



Effects of annual potassium dosage on the yield and quality of *Coffea robusta* in Vietnam

Hawassa, Ethiopia, 25 November 2015

Agricultural production in Vietnam

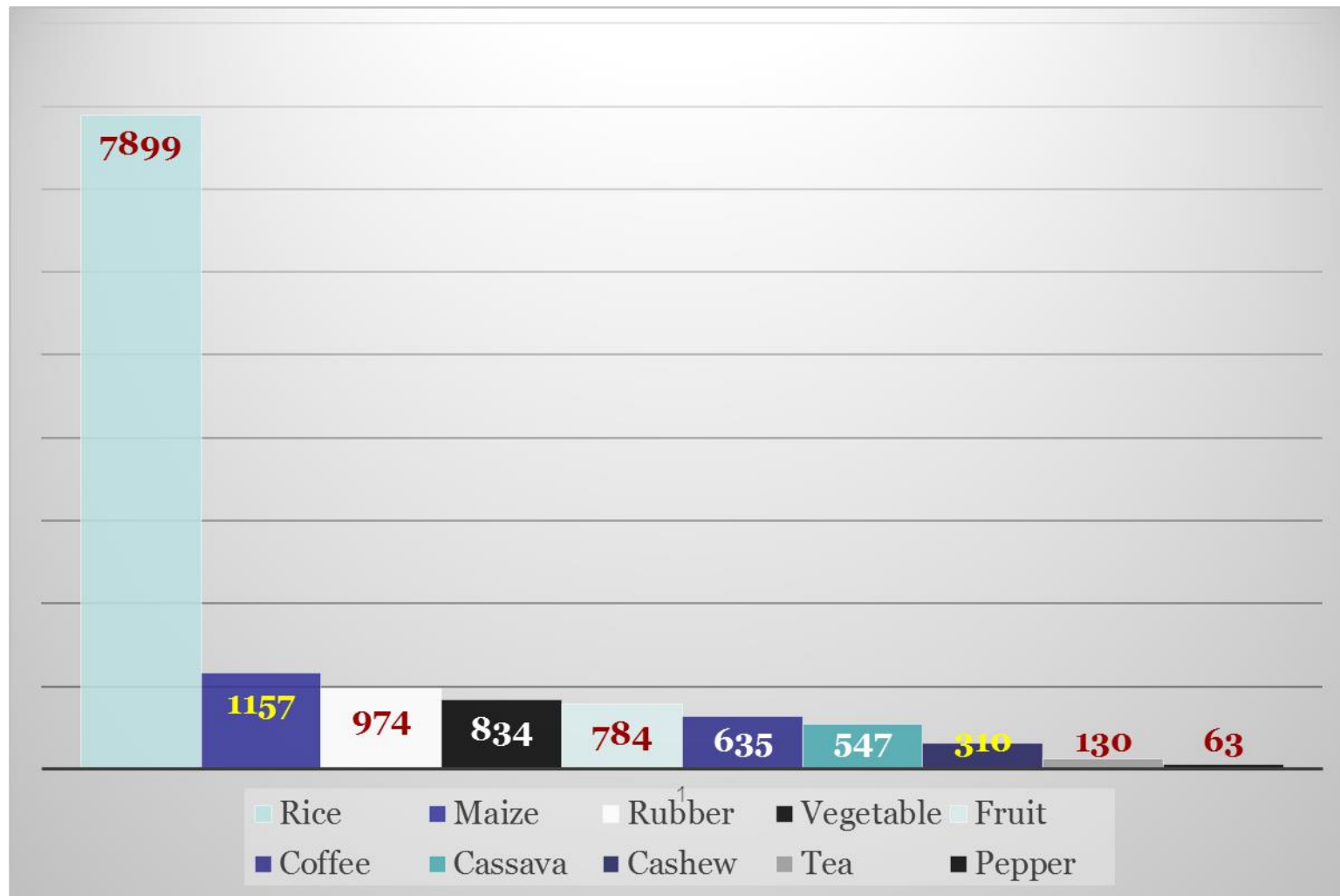


Vietnam agriculture-facts



- Total areas: 331,698 km²
- Population: 90.5 mil
- Agriculture-based economy, though agriculture share in GDP is only 22%
- More than 70% of population engaged in agriculture
- Dominant area under food crops
- Agriculture is a very open sector/the big share of key products are for export

Planted area of main crops, 2013



MARD, 2014

Crops production and export, 2013

Crops	Production, 1000 tons	Export, 1000 tons	% Export
Milled Rice	28,649	6,653	23.2
Coffee	1,322	1,308	98.9
Rubber	935	1,090	116.6
Tea	187	142	75.9
Cashew	285	264	92.6
Pepper	123	134	108.9
Cassava	9,740	3,142	32.2

MARD, 2014

Agricultural products export in 2014

- Wood and timber products: 6.54 (US\$ billion)
- Shrimp: 4.00
- **Coffee: 3.60**
- Rice: 3.00
- Cashew nuts: 2.00
- Catfish: 1.80
- Rubber: 1.80
- Vegetables and fruits: 1.47
- Pepper: 1.20
- Cassava: 1.12

Coffee production in Vietnam



Vietnamese coffee landmarks

- **1857:** Coffee trees first introduced to Vietnam
- **1900:** Area about **2,000** ha
- **1977:** 120 years after introduction, area reached **20,000** ha
- **1981:** First year of coffee exports with 68,700 tons
- **1987:** Area reached **100,000** ha
- **1999:** Area reached around **500,000** ha
- **2008:** Production reached 1,000,000 tons; the export value reaching US\$ 2 Billion
- **2010:** Vietnam Arabica plants its way into the future
- **2013:** **635,000** ha

Coffee yield

- **In 1940s:**
 - Arabica 400-500 kg of green bean/ha
 - Robusta: 500-600 kg/ha
- **To date:**
 - Arabica 1,800 kg of green bean/ha
 - Robusta: 2,300-2,500 kg of green bean/ha (world leading), some may get up to 4,000-4,500 kg/ha (from those of new variety robusta farms).

Coffee production

- Types of coffee producers
 - 80% of production is from small farms of 0.5-2.0 ha and 20% is from state farms and large scale farms
- Labor force involved in coffee sector
 - More than 1 mil. jobs for farmers in Central Highlands
- Production costs
 - Total cost: 4,000-4,500 USD/ha (yield of 3 tons/ha)
 - Labors, fertilizers, pesticides, gasoline and other costs
 - Main cost: Labors (55-60%), fertilizers (25-30%)

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Introduction

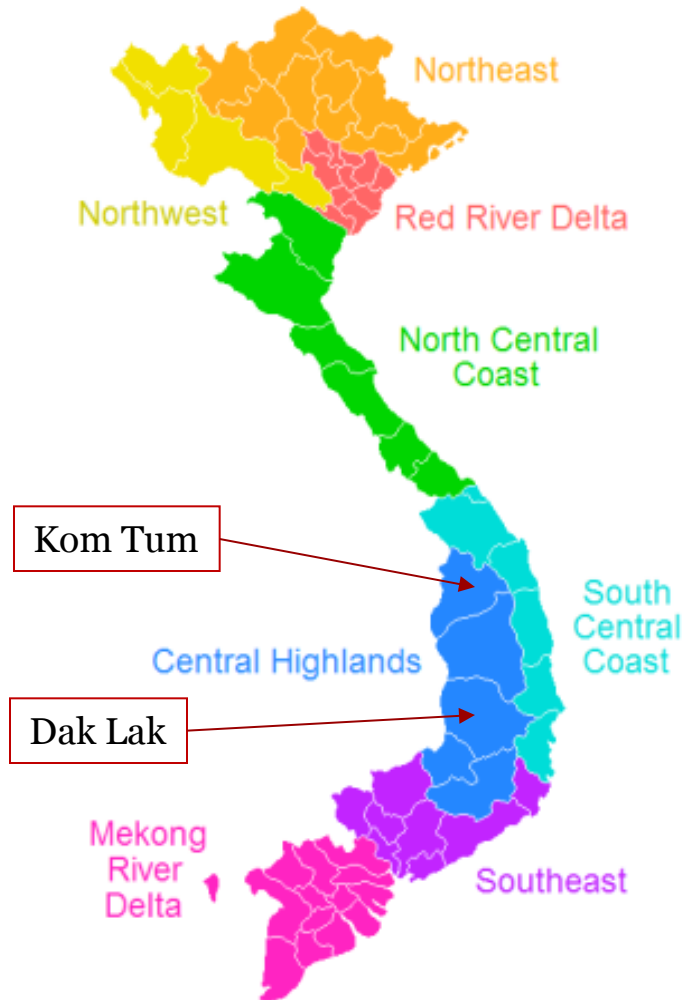
- Coffee is a major economic engine for the local developing agricultural sector
- Coffee displays high demands for fertilizer:
 - 30-35 kg N + 5.2-6.0 kg P₂O₅ + 36.5-50.0 kg K₂O for 1 ton coffee bean
 - A hectare of high producing coffee: 135 kg N, 34 kg P₂O₅ and 145 kg K₂O
- In Vietnam:
 - 200-240 kg N + 75-90 kg P₂O₅ + 250-260 kg K₂O (basaltic soil)
 - 200-230 kg N + 130-150 kg P₂O₅ + 125-180 kg K₂O (gneiss soil)
 - High coffee bean yield applied 400-500 kg K₂O per hectare
- **What is the optimum K application dosage for commercial Robusta coffee in Central Highland of Vietnam?**

Materials and methods

Experiments were carried out during 3 consecutive years (2012-2014) in two sites:

1. Quang Phu town, CuMgar district, Dak Lak province (12°49.5N; 108°5.3E, elevation: 480m) – **basaltic soil**

2. Dak Ha town, Dak Ha district, Kom Tum province (14°30.3N; 107°54.9E, elevation: 600m) – **granite soil**



Location	Cu Mgar, Dak Lak	Dak Ha, Kon Tum
Rainfall (mm/year)	1,800	1,600
Rainy season	May to October	April to December
Soil type	Rhodic Ferralsols	Ferralic Acrisols
pH KCl	4.5 - 5.5	3.5 - 4.5
OM (%)	3.0 - 4.0	2.0 - 3.0
N (%)	0.15 - 0.2	0.1 - 0.15
P ₂ O ₅ (%)	0.20 - 0.25	0.05 - 0.10
K ₂ O (%)	0.04 - 0.08	0.03 - 0.07
Texture	Light clay	Sandy

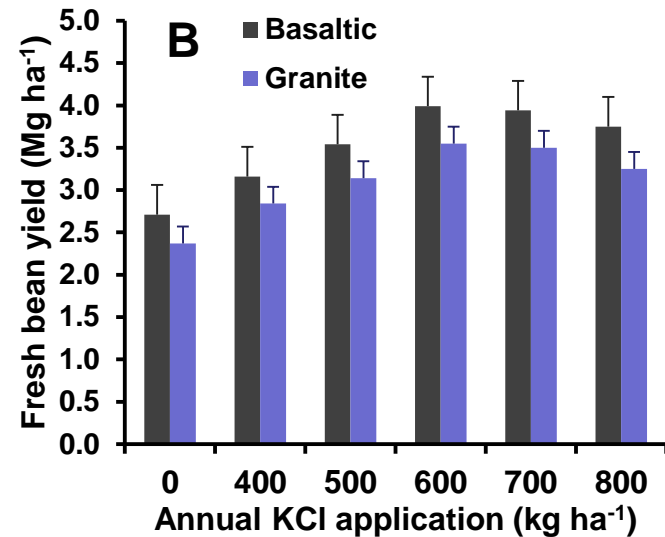
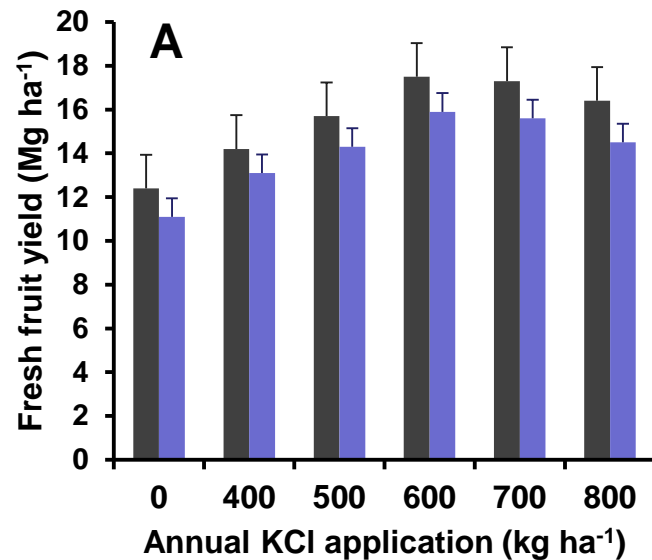
Experimental sites

Materials and methods

- Robusta coffee (> 10 year olds)
- 6 treatments at 4 replications
- The treatments:
 - 6 levels of annual potassium (MOP) application: 0, 400, 500, 600, 700, and 800 kg ha⁻¹
 - a uniform background of 652 and 667 kg ha⁻¹ year⁻¹ of nitrogen (urea) and phosphorus (FMP)
- Designed following the RCBD - random completed block design - method
- 24 slots (180 m² or 20 coffee trees slot⁻¹)

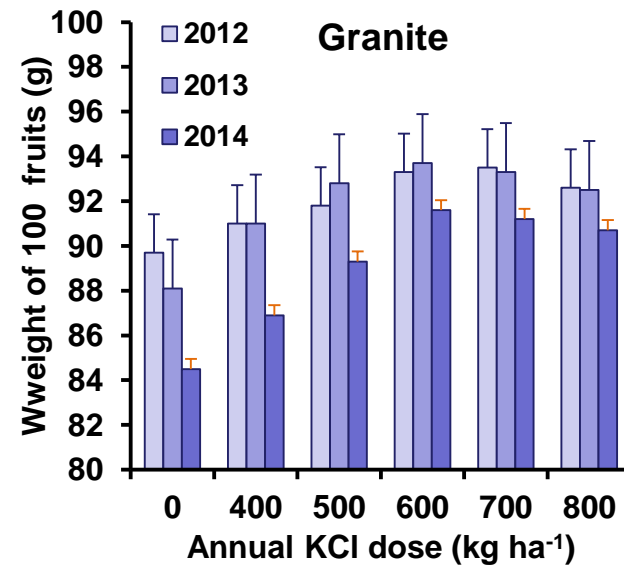
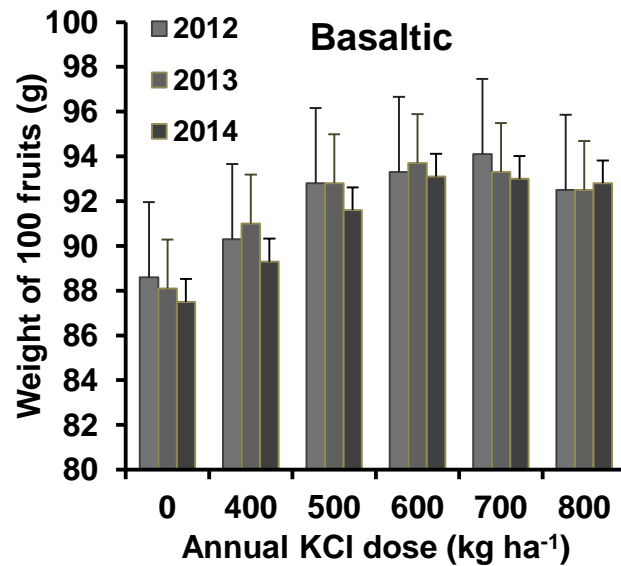


Results and discussion



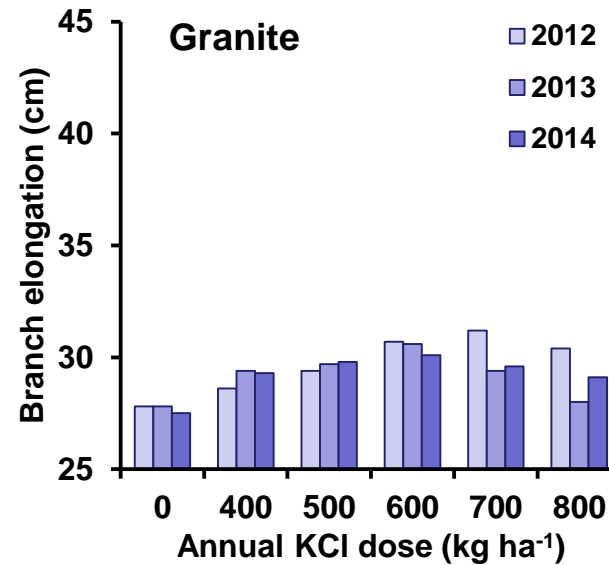
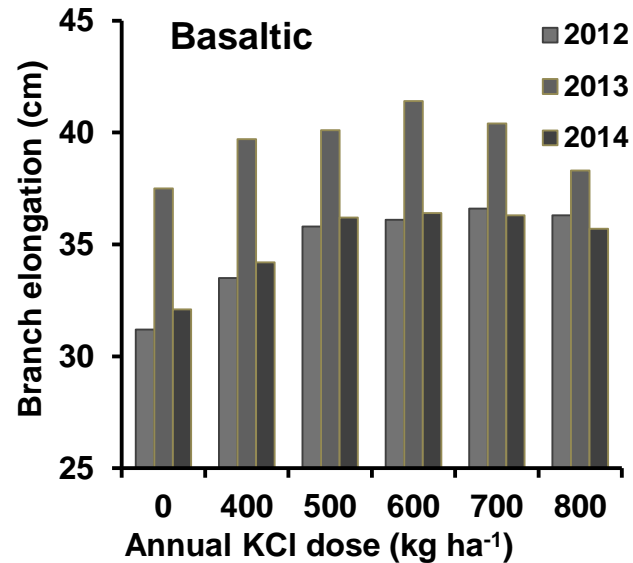
Effect of annual potassium dosage on coffee fruit (A) and bean (B) fresh yields grown on basaltic and granite rock bed soils. Data are means of 3 years (2012-2014). Bars indicate for LSD values at $P > 0.05$

Results and discussion



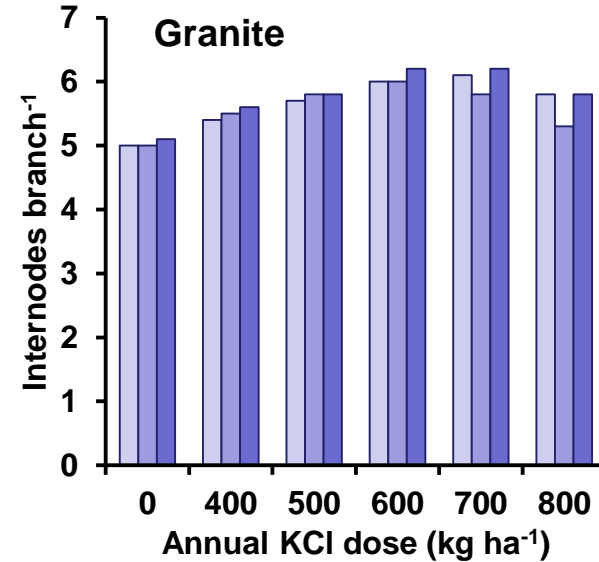
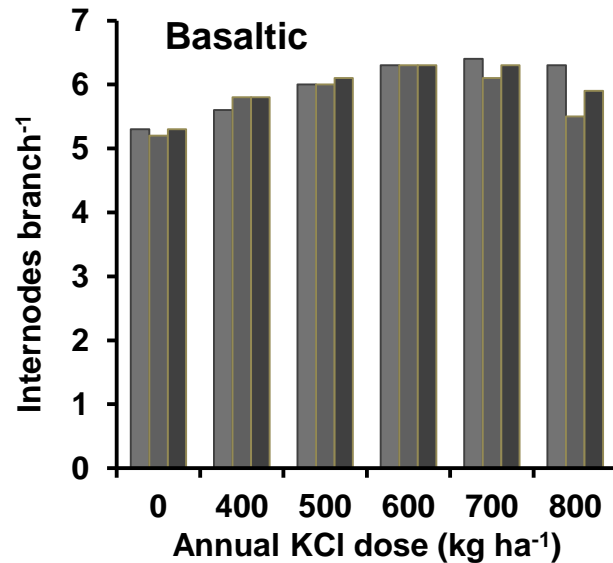
Effect of potassium dosage on fresh fruit weight in 3 consecutive years in coffee plantations grown on basaltic or granite soil in Vietnam. Bars indicate for LSD values at $P > 0.05$, within each year

Results and discussion



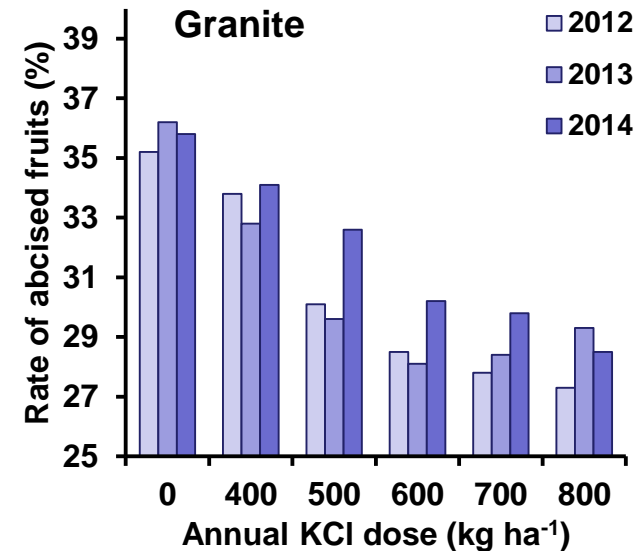
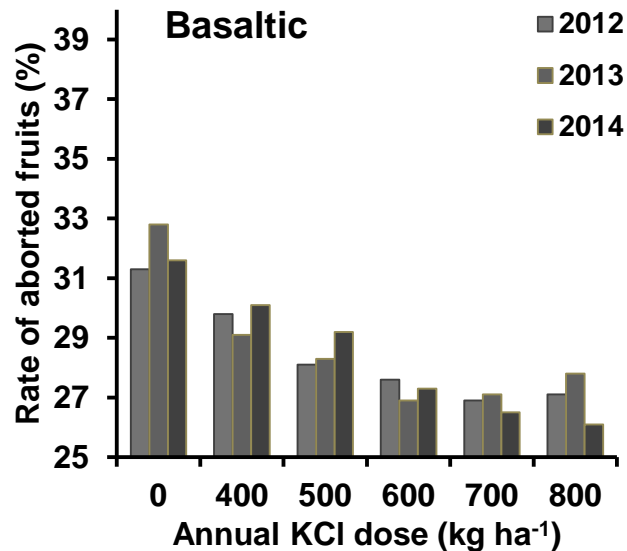
Effects of potassium dosage on branch elongation of coffee trees grown on basaltic and granite bed rock soil during the 6 wet months of consecutive 3 years

Results and discussion



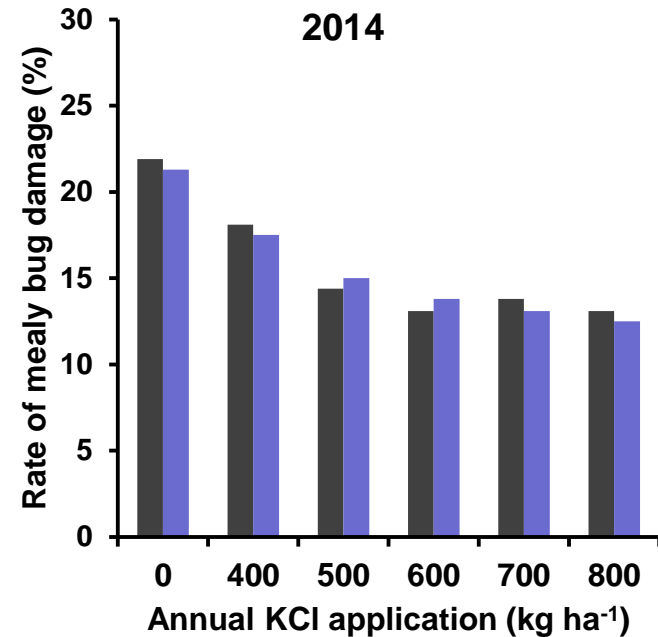
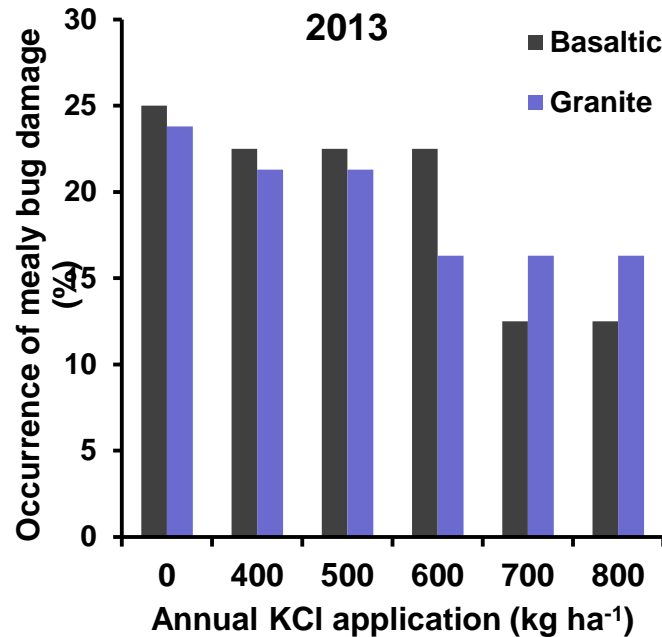
Effects of potassium dosage on internodes formation of coffee trees grown on basaltic and granite bed rock soil during the 6 wet months of consecutive 3 years

Results and discussion



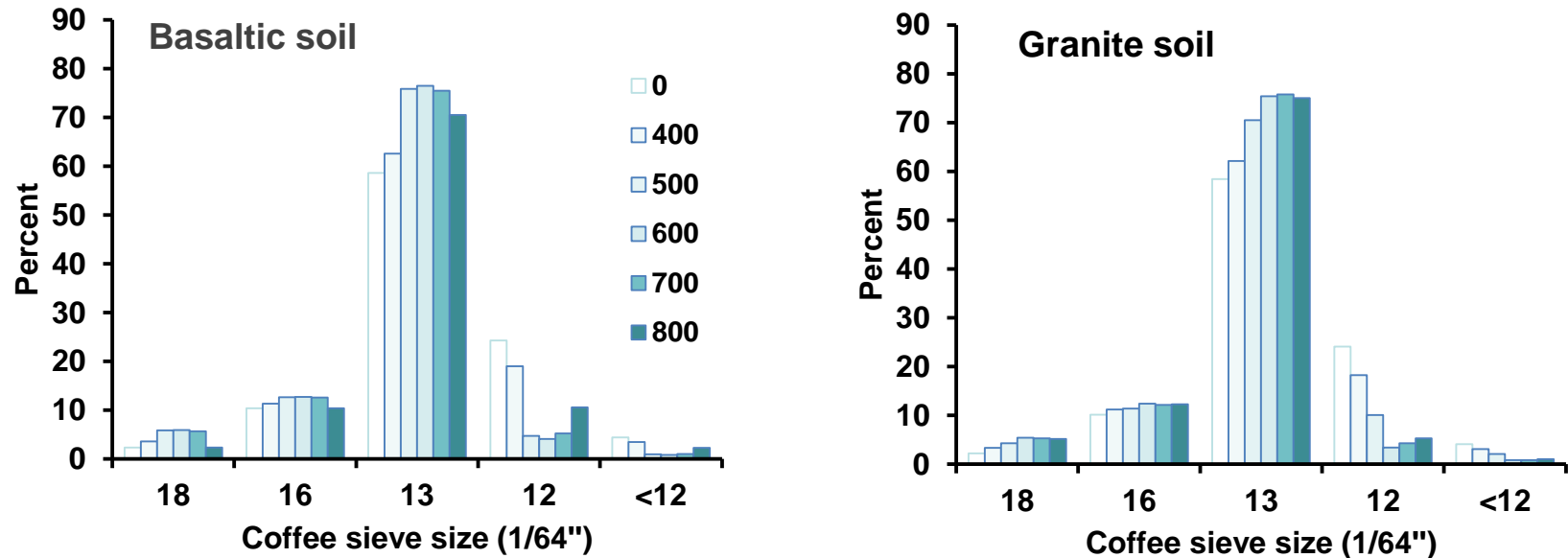
Effect of potassium dosage on the rate of aborted fruit in 3 consecutive years in coffee plantations grown on basaltic or granite bed rock soils

Results and discussion



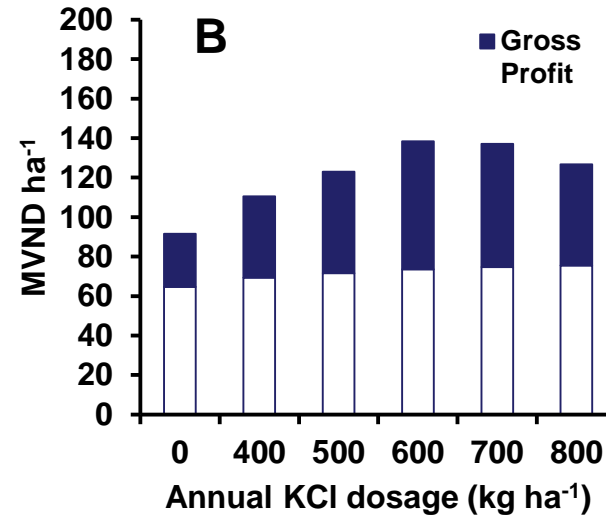
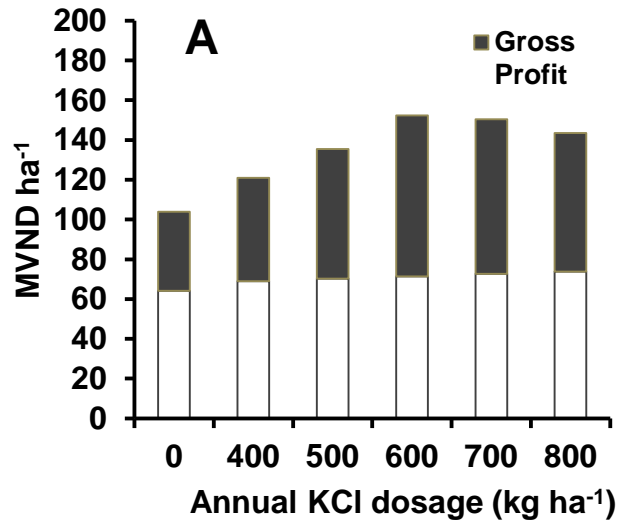
Effect of potassium dosage on the occurrence of mealybug damage in coffee plantations on basaltic and granite soils

Results and discussion



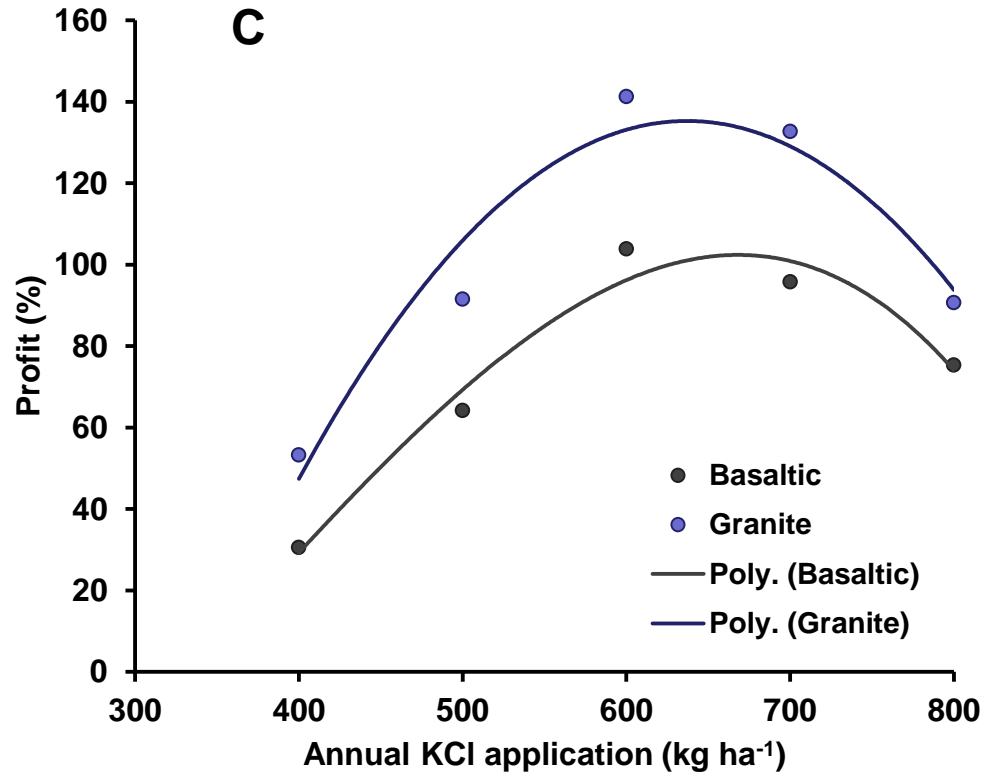
Effect of KCl dosage (Legend; kg ha⁻¹) on the distribution of coffee bean size, in coffee plantations grown on basaltic and granite rock bed soils in Vietnam. Data present means of 2 years (2013-2014)

Results and discussion



Annual mean input, income, and gross profit (million VND ha⁻¹) as a function of annual potassium dosage in basaltic (A) and granite (B) soils

Results and discussion



The rate of profit as a function of K application in basaltic and granite soils

Practical recommendation

- An annual dosage of 600 kg ha⁻¹ would be the optimum level, but this dosage is 3 times greater than recommended for highly yielding coffee plantations (Jessy, 2011)
- A key question in the present study related to the tendency of coffee growers in Vietnam exaggerating fertilizers inputs, and the subsequent need to determine reasonable optimum levels

Thanks for Your Attention!

