TRIAL RESULTS

COFFEE

MINAS GERAIS, BRAZIL (2017)

HIGHLIGHTS

POLY4-TREATED COFFEE HAD UP TO 15% BETTER QUALITY BEANS COMPARED TO MOP ALONE

POLY4 APPLICATION INCREASED SOIL S CONCENTRATION BY +188% COMPARED TO MOP, PROVIDING MORE NUTRIENTS FOR FUTURE CROPS

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TRIAL OBJECTIVE

To assess POLY4 as a potassium fertilizer in different application regimes for coffee in Brazil.

Brazil is the world's largest coffee producer (2.96 million tonnes in 2016) and responsible for approximately one-third of global production.[1]

USDA FAS estimate the world coffee production for 2017/18 to be 159 million bags. Top world coffee producers during this period are forecast to be:

COUNTRY	TOTAL PRODUCTION FORECAST (THOUSAND 60KG BAGS)
Brazil	52,100
Vietnam	28,600
Colombia	14,600
Indonesia	10,900

OVERVIEW

PARTNER: UNIVERSIDADE FEDERAL DE LAVRAS, BRAZIL

LOCATION: BRAZIL

YEAR: 2017

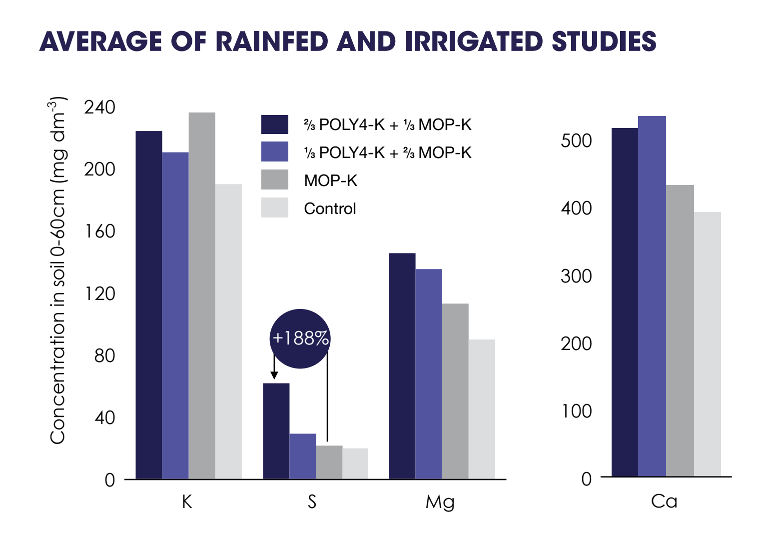
- Minas Gerais produced more coffee than any other Brazilian state (>1 M hectares planted) – approximately 50% of the Brazilian harvest.[2]
- Coffee is a large user of fertilizer[3] (497 kg of fertilizers as NPK and 465 kg of Ca and Mg). Both coffee yield and quality respond to applications up to 400 kg K_2O ha^{-1} for irrigated crops.[4]
- Fertilizer applications are typically split throughout the growing season until harvest in June to August.
- Treatments were K fertilizer applications of POLY4 and MOP applied to irrigated coffee in the first year of the crop at different dates[5] and rates.
- Each trial was a randomised block with six replicates.

TREATMENT TABLE[5,6]

TREATMENTS	AVERAGE NUTRIENTS APPLIED (kg ha^{-1})				
	K_2O	S	MgO	CaO	Cl^-
RAINFED:					
Control	0	0	0	0	0
⅔ POLY4-K + ⅓ MOP-K	203	182	58	163	82
⅓ POLY4-K + ⅔ MOP-K	205	91	29	82	120
MOP-K	207	0	0	0	159
IRRIGATED:					
Control	0	0	0	0	0
⅔ POLY4-K + ⅓ MOP-K	352	315	100	282	142
⅓ POLY4-K + ⅔ MOP-K	356	158	50	141	209
MOP-K	360	0	0	0	276

SOIL NUTRIENT CONCENTRATIONS[5,6]

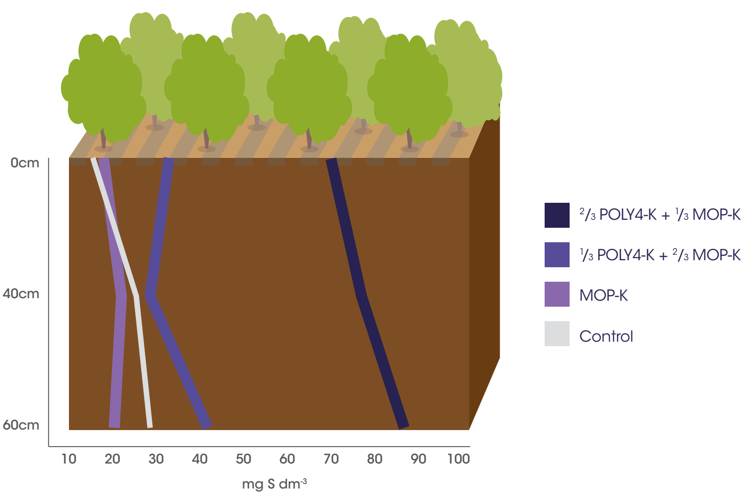
- POLY4 co-applies K, Ca, Mg and S.
- Compared to MOP, applying more POLY4 increased residual soil Ca and particularly Mg and S.
- The maximum POLY4 application in ⅔ POLY4-K + ⅓ MOP-K always (six out of six measurements) resulted in greater residual soil S concentration (188% of residual soil S compaired to MOP only).
- POLY4 application gave a residual soil S benefit, despite S being very mobile in most soils.
- Applying K fertilizer always increased residual soil K.



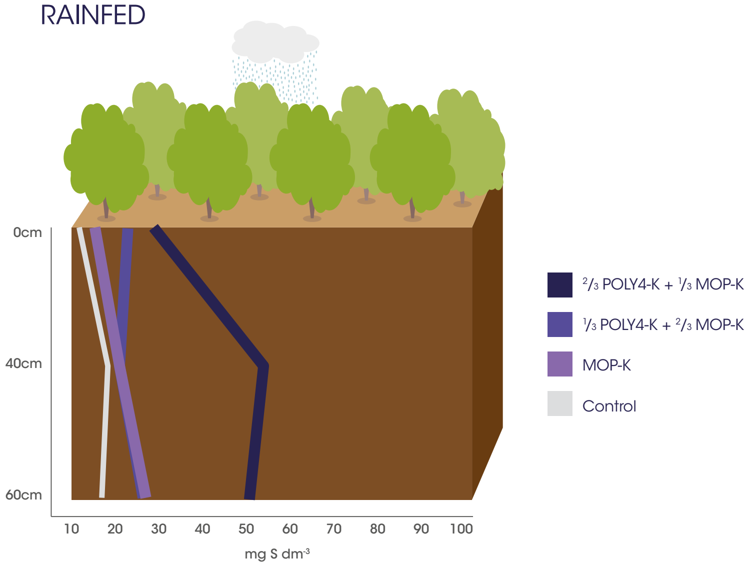
SOIL PROFILES: CONCENTRATION OF SULPHUR

- Despite S being very mobile in most soils, POLY4 application left a residual soil S benefit and a legacy of greater soil S at all depths, for both irrigated and rainfed coffee.
- POLY4 application of two-thirds of the K need in ⅔ POLY4-K + ⅓ MOP-K, increased soil S from 0-60cm by 111% in rainfed conditions and by 263% when irrigated.
- POLY4 application of one-third of the K need in ⅓ POLY4-K + ⅔ MOP-K, increased soil S from 0-60cm by 53% in rainfed conditions and by 48% when irrigated.

SOIL S CONCENTRATION PROFILES
IRRIGATED



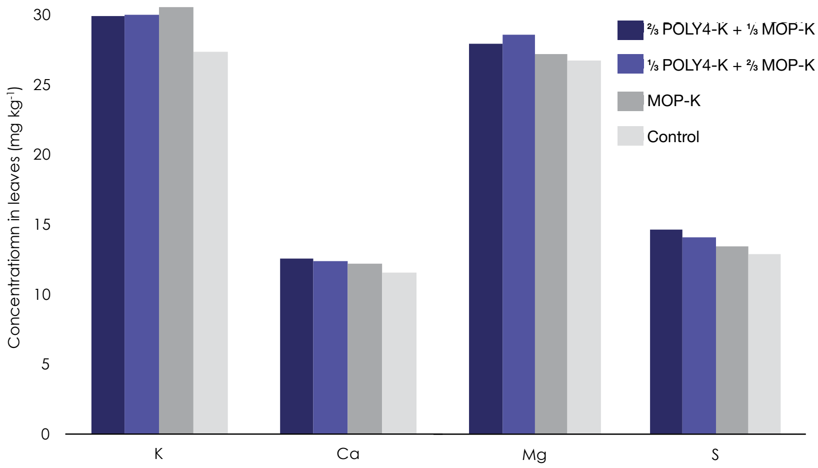
SOIL S CONCENTRATION PROFILES
RAINFED



NUTRIENT UPTAKE: LEAVES

- The leaf nutrient concentrations show similar but less distinct trends to the soil data.
- Compared to MOP, applying more POLY4 increased leaf concentrations of Mg, and particularly Ca and S.
- The maximum POLY4 application (⅔ POLY4-K + ⅓ MOP-K) always resulted in greater leaf S concentration.

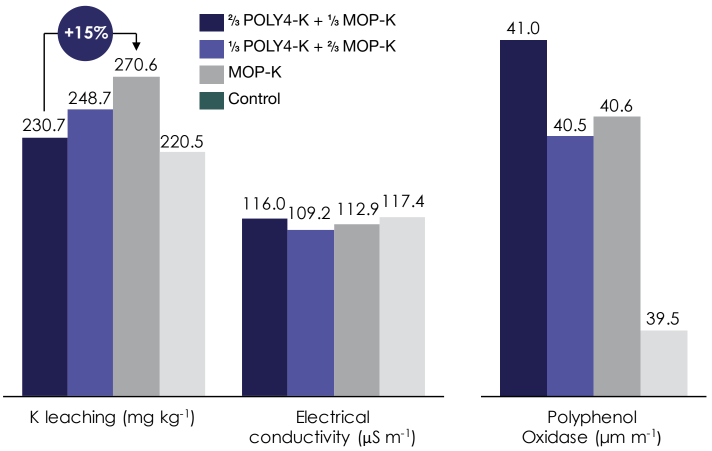
AVERAGE OF RAINFED AND IRRIGATED STUDIES



COFFEE QUALITY

- High quality coffee beans are identified by:
  - o Reduced K leaching
  - o Lower electrical conductivity;
  - o Greater polyphenol oxidase activity.
- The largest POLY4-K (⅔ POLY4-K + ⅓ MOP-K) input had 15% better coffee quality (K leaching) compared to MOP-K alone.
- The best quality coffee, according to polyphenol oxidase activity, was achieved by the maximum POLY4 fertilizer-use (⅔ POLY4-K + ⅓ MOP-K).

AVERAGE OF RAINFED AND IRRIGATED STUDIES



Notes: 1) https://apps.fas.usda.gov/psdonline/circulars/coffee.pdf (accessed 6 January 2018); 2) https://www.utzcertified.org/index.php?option=com_interactivemap&view=memberDeta (accessed 6 January 2018); 3) Coltro et al. (2006). http://www.ce.cmu.edu/~hsm/lca2007/hw/ijlca-coffee-hw2.pdf (accessed 6 January 2018); 4) Clemente, J. M., et al, 2015. http://www.scielo.br/pdf/asagr/v37n3/1807-8621-asagr-37-03-00297.pdf (accessed 6 January 2018); 5) Rainfed: 2/3 POLY4-K + 1/3 MOP-K = 480 kg POLY4 ha^{-1} and 115 kg MOP ha^{-1} in October and again in December 2016, plus 115 kg MOP ha^{-1} in February 2017; 1/3 POLY4-K + 2/3 MOP-K = 480 kg POLY4 ha^{-1} and 115 kg MOP ha^{-1} in October, plus 115 kg MOP ha^{-1} in December 2016 and February 2017; MOP-K = 115 kg MOP ha^{-1} in October and December 2016 and January 2017. Irrigated: 2/3 POLY4-K + 1/3 MOP-K = 415 kg POLY4 ha^{-1} in September, October, December 2016 and January 2017, plus 100 kg MOP ha^{-1} in March and April 2017; 1/3 POLY4-K + 2/3 MOP-K = 480 kg POLY4 ha^{-1} in September and October 2016, plus 110 kg MOP ha^{-1} in December 2016, January, March and April 2017; MOP-K = 100 kg MOP ha^{-1} in September, October, December 2016, January, March and April 2017; soil pH = 6.1 6) Initial soil analysis: Rainfed: pH 6.1, OM 0.39%, P 9 mg dm^{-3}, K 153 mg kg^{-1}, Ca 770 mg kg^{-1}, Mg 166 mg dm^{-3}, S 13 mg kg^{-1}, CEC 10.1 cmol dm^{-3} Irrigated: pH 6.0, OM 0.29%, P 6 mg dm^{-3}, K 115 mg kg^{-1}, Ca 687 mg kg^{-1}, Mg 158 mg dm^{-3}, S 12 mg kg^{-1}, CEC 8.7 cmol dm^{-3}.

Sources: Universidade Federal de Lavras 47000-LAV-47010-16

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