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Essential magnesium
Sulphuric acid projects
Polyhalite agronomy
Filtration and thickening

POLY4 corn trial in South Africa. Sulphur and other nutrients present in the polyhalite product POLY4 can improve corn growth and yield.



Maya Rehill of Anglo American Crop Nutrients discusses the latest crop trial findings for the polyhalite product *POLY4* with the company's regional agronomists. These highly positive trial results add to an already extensive evidence base on *POLY4*'s crop benefits.

Anglo American Crop Nutrients is continuing to expand its worldwide crop science programme. Agronomic trials of its polyhalite product *POLY4* have now grown to encompass North America, South America, Europe, Africa, the Middle East, China, India, Southeast Asia and Australasia.

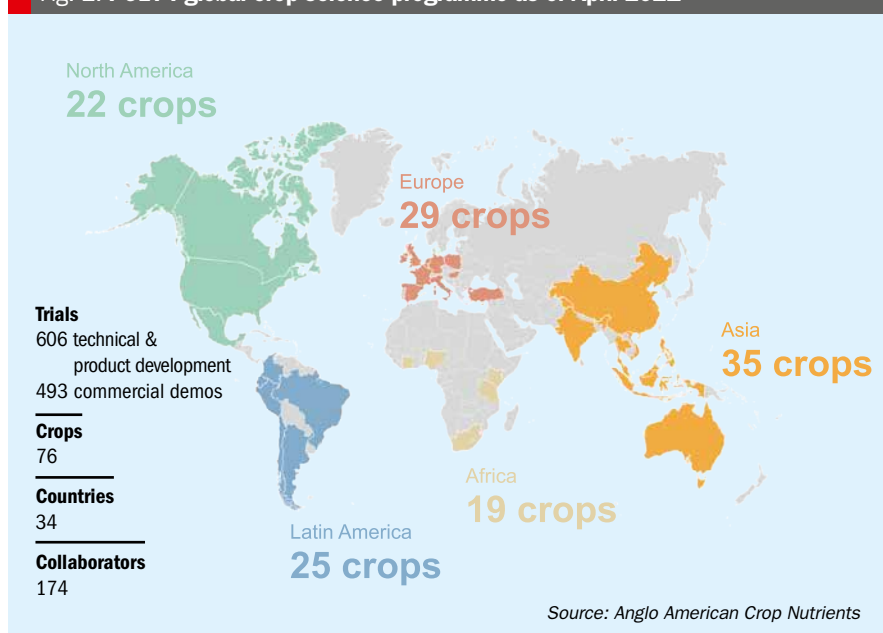
To date, a total of 606 technical and product development trials, as well as 493 commercial demonstrations, have been carried out across the world (Figure 1). As a consequence, the evidence base on the agronomic benefits of polyhalite continues to grow – underpinning the company's commercial efforts and supporting global *POLY4* sales.

Wide-ranging and positive *POLY4* trial results, for many different crop types, have undoubtedly helped boost contracted fertilizer market sales. In advance of first production, Anglo American has now signed offtake agreements with leading commercial suppliers totalling 13.8 million tonnes per annum.

Growing global

"Since the early greenhouse trials in 2013, the scope of the *POLY4* agronomy programme has expanded significantly, both in terms of geography and

Fig. 1: *POLY4* global crop science programme as of April 2021



crop types,” says Ross Mitchell, Head of Agronomy and Technical Services at Anglo American Crop Nutrients. “Up to now, we have tested *POLY4* on 76 crops and in 34 countries.”

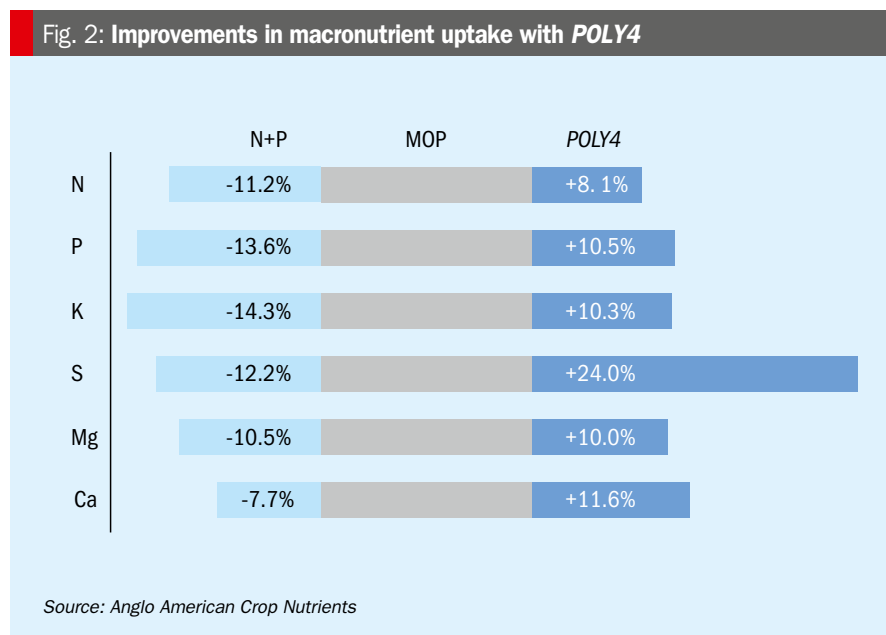
Mitchell adds: “The foundation upon which we build our trials is understanding the current farming systems in each region – and how *POLY4* can support, enhance, and sometimes even reshape local fertilizer programmes to improve crop performance.”

Many factors need to be assessed before *POLY4* trials commence. These range from the variety of crops grown to factors that affect fertilizer practices. The latter can include farm economics, fertilizer availability, soil conditions, agronomic advice and application recommendations.”

POLY4 is a flexible product and its use can be fine-tuned to meet regional requirements. Whether higher crop yields or better crop quality are required – sometimes both – or if longer-term benefits such as soil improvements are desired, the application of *POLY4* can be tailored to meet the specific needs of farmers and growers.

Each *POLY4* trial assesses yield results while also focussing on other improvements that complement what farmers are doing already. “Of course, yield is king – yield drives profit for a large majority of farmers,” says Mitchell, while adding:

“But besides the advantageous output factor, *POLY4* also offers broader benefits related to inputs in the farming system. The convenience factor, for example, where farmers do not need to spread more fertilizers or can decrease



the number of field passes, yet achieve the same or even better results, will be of value.”

Broad benefits

POLY4 is a multi-nutrient product offering multiple benefits. These notably include better nutrient recovery and uptake by crops and a sustained dissolution rate – characteristics which, in turn, fuel crop yield improvements.

“Comparatively, the effectiveness of different fertilizers can be judged by measuring their nutrient use efficiency,” says Robert Meakin, Head of Crop Science and Product Development. “We have analysed

and compared apparent nutrient recovery in up to 70 *POLY4* global trials.”

The findings are shown as a series of bar charts in Figure 2. As Meakin explains, the central bars represent 100 percent nutrient uptake (in above-ground crop biomass) by a crop supplied with nitrogen (N) and phosphorus (P) together with muriate of potash (MOP) as a potassium (K) source. The N+P bars (left) show the impact of completely removing the potassium source. The *POLY4* bars (right), meanwhile, show the impact of switching the potassium source from MOP to *POLY4*. This substitution clearly supports higher nutrient uptake. For example, potassium uptake in the *POLY4*-fed plants increased by 10.3 percent

Fig. 3a: Average cabbage marketable yield (t/ha)

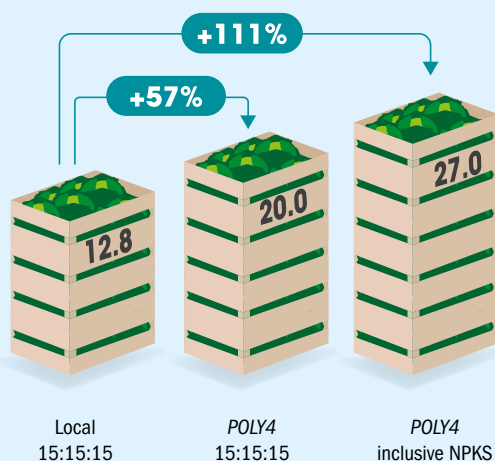


Fig. 3b: Average tomato marketable yield (t/ha)

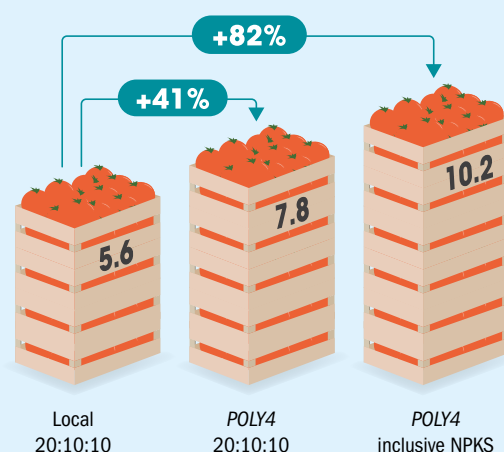
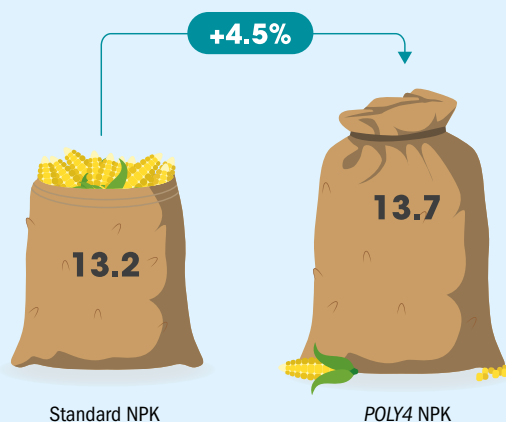
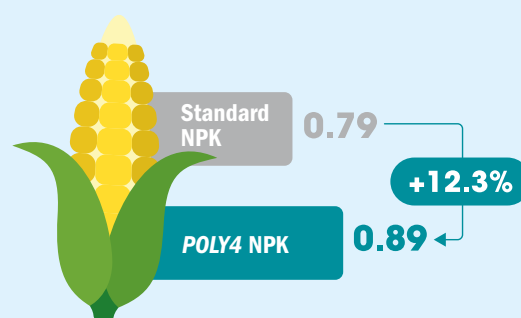


Fig. 4: Corn relative yield (t/ha)



Source: Anglo American Crop Nutrients

Fig. 5: Grain S (g/kg)



Source: Anglo American Crop Nutrients

compared to the MOP-fed crop. The benefits do not end there either. Many other nutrients as well as potassium show higher nutrient use efficiency with *POLY4*.

“Moreover, with supply of sulphur, magnesium, and calcium, *POLY4* promotes nutrient release and improves the nutrient uptake by up to 24 percent. This results in marked improvements in both crop yield and quality,” confirms Meakin.

Field focus

The agronomy programme continues to generate a strong body of evidence showing *POLY4* performing consistently well on both broad-acre and high-value crops in various agroecological zones.

POLY4 supplies four of the six macro-nutrients a plant needs – potassium, sulphate-sulphur, magnesium and calcium. Because these are released in a gradual and sustained way, the product is able to meet the nutrient needs of crops over a longer time period, rather than delivering an immediate hit.

The task of the agronomy team at Anglo American Crop Nutrients is to understand and make sure that complex crop nutrition supplied by *POLY4* is used correctly in all agricultural areas throughout the world. It is equally important to find out:

- When is the right time to use it
- What is the right amount to put on
- What is the right rate of application.

Below, our expert regional agronomists, who work with farmers and researchers across the world, highlight the performance of *POLY4* in recent crop trials.

Innovative crop nutrition

Crop yields in Nigeria are generally low, despite the country’s huge agricultural development potential and the fact it has one of the fastest growing populations in the world.

“By supplying 95 percent of all locally produced food, smallholder farmers are the backbone of Nigerian agriculture,” says Candice Pienaar, Africa Regional Agronomist. “Horticultural crops can make an enormous impact on rural livelihoods due to increased income for farmers and the high nutritional value of vegetables for local communities.”

Two farms in Northern Nigeria were selected as trial sites to evaluate the effects of *POLY4* blends on dry-season cabbage and tomatoes: one with a clay soil near Kaduna, and the other with a sandy soil near Kano. Results at both farms showed significant and consistent yield and quality improvements, independent of their very different soil types.

The application rates for the blends all followed local smallholder farmer practices, explains Pienaar: “Fertilizer application rates for smallholder agricultural production in Nigeria is low, but the *POLY4*-based blends were designed to give these farmers maximum yield and quality improvements even when applied at low rates.”

On average results showed:

- **Cabbages:** the standard 15:15:15 fertilizer yielded 12.8 tonnes of cabbage per hectare, while the use of a *POLY4*-inclusive 15:15:15 increased the yield to 20 tonnes per hectare, a 57 percent yield increase. Additionally,

the new crop-specific *POLY4*-inclusive NPKS blend achieved the highest cabbage yield of 27 tonnes per hectare. (Figure 3a).

- **Tomatoes:** while the local 20:10:10 fertilizer yielded 5.6 tonnes of marketable tomatoes per hectare, a *POLY4*-inclusive 20:10:10 increased the yield to 7.8 tonnes of marketable tomatoes per hectare, a 41 percent yield increase versus local practice. Furthermore, the use of a new crop-specific *POLY4*-inclusive NPKS blend at the same 60 kg/ha N application rate resulted in an even greater marketable tomato yield of 10.2 tonnes per hectare, delivering an 82 percent yield advantage (Figure 3b).

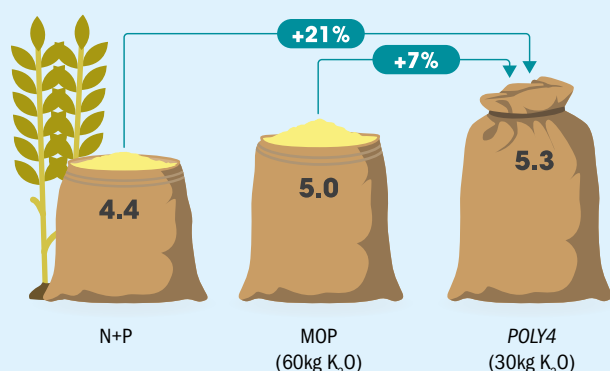
These trials demonstrated that Nigerian farmers can easily adopt *POLY4* into their farming practices, concludes Pienaar: “Innovative and improved fertilizer solutions such as balanced crop nutrition with *POLY4* can have a significant positive impact on the yields, quality, income and livelihoods of local vegetable farmers.”

Superhero sulphate-sulphur

Farmers in the United States, because they are already at a high crop productivity level, focus more on improving the efficiency of their operations and making better use of inputs such as fertilizers to ensure a successful return on their investment.

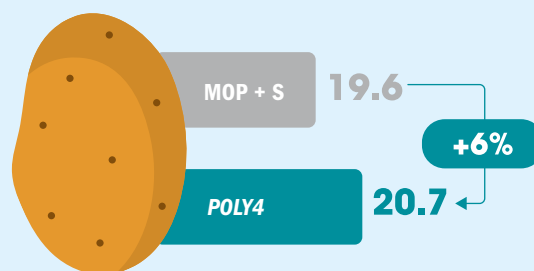
“*POLY4* can potentially be used as a sulphur source replacing certain alternative products like ammonium sulphate,” explains Brad Farber, Lead Regional Agronomist in North America. “For example, corn

Fig. 6: Wheat grain yield (t/ha)



Source: Anglo American Crop Nutrients

Fig. 7: Potato tuber dry matter (%)



Source: Anglo American Crop Nutrients

has a high sulphur need. The demand for yields increases, when combined with decreasing sulphur deposition from the atmosphere, means the soil organic matter can no longer meet the crop's high sulphur needs."

Farber continues: "15 research and commercial farm trials on corn in Iowa, Illinois, and Minnesota between 2015 and 2019, showed that *POLY4* programmes improved the average yield by 620 kg/ha – an increase of almost five percent compared to the standard NPK programme where K was provided by MOP. Yield increased because crops had both more kernels and larger kernels: the number of kernels per square metre actually increased by five percent, while the thousand kernel weight increased by more than one percent on average."

"Sulphur uptake can be a significant contributor to crop growth and eventual yield," sums up Farber. "*POLY4* increased grain sulphur by more than 12 percent."

The results of these corn trials are shown in Figures 4 and 5.

There are two major fertilizer seasons in the North American Midwest – autumn and spring – as Matt Wiebers, North America Regional Agronomist, explains:

"Sulphur containing fertilizers are usually applied in spring, and not before, because they contain both nitrogen and sulphur – two nutrients that are leachable and therefore move with water. Corn growing areas are primarily rainfed and, with current weather events being somewhat unpredictable, in a heavy rainfall nitrogen

and sulphur tend to leach down into the soil profile away from the crop roots."

As a source of sulphate-sulphur for corn, the sustained nutrient delivery profile of *POLY4* ensures a continuous supply of nutrients throughout the growing season that matches the crop's needs.

Farmers are innovators and are therefore generally open to new products and technologies, if they offer convenience and increase efficiency, says Wiebers:

“Of course, yield is king – it drives profits – but *POLY4* offers broader benefits too.”

"Every farmer can appreciate the convenience of simplifying on-farm operations and fertilizer applications while still increasing productivity. *POLY4* provides an effective solution with its gradual and sustained release of sulphate-sulphur, plus it can be safely blended and applied to fields in autumn with the other P and K fertilizers farmers are already applying.

"This improves efficiency by reducing the number of field passes – covering more acres in less time – and saving the hassle during a busy time of the year. Furthermore, with *POLY4* you have a crop nutrition product that emulates many of the properties of specialty fertilizers but can be produced in bulk and at scale making it available to all farmers when it enters the market."

Nutrition on demand

Indian agriculture provides more people with livelihoods than any other sector in the country. Indeed, some 70 percent of rural households in India still depend primarily on agriculture for their livelihood, with 82 percent of farmers being smallholders.

The use of *POLY4* can help Indian farmers overcome many challenges, says Satendra Upadhyay, India Regional Agronomist:

"*POLY4* can help strengthen crop productivity in India by offering balanced crop nutrition while avoiding overuse of fertilizers. Poorly balanced use of fertilizers, especially chemical products, encourages land to become less productive rather than more productive and degrades the soil health and quality hence causing soil pollution."

Upadhyay highlights the promising performance of *POLY4* on some of the key crops produced in India, such as wheat and potatoes:

"Amalgamation of trial results have shown that *POLY4* increases both wheat yield and biomass. In trials conducted by the India Agriculture Research Institute in New Delhi, supplying 50 percent of recommended potassium with *POLY4* increased grain yield by seven percent, versus crops that received their full K recommendation from MOP.

"Furthermore, when compared to the common farmer practice of applying N and P from urea and DAP, *POLY4* achieved a 21 percent increase in yield."

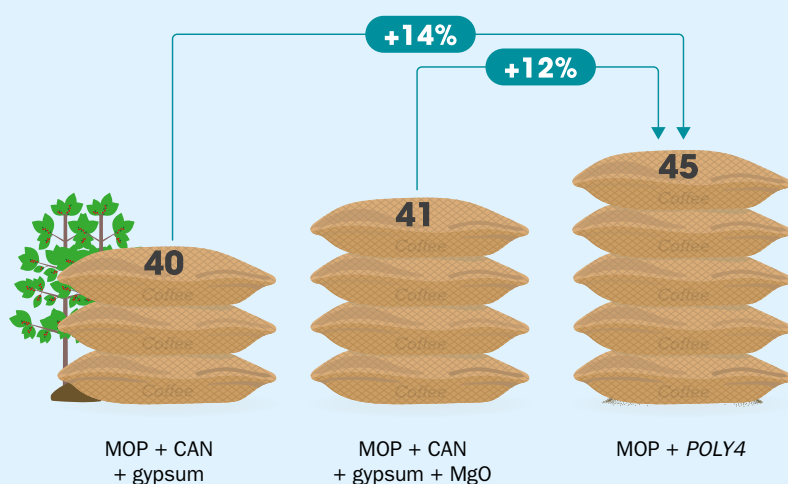
These results are shown in Figure 6.

The performance of *POLY4* on potatoes was also assessed, as Upadhyay explains:

"The majority of Indian potatoes are grown in the northern state of Uttar Pradesh, where we carried out three-year trials with the Sardar Vallabhbhai Patel University of Agriculture and Technology based in Meerut.

"These trials demonstrated that a *POLY4* fertilizer programme offers potato farmers more benefits than a conventional MOP and elemental sulphur treatment. The

Fig. 8: Average coffee yield (kg/plot)



Source: Anglo American Crop Nutrients

marketable potato yield increased by an average of 13 percent with *POLY4*.”

This programme also improved potato quality (see Figure 7), adds Upadhyay:

“By offering a better balance of nutrients, including calcium, as well as a reduced chloride dose, *POLY4* helps to improve quality of tubers. Tuber dry matter content was increased by six percent in the *POLY4*-treated potato crop, compared to MOP plus sulphur, thus improving the frying quality of potatoes.”

“*POLY4* can also help resolve the well-known antagonism between soil potassium and magnesium that limits yield for potato growers,” concludes Upadhyay. “It can do this thanks to two helpful characteristics – its sustained dissolution rate and the ability to supply magnesium alongside potassium.”

Magic of magnesium

Latin America accounts for nearly 60 percent of worldwide coffee production, with Brazil and Colombia being the leading producers. Colombia ranks as the second largest coffee producing country in the region with an average annual production of almost 14 million 60-kilogram bags.

The majority of coffee in Latin America is produced by smallholder farmers whose livelihoods fully rely on the high quality of their crop to achieve a high price, says Lino Furia, Regional Agronomist in Latin America: “In Colombia, coffee is grown by approximately 900 thousand farmers on

700 thousand hectares, meaning that on average a coffee grower operates on less than one hectare of land.”

Colombian coffee is mainly exported to Europe, with quality criteria and standards greatly influencing the way coffee is produced, including:

- European quality standards
- The demand for certified organic coffee
- The implementation of good agricultural practices (GAP)
- Fair Trade principles
- Demand for low carbon footprint products.

Furia says that to receive higher scoring on quality certification, and consequently a higher price, farmers aim to harvest consistent and uniform coffee cherries based on size, colour and maturity:

“Compared to Brazil, where the quality of coffee is lower due to mechanical methods of harvesting and industrialised assessment of quality, Colombian coffee is used as a benchmark for a superior coffee quality. In Colombia, the fruit is harvested from the same trees six times a year when only the mature and large cherries are handpicked each time.

“Colombia grows mostly Arabica beans which are considered to be of a better quality. Arabica beans are large and extended in shape and offer a more refined taste.

“Coffee crops demand a large supply of nutrients. Usually, 200 kilograms of potassium is applied per hectare – more than two times soybean requirement, for exam-

ple. However, high levels of chloride in currently used fertilizer sources negatively affect the size and density of the fruit.

“And this is where *POLY4* can help to achieve higher quality of coffee by providing low-chloride potassium as well as a balanced nutrition of soluble magnesium, sulphur and calcium.

“Coffee trees traditionally are fertilized three times a year with the standard local practice of 20:5:20 NPK blends. Kieserite is added to meet the crop’s magnesium demand. Gypsum is also applied where soil aluminium levels are high or when a small amount of sulphur is required.”

Cenicafé, a member of the Colombian Coffee Growers Federation, has assessed the performance of *POLY4* on coffee at two sites over four years, explains Furia:

“In these *POLY4* trials, standard N and P rates were applied and demand for K was met by mixing MOP with *POLY4*, consequently replacing up to 35 percent with low-chloride potassium and increasing Mg supply. The *POLY4* plan consistently increased yield across the four years of trials – by up to 14 percent on average – while also maintaining the coffee cup quality. In contrast, application of non-*POLY4* sources of S, MgO or CaO gave less yield.”

These results are shown in Figure 8.

The acidic, weathered tropical soils common in Latin America frequently harbour toxic levels of aluminium, particularly at depth, says Furia:

“An additional benefit of *POLY4* fertilization is the detoxification effect of its CaSO_4 and MgSO_4 elements. These have the ability to counteract and improve resistance to aluminium toxicity, encouraging more expansive root growth deeper in the soil profile.

“The use of lower carbon footprint products like *POLY4* with its simple production process (mining + crushing + granulation with starch) is also valued by both the international coffee market and farmers. Low carbon footprint products improve quality certification scores making it easier to sell coffee at a higher price.”

Combined, these characteristics make *POLY4* a highly-attractive, natural, multi-nutrient option for crop fertilization, Furia concludes, one that can greatly improve farmer economics. ■

About the author

Maya Rehill is the customer marketing manager at Anglo American Crop Nutrients.