POTATO Review

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ROLL-OUT FOR NEW SUFFOLK BRAND

EVALUATING THE OPTIONS FOR POTATOES

Farmers are looking for irrigation equipment which will reduce labour costs, improve crop productivity and increase water use efficiency. Dr JERRY KNOX of Cranfield University assesses the factors which need to be taken into account when considering a switch from standard hosereels to alternative systems

The dominant method of potato irrigation in the UK has always been a hosereel fitted with a rain gun, but booms, which potentially offer much better uniformity, are gaining popularity. Technological developments have also resulted in widespread uptake of alternative semi-permanent systems, including trickle and sprinkler irrigation.

Hosereels are always criticised for being inaccurate and inefficient but they are robust, versatile and fit well into typical UK farming systems. This is because the relatively short irrigation season, the small seasonal application depths (the total amount of water applied) and the flexibility required by rotational cropping patterns (following potatoes around a farm with non-standard field sizes) have favoured flexible systems with low capital costs.

Interestingly, recent research funded by the Horticultural Development Council (HDC) on the efficiency of overhead irrigation has found that under low wind conditions and when managed correctly (ensuring correct lane spacing and operating pressure), the uniformity of rain guns can in fact be very high – typically around 75–80%.

Major improvements in the design of hosereels fitted with booms have overcome many of the problems which previously made them unpopular with potato growers. The largest booms can irrigate a strip of equal width to a gun and the latest designs are simpler to fold up for moving between strips. Fields with uneven topography, low infiltration rate soils and irregular shapes can create problems, but on large, flat fields booms are becoming the *de facto* choice.

However, they have much greater instantaneous application rates than guns, so run-off and soil capping can be a problem, particularly on silty soils and/or sloping land. Notwithstanding this, sales are growing strongly, driven by demand from the field-scale vegetable, potato and salad sectors where improving irrigation efficiency has become a driving factor.

There has also been a shift away from mobile overhead irrigation to semi-permanent systems such as solid-set micro-sprinklers. These are an economic alternative where frequent applications are required, and are well suited to small areas or irregular shaped fields that are difficult for large mechanised systems.

The cost of close lateral spacing and extensive pipe networks is compensated for by lower operating pressures (typically 3 to 4 bar in-field) allowing cheaper plastic pipe to be used. Advances in remote control technology enable field blocks to be managed on an individual basis, with irrigation applications adjusted according to variations in crop cultivar and local soil type. >>

Trickle allows smaller and more timely applications, and more accurate scheduling.

The advantages of solid-set sprinkler systems have resulted in widespread trialling, particularly by major producers engaged in growing specialist varieties who are seeking to maximise their benefits from limited water resources. Interest in trickle has also been reawakened due to product improvements and the introduction of low-cost disposable drip tape. Commercial potato growers are again experimenting with the technique and the reported area under trickle is on the rise, following a period of stagnation.

Unfortunately, there is still only limited evidence on the performance of trickle on potatoes. Recent on-farm trials, although not scientifically replicated or fully instrumented, have usefully identified field-scale problems. Issues relating to installation and retrieval have been resolved but growers need to remember that trickle still requires a very high level of management input.

The benefits on potatoes primarily relate to attaining premium crop quality (controlling the incidence of common scab). However, these systems are still very dependent on ambient weather conditions; a wet summer makes trickle a very expensive form of supplemental irrigation, and of course declining crop prices have meant that growers really need to achieve additional benefits in order to justify the capital cost.

As water becomes more expensive, the potential for savings by switching to trickle becomes particularly attractive but on-farm trials in the UK have produced conflicting messages. This is because accurate comparisons between trickle and overhead irrigation are difficult without replicated trials using a range of treatments and measuring yield, quality and crop water use.

With trickle, it is more difficult for the grower to assess how much water is needed and it is easy to switch the system on too often or for too long. Indeed, research from overseas suggest that water savings are usually marginal, or even negative.

Silsoe's Jerry Knox reports increased interest in booms, solid-set sprinklers and trickle tape for use on potatoes.

Clearly, the use of a scientific scheduling approach is critical but scheduling potatoes under trickle is also difficult. This is because the wetted area is localised and conventional soil moisture measurements may be unrepresentative of actual soil profile wetness.

Another problem with interpreting farm trials data is in distinguishing between the water saving directly due to the use of trickle irrigation from that achieved by better scheduling and more intensive management. Whether the savings will persist once a trial is less closely monitored remains unknown. But achieving real water savings under trickle will inevitably become more important once the marginal cost of water (direct abstraction) starts to rise.

All potato growers are interested in better irrigation efficiency but clarification is required in terms of recognising the fundamental difference between efficiency and uniformity. The important point to stress is that trickle irrigation can potentially use less water than spray irrigation but crop water use (transpiration) from a fully irrigated crop is similar, irrespective of the method of application.

Using trickle, however, spray evaporation, wind drift, and leaf interception are all avoided, and soil evaporation is much reduced. As a static (solid-set) system, it allows smaller and more timely applications, and is easier to automate than portable or moving overhead irrigation systems. This permits more accurate scheduling. Potentially, trickle can also give a high uniformity of application, thus reducing the need to over-irrigate to compensate for dry spots.

In contrast, hosereels can provide poor application uniformity, particularly when windy, and this can result in localised plant water stress while other parts of the field are over-irrigated, thus wasting water. Wind drift can also carry small droplets out of the irrigated area. Reducing each of these losses is the key to improving application efficiency.

Despite these criticisms, there is surprisingly little hard data on the efficiency of water application from overhead systems under UK conditions. Agronomists scheduling commercial crops have reported that in hot, dry weather sometimes only 60–70% of the water applied from hosereel and gun systems appears to be accounted for in their soil moisture measurements. However, these evaluations have not been controlled by simultaneous catch-can or gun discharge measurements. Incorrect settings or low pressure could have meant less water was actually applied than intended, or

COMPARING IRRIGATION COSTS

Measuring the cost of irrigation and its benefits on potatoes needs to be done carefully. This is because costs are site specific and will vary depending on the water source and the distribution network. However, in-field costs (i.e. downstream from a pressurised hydrant at the field edge) are easier to compare, although they still vary depending on row/bed configuration, topography (slope) and water quality.

Irrigation costs comprise fixed (i.e. capital costs amortised over their useful life of the system) and variable (in-field running costs including labour, fuel, water and repairs) components.

For a typical hosereel without winter storage, the capital costs are around £2800–£3200/ha, the total annual cost is approximately £500–£600/ha irrigated, and the average cost per unit of water applied is around £0.40–£0.45 per m^3, net of losses.

It is estimated that to replace a gun with a modern boom irrigating a 72 metre strip with spray nozzles would cost about another £8000. Spread over 30 hectares, this would increase in-field capital costs by £36/ha/per year (amortising over 10 years at 6% real interest rate, and assuming other costs remain unchanged).

Trickle costs depend very much on field configuration, product type and tape thickness, but assuming potatoes are grown on 0.90cm centres, the annualised costs for a one-year disposable tape are approximately £650/ha irrigated with an average cost per unit of water applied of around £0.50–£0.60 per m^3. These exclude 'other' costs for filtration and fertigation. Sprinkler costs are reported to be marginally less than those for trickle.

The net (marginal) value of water therefore varies depending on the irrigation benefits attributed to the crop (recognising that different potato varieties have different responses to irrigation in terms of yield and quality) and costs (reflecting the different capital and variable costs of the systems used).

The overhead methods predominantly used in the UK have generally been considered to be inaccurate and potentially wasteful. This was less important in the past, when a smaller proportion of the national potato crop was fully irrigated, when scheduling itself was inaccurate, quality was not the main objective and water was readily available. However, increased competition for resources coupled with new water regulations, will require a move towards more accurate and efficient application systems.

The increasing interest in booms, sprinklers and trickle for use on potatoes suggests shifts in irrigation practice are well underway, particularly in catchments where water is highly valued.

the poor uniformity and a limited number of probe sites could have distorted the results.

Water distribution measurements at Cemagref (the national irrigation research organisation in France) at temperatures of up to 31°C and across a range of wind speeds, showed that 85–90% of the water discharged from a gun was collected in catch-cans at canopy level. Evaporation from foliage could account for another 2 mm loss (i.e. 8% of a typical 25 mm application). This suggests that at least 80% should reach the soil in daytime summer conditions, and more at night (probably over 90%).

Given that other systems have similar foliage losses – plus daytime aerial losses of say 5% – switching between overhead methods may not drastically improve application efficiency. Indeed, the very fine drops from some spray nozzles are more likely to evaporate and drift than the large drops from guns.

An equally important problem, particularly with guns, is the poor uniformity of water application. This can result in drainage losses on a fully irrigated crop, particularly where a farmer tries to compensate by applying even more water.

Scheduling by point measurement methods, such as capacitance probes, is also potentially inaccurate if the water is not uniformly applied. The use of booms should help significantly here by applying water accurately, saving water and helping provide a more uniform and higher quality crop.

SOURCES of useful information on improving irrigation efficiency:

- *Irrigation best practice: water management for potatoes, a guide for growers.* Produced by Defra email: ian.senior@defra.gsi.gov.uk
- *Improving irrigation efficiency: five minute irrigation performance checklist.* PDF downloaded from UK Irrigation Association (www.ukia.org)
- *Improving irrigation efficiency: optimising rain gun performance in field-scale vegetable production.* www.silsoe.cranfield.ac.uk/iwe/students/timlacey.htm