Understanding limitations to potato yields

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"understanding how potatoes grow determines how to grow potatoes" Allen & Scott (2001)

Potato growers in Ireland and the UK are striving to reduce production costs and increase yields in order to maintain the economic viability of their business. The purpose of this paper is to explore how yields are formed, what factors may be limiting them and how these limitations may be removed or reduced.

Work published by John Montieth in 1977 showed that that the yield of many crops was proportional to the amount of solar radiation absorbed by those crops. Subsequent studies have shown that the amount of radiation absorbed by the crop is proportional to crop ground cover (e.g. the percentage of available ground covered with green, productive potato leaves. Therefore, yield production is proportional to the extent and duration of the crop canopy. Long-term (1991-2015) weather data derived from NASA shows that when compared with Cambridge in the East of England receipts of solar radiation in Dublin are less particularly in July and August. To what extent does this reduction in summer sunlight affect the yield potential of potato crops? Work done at Cambridge University Farm has shown that reducing the amount of sunlight reaching the crop canopy by about 40% resulted in only a 15-20 % decrease in yield. This is because crops growing in duller conditions convert a larger proportion of the sunlight into yield that crops growing in bright conditions. Analysis of data has shown that the time-course of canopy development has a much larger effect on yield that how bright or dull the season is. In the northern hemisphere, day length reach a maximum around 21 June and to maximise yield potential the development of ground cover should be timed to coincide with this. Studies have shown each day's delay in crop emergence was associated with a decrease in yield of 0.25 t/ha. However, in the UK planted and emerging crops are at risk of frost whilst in Ireland, planting on the heavier-textured soils is often delayed due to them being slow to dry-out in the spring. Potato cultivations and planting in soils that are too wet results in damage to the soil structure which results in loss of yield potential. Survey data by Stalham *et al* (2005) showed that potentially two-thirds of the UK crop is grown in compacted soils and this limits potato yield and a similar situation probably exists in Ireland. Clearly, when soil conditions do become favourable it is imperative that these opportunities are exploited. Recent studies have shown that due to the availability of large, powerful tractors many growers de-stone their field deeper than is agronomically necessary and this is detrimental to yield. Shallower de-stoning often resulted in increased yield with no discernible effects on crop quality (e.g. bruising, greening etc.). However, shallower de-stoning was associated with faster work rates which are important since de-stoning is often the rate limiting step at planting. Further studies have shown that since the speed of tandem and 'trandem' de-stoners is dictated by slowest de-stoner operating them singly, in lands, speeds up the process. Detailed analysis of crop performance (using crop monitoring and modelling) has been useful in identifying the reasons for loss of yield potential. For example, this type of analysis has

been used to show how much yield potential has been lost and the possible caused of this loss. This type of analysis is important since it helps growers identify the real cause of yield loss and thus where improvements need to be made. For example, growers often apply more N than is agronomically justified as 'insurance' to protect their yield potential against adverse weather and soil condition. Ongoing work has shown that these insurance applications are associated with significant reductions in yield due to the adverse effects of excess N on partitioning.

Whilst we cannot alter weather patterns, we can make sure that we have agronomic knowledge and resources to make sure that we maximise the yield potential of each field in each season.