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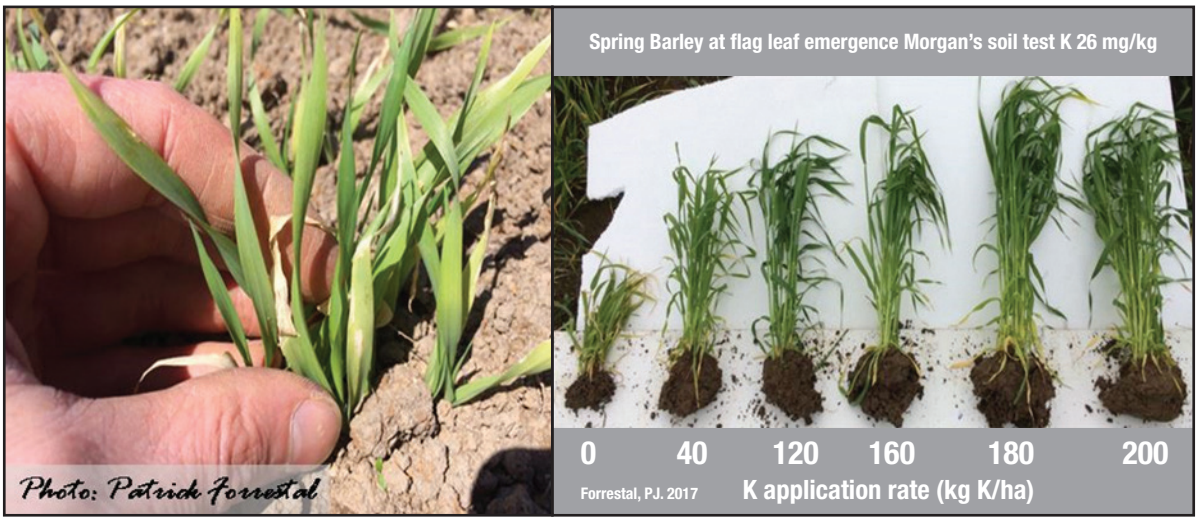
Potassium for the soil and crop: the importance of getting it right

Patrick J. Forrestal[1], Mark Plunkett[1], Cathal Redmond[1] and Martin Bourke[2]
[1]Soils, Land Use and Environment Dept. Teagasc, Johnstown Castle, Co. Wexford.
[2]Teagasc Advisory Service, Tinnahealy, Co. Wicklow

Introduction

Crops including spring barley require high levels of potassium (K) to support yield, often at similar levels to nitrogen (N). Potassium has traditionally received much less focus compared with nitrogen. Nevertheless, K can play an important role in improving nitrogen use efficiency (NUE) bringing environmental benefits in addition to yield, plant vigour and lodging resistance benefits. A recent Teagasc trial showed that application of K fertiliser increased NUE from a low of 31% where the soil K was low and no K was applied to 85% at the highest K application rate on the same soil (Forrestal et al., unpublished). This dramatic effect highlights the importance of getting soil and fertiliser K right and the impact which K can have on NUE. Yield improvement over the past few decades has resulted in increased K offtakes. Without soil testing to monitor soil status and appropriate K fertilisation from manures, crop residues and/or mineral fertilisers, the potential for potassium deficiency to place a drag on crop yields and NUE has increased.

Figure 1. Visual early season deficiency symptoms and response to K application on a K deficient soil.



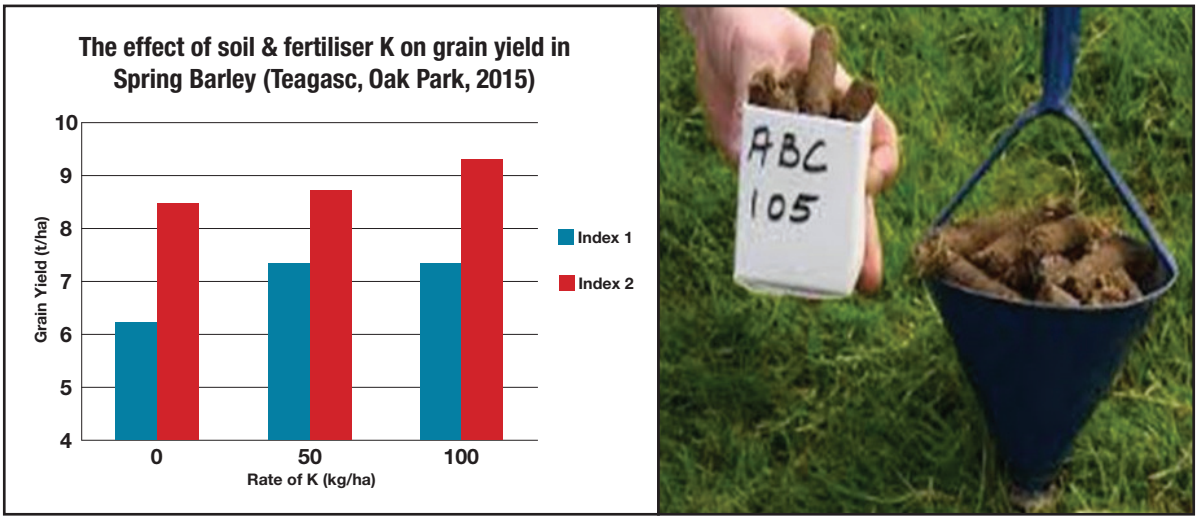
Behaviour and role of Potassium in plants

An important distinction between many nutrients (for example N, P, S) and Potassium (K) is that K is not incorporated into the structures of organic compounds in the plant. As K is not organically bound it becomes available from manures and residues (e.g. chopped straw) relatively quickly compared to other nutrients. Potassium remains in its ionic form (K+) within the plant regulating cell osmotic pressure, the process which controls water loss and uptake by the plants. It also activates more than 80 enzymes controlling processes including photosynthesis, nitrogen fixation in legumes and formation of starch. As a result adequate K nutrition is a key factor in the formation of healthy and full tubers and grains.

The dangers of allowing soil K levels to become depleted

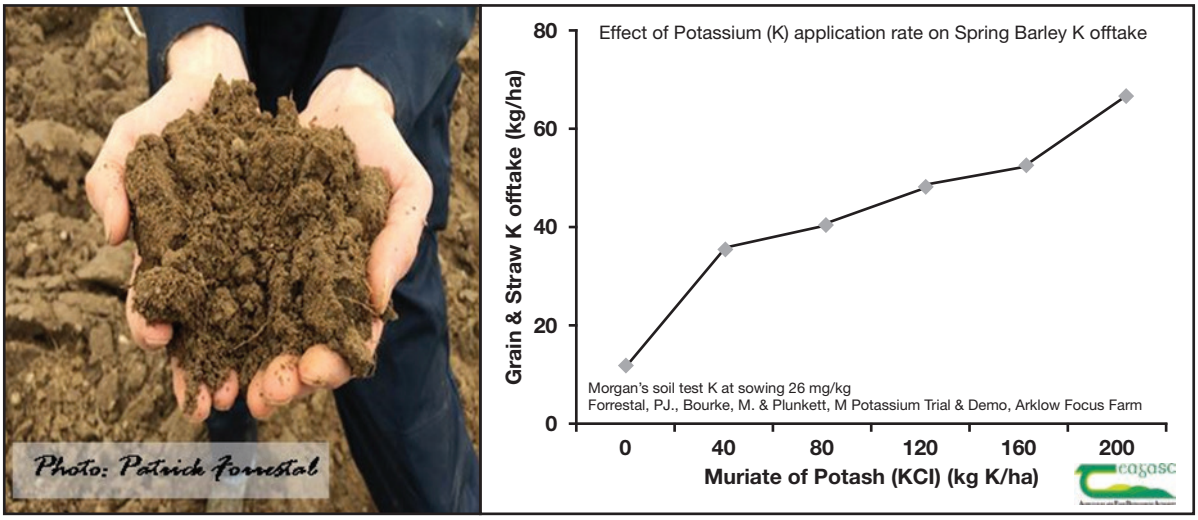
In Ireland Index 1 and 2 are considered deficient and at these soil test index levels a positive response to K fertiliser application is to be expected. Figure 2 shows that at zero K application the effect of soil index (1 vs 2) was more than 2 tonnes/ha. Even with application of K fertiliser a wide gap remained between the grain yields at the index 1 and index 2 sites highlighting the importance of maintaining soil K levels informed by regular soil testing.

Figure 2. Effect of soil test K level and K fertiliser application on spring barley yield



At a Morgan's soil test K level of 26 mg/kg (Index 1) the ability of the soil to supply K to the crop was severely limited. Figure 3 shows that at this soil test level the soil supplied only 10 K kg/ha to the crop. There was a dramatic response in K uptake to the first increment of 40 kg K/ha application with a high level of apparent K fertiliser recovery at 40 kg K/ha. The crop responded positively to each incremental application of K at this site and particularly to the final increment from 160 to 200 kg K/ha. The sharp increase in K uptake in response to the final K increment is also associated with the crop reaching maximum yield potential for the site and year (Figure 4) showing some evidence of luxury K consumption. Luxury consumption, where plants absorb K which is in

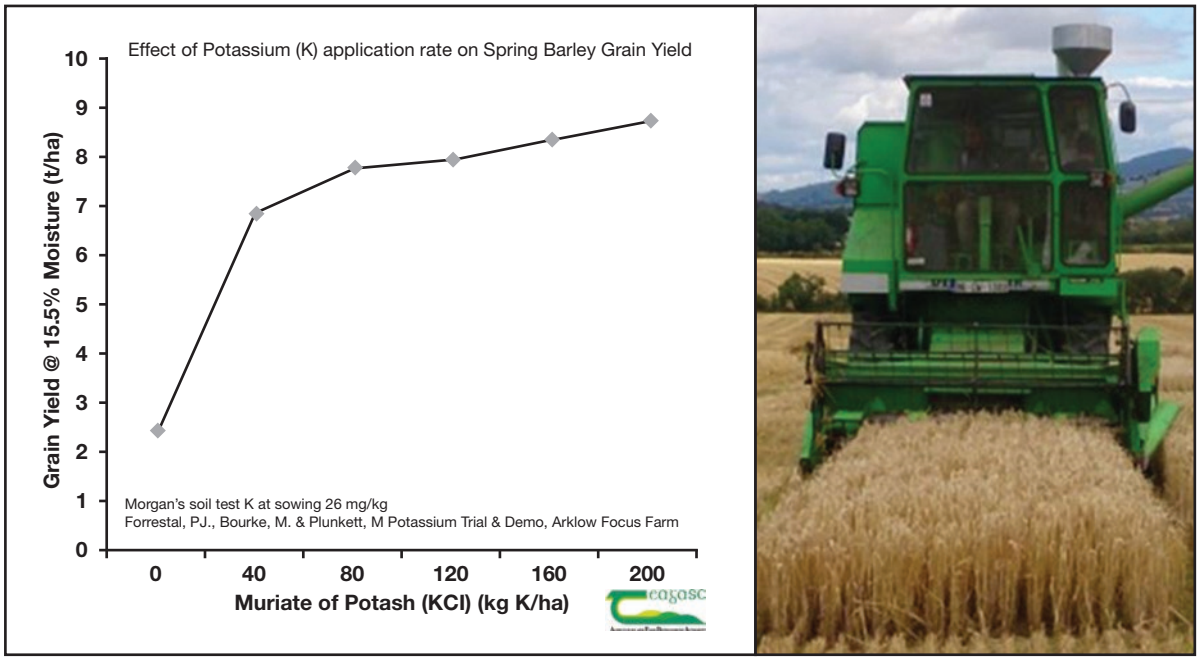
Figure 3. Soil and fertiliser capacity to supply K to spring barley crop at low soil test K



excess of growth requirements is a recognised down side to having over availability of K. It is therefore the important to conduct regular soil testing and to implement appropriate fertiliser programme planning to ensure that available K levels are not increased above the optimum recommended level (Index 3 in the Irish system). Excessive soil or fertiliser K availability to plants will lead to suppression of uptake of other cations (positively charged ions), in particular calcium and magnesium.

A dramatic yield response to K fertiliser application was observed at this low soil test K site with grain yield increasing from 2.4 to 6.7 t/ha or a 4.3 t/ha response to the first 40 kg K/ha applied (Figure 4). Grain yield continued to increase up to 200 kg/ha at this site resulting in a maximum yield of 8.6 t/ha or almost a 2 t/ha increase in yield compared to the 40 kg K/ha application rate. This shows just how responsive some sites can be to K fertiliser application where soil test levels have been run to a very low level.

Figure 4. Effect of K fertiliser application on spring barley yield at low soil test K



In summary these experiments highlight the importance which K has in underpinning crop production. While the responses are extreme, they highlight what can happen if K nutrition is neglected and soil test K levels decline. Increasing crop yields have placed a greater removal pressure on soil K supplies than ever before.

Potassium is subject to a level of leaching loss from soils in humid high rainfall regions such as Ireland and the U.K. and cropping systems which do not chop and return straw remove higher levels of K than those that do not. These factors combine to increase the importance of regular soil test and the design of fertiliser programmes which adequately provide for soil K build up and losses in addition to plant requirements and off takes.

YEN YIELD TESTING

Spring Potash Trials

The yield testing arm of the YEN is funded by the European Innovation Partnership (EIP) scheme to run on-farm experimentation testing yield enhancing ideas. ADAS are currently running Farmer Innovation Groups (FIGs) testing ideas around amino acids, spring potash, canopy longevity, crop momentum and soil management, which will run over two seasons.

The objective of the spring potash FIG is to test the potential benefit of adding additional potash, in the form of muriate of potash (MOP, 60% K_2O), in the spring at the same time as the main nitrogen application. Potassium and nitrogen are strongly associated within plant processes as nitrogen stimulates cell growth which increases cell water intake. Potassium is then needed to maintain cell turgor by regulating cell water content, this is essential to optimise light interception as it effects leaf morphology. The formation of proteins from nitrate and their distribution around the plant is also dependant on adequate potassium levels, therefore affecting the crop N response.

The trial first ran is spring 2018 and will be repeated again for 2019. 4 farms participated in the trial which compared standard farm practice with 100 and 200 kg/ha MOP.

If you are interested in joining an additional group then please email yen@adas.co.uk

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