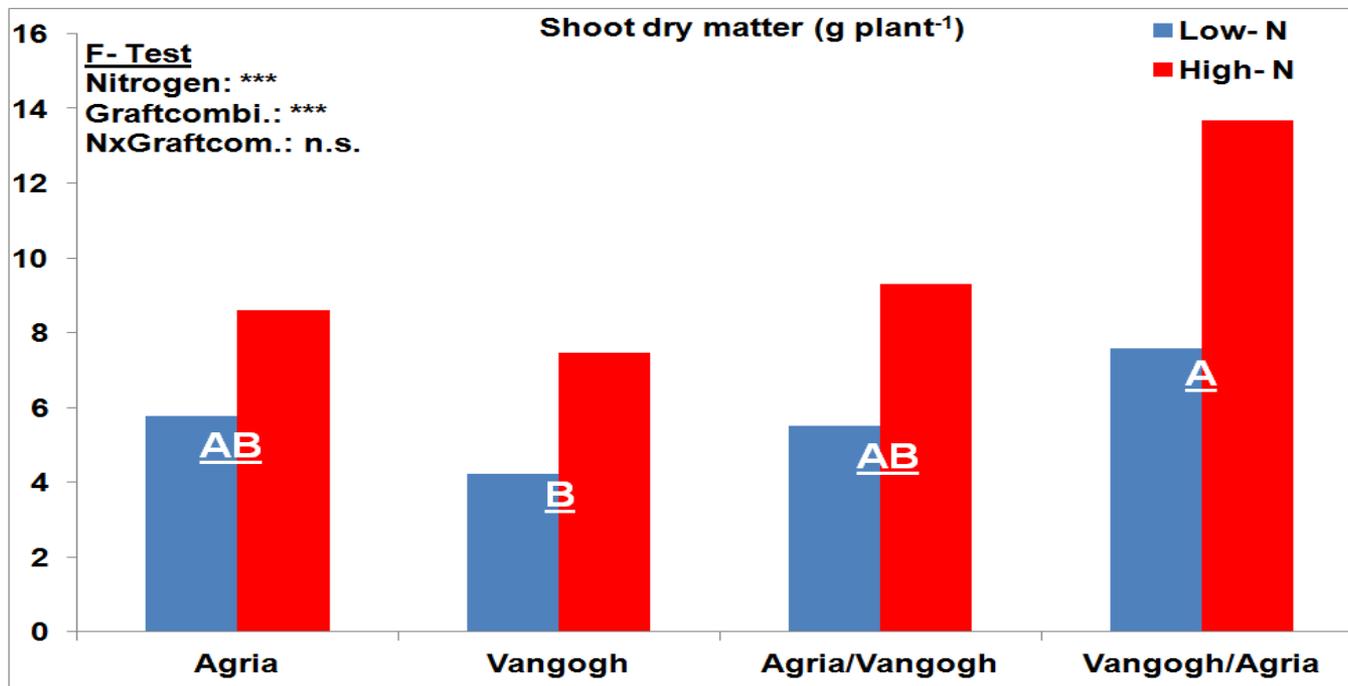
□ Total root length (m/plant).

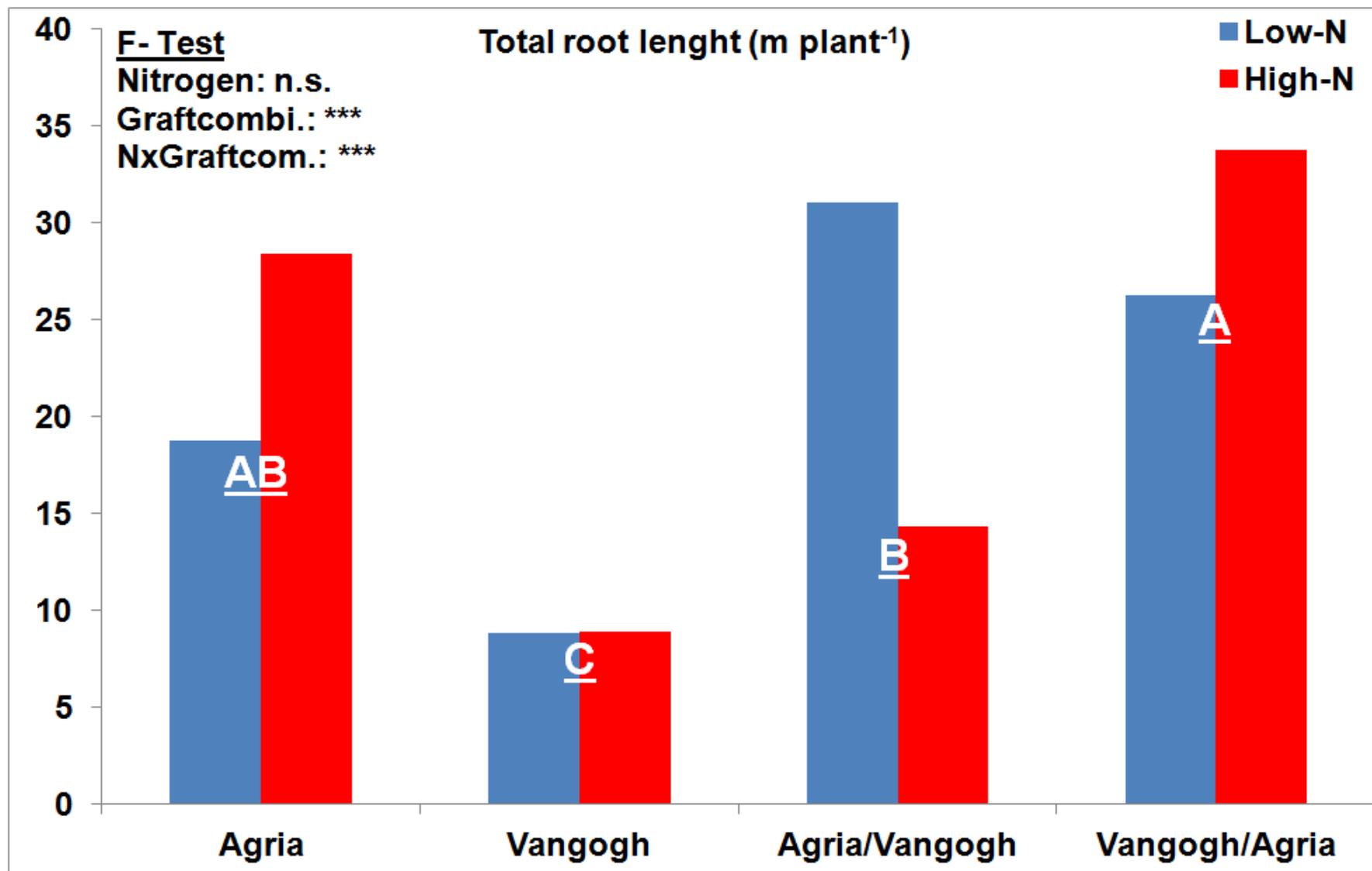


Results



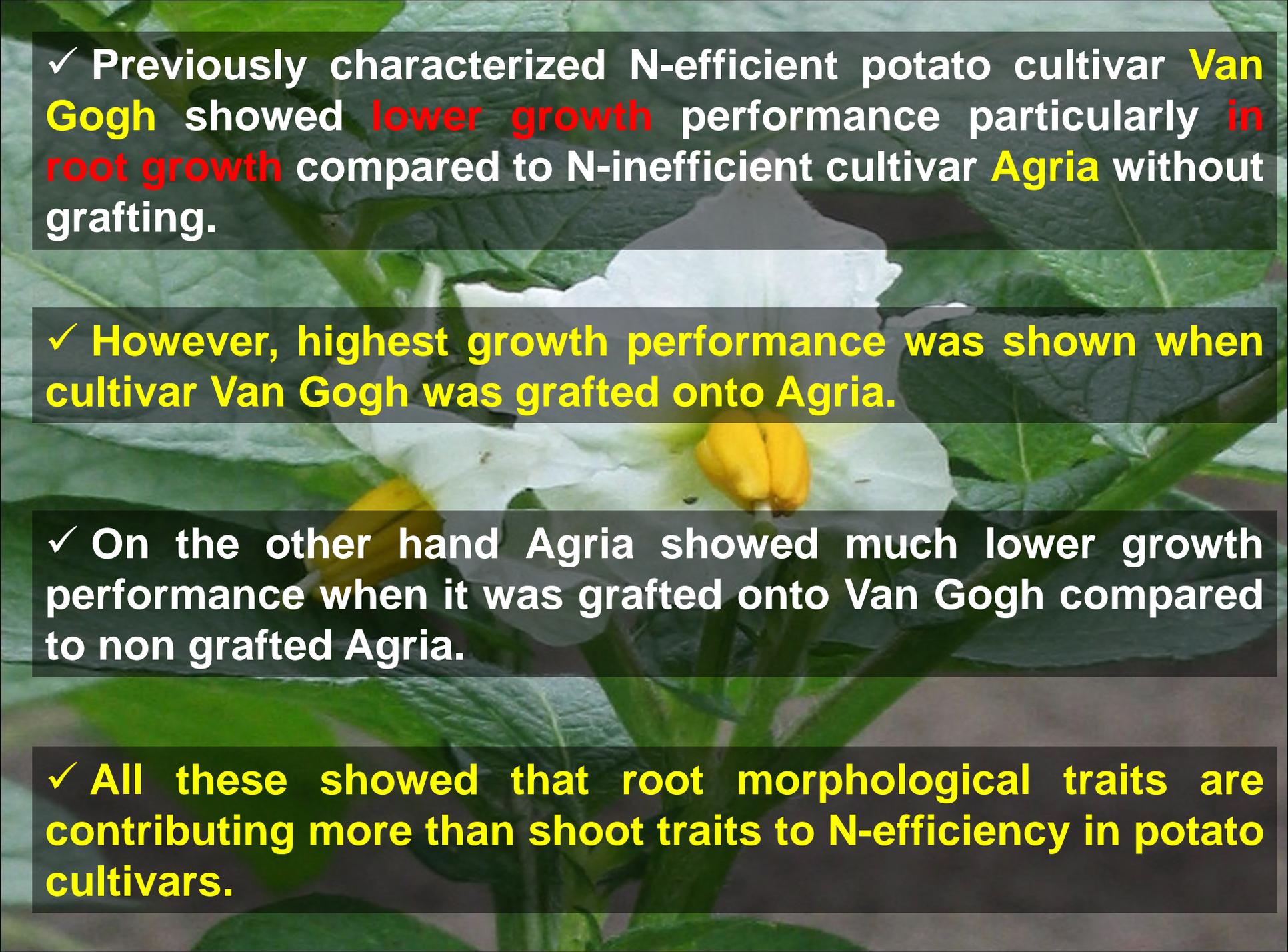






Conclusions

- ✓ Significant differences were found between N rates in shoot growth (**shoot fresh and dry matter, leaf area**), **however** not in root growth (**fresh and dry matter**) of reciprocal grafted plants.
- ✓ Cultivars and graft combinations differed **significantly** in **shoot** and **root growth** and **leaf chlorophyll (SPAD)** content.
- ✓ However, **except root length and chlorophyll (SPAD)** content **no cultivar x nitrogen interaction** was found in other parameters.



✓ Previously characterized N-efficient potato cultivar **Van Gogh** showed **lower growth** performance particularly in **root growth** compared to N-inefficient cultivar **Agria** without grafting.

✓ However, highest growth performance was shown when cultivar **Van Gogh** was grafted onto **Agria**.

✓ On the other hand **Agria** showed much lower growth performance when it was grafted onto **Van Gogh** compared to non grafted **Agria**.

✓ All these showed that root morphological traits are contributing more than shoot traits to N-efficiency in potato cultivars.



Thank you for your attention