Rows vs Beds: a UK Perspective?

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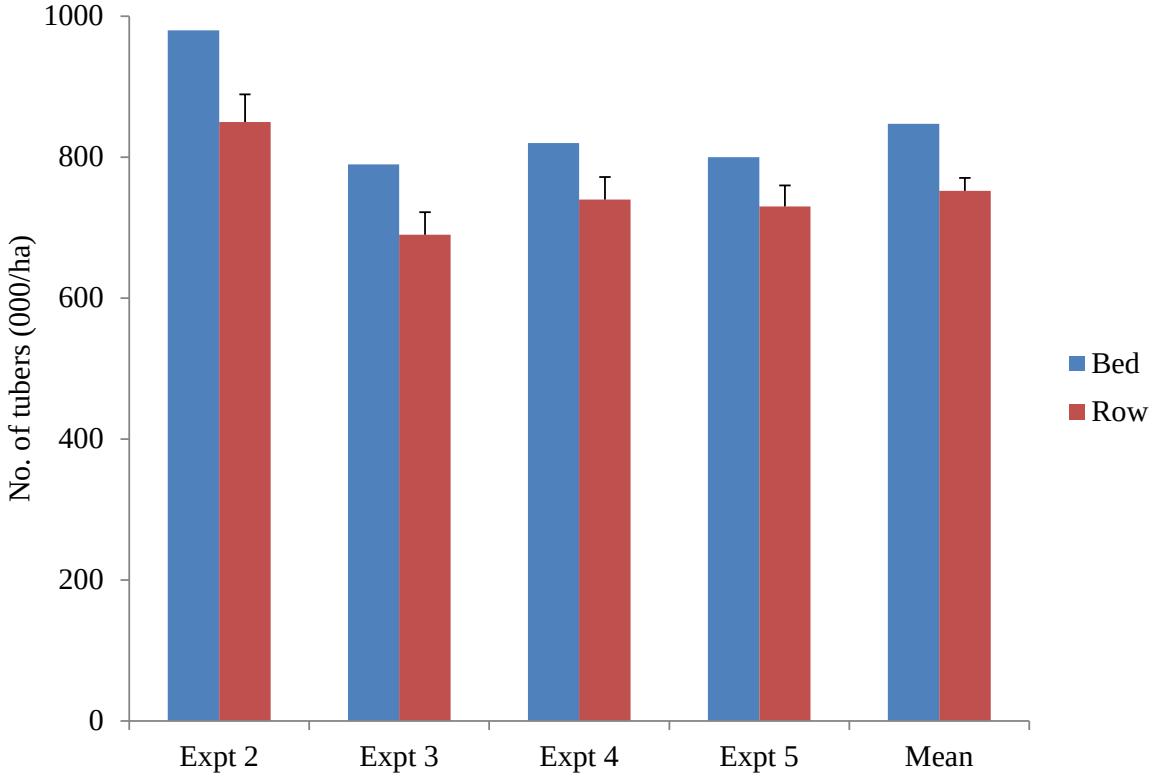
It is often asked by potato growers in the UK whether they should use beds rather than rows to grow their crops. There are a number of factors influencing the decision, some based on science, others based on anecdotal evidence. The most scientific reason would be the more even use of resources (soil, nutrients, water and radiation) within beds. Potatoes are almost universally grown in wide (28 to 40") rows. With very wide row spacings, at the typical target plant populations required for economic production in terms of tuber size grading for the intended market, within-row spacing can be very close. This leads to early competition between plants within rows, particularly with respect to shading of leaves by adjacent plants. Since radiation interception by the canopy is a major determinant of the number of potential tubers set by the plant (O'Brien *et al.* 1998), this early mutual shading has the potential to reduce tuber populations in traditional row systems compared with systems where plants are spaced more uniformly and the onset of competition occurs later during the development cycle.

Fowler (1988) completed his thesis on the effect of rectangularity of spacing on crop performance. Squarer planting (i.e. bed-type systems) increased the initial rate of ground cover development compared with rectangular systems of planting (i.e. traditional wide rows), but the effect diminished as planting density increased. His work showed a 13 % increase in the number of tubers produced with beds compared with rows (Figure 1). This increase in tuber population makes beds more suitable for salad (fingerling) and seed crops. It is also a viable solution for varieties which produce few tubers per stem and/or few stems per seed tuber as it can reduce the quantity of seed required to produce small to mid-sized tubers required by certain markets. On row systems where within-row spacing exceeds 18", a missed seed drop may be very significant as very wide gaps develop and yield loss occurs, and bed configuration reduces the effect of a miss. Conversely, attempting to grow prolific varieties for production of large processing tubers or baking outlets on beds is likely to reduce mean tuber size and make it more difficult to produce crops with a high proportion of very large tubers.

Figure 1. Effect of rectangularity on number of tubers (Fowler, 1988).



Although Fowler (1988) demonstrated these differences in tuber populations between beds and rows, in reality it is difficult to measure in practice, particularly as the yield may differ as well as the tuber population. He showed that at high planting densities, rate of canopy senescence was similar for bed and row configurations, leading to an increased radiation interception capacity for beds over the course of the season compared with rows. However, at low planting densities, the advantage conferred by beds was lost later in the season as beds senesced faster than row systems. The link between yield and canopy duration was close, so the effect of plant arrangement on tuber grading is heavily influenced by planting density.

Dedicated growers of salad (fingerling) crops in the UK almost universally plant in beds to take advantage of the increased tuber population, and on sandy soils this has led to configurations of three, four and even five rows in a 72" track width. Three rows per bed is by far the most common, with the 'quad' system gaining popularity in the 1990's. The latter system is actually a pair of close-coupled rows, with the plant arrangement on a diamond pattern, rather than four equally-spaced rows, and therefore the effect on tuber population is actually diminished. The 'quint' system is a 'quad' plus an extra central row. As the number of rows per bed increases, soil flow around planter shoes and covering shares becomes an issue and only on the sandiest soils can four or five rows per bed become a practical solution. Where growers have both maincrop and salad crops, a compromise needs to be made for either crop as having two dedicated planters is often economically unviable.

Bed systems have been proven to be more efficient at capturing water as there are 50 % less furrows for water to shed into. Measurements of water infiltration following ¾" to 1"

irrigation events has shown that *c*. 15 % of water can be lost through vertical drainage in traditional ridge and furrow systems, but only *c*. 5 % in beds under the same regimes. However, this extra water capture in beds often does not translate into increased yield. As a negative, on heavier soils beds can be difficult to harvest if heavy rainfall occurs that brings the soil back to field capacity.

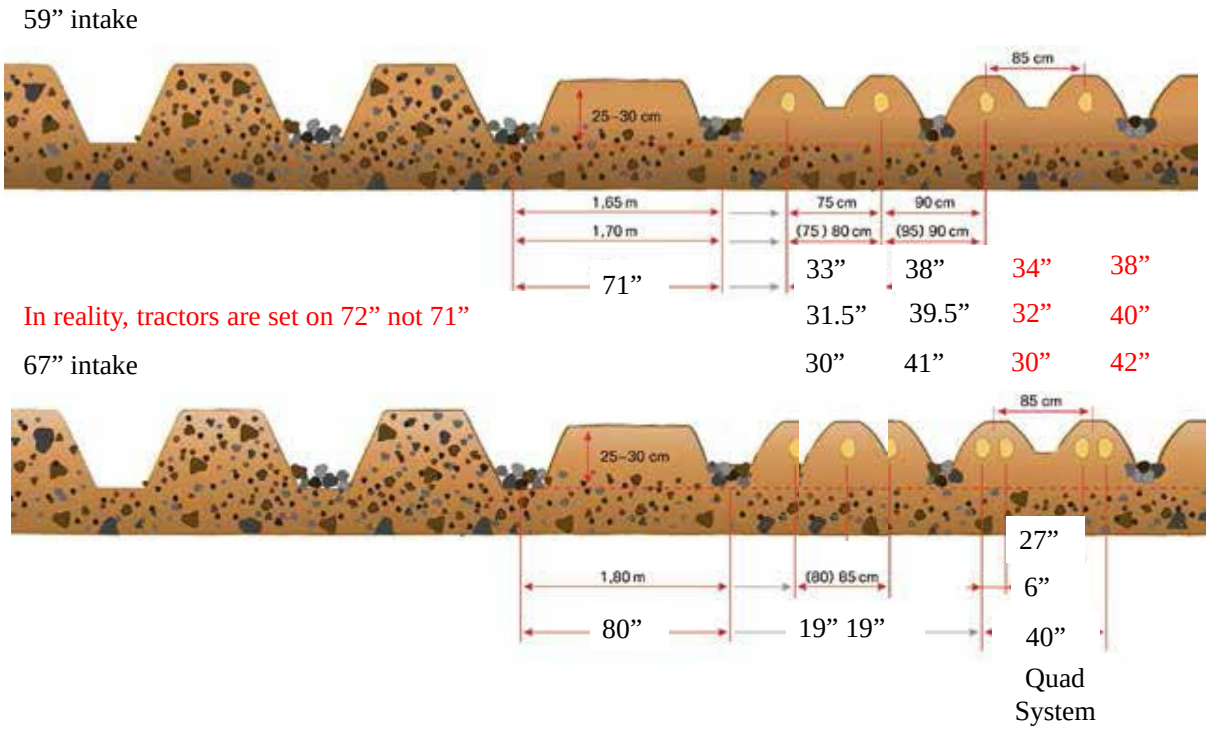
In the UK, the most common track width for machinery is 72", whereas in mainland Europe it is typically 60" (two 30" equally-spaced rows). There is a misconception that narrow rows limit yield potential, as some experiments at NIAB CUF have yielded as much as 50 t/acre. Additionally, both Germany and the Netherlands plant on 30" rows and have higher average yields than the UK. What drove the change from 60" to 72" track width in the UK was the adoption of destoners in the mid-1970's, where a bigger furrow between beds was required to bury the stone and clod removed from the bed. With harvester technology at the time, destoning was reported to improve spot harvesting rates by 40 % and reduce severe tuber damage by 30-50 % (Witney & McRae 1992), and therefore destoning (or declodding) was widely adopted. However, harvesting technology in Europe has moved on considerably in the interim period and harvesters can deal with clod far more effectively. Initially the move in wheel track for destoning systems was 68" but as tractor (and tyres) got bigger, the system settled on 72". With the move to wider wheel tracks came the need to apparently work soils deeper to create bigger ridges, with no scientific reason. Working soil deeper results in more stone (and appreciably more clod in heavier soils) and so the wheeled trenches became fuller and the compacted area greater. Tyres on tractors towing destoners are now typically 15" wide, so the furrow must be of similar width to accommodate. This has resulted in 'skewed inboard' configurations being adopted, where the planter produces rows 34" apart within the bed and 38" apart between adjacent beds (Figure 2). As tyre size increased, this has moved to 32" within-bed and 40" between beds to avoid compacting the ridge flanks and reduce the proportion of green tubers that are exposed to light as the compacted soil cracks and erodes. Indeed, beds have been shown to reduce the proportion of greening as there is 10-20 % less surface area in flat-topped beds compared with ridge and furrow systems.

The idea that controlled wheelings on 72" centres reduces the effects of compaction within the zones where roots and tubers grow is therefore compromised. Using narrower (12-13") tyres avoids the problem but the lack of traction during destoning and the lack of a firm wheeling for harvesting under wet conditions means that wide furrows and tyres are the norm rather than the exception. The majority of growers in the UK use two-row trailed harvesters and this can lead to damage at harvest owing to tractor wheels from both harvester and trailers compressing and exposing tubers in the flanks of the ridge, particularly when opening up a field. The use of self-propelled harvesters can eliminate some of these issues but not all.

One grower in the UK has successfully adopted the Grimme Maxi-Bed system, where the wheeltrack is increased to 108" (2.7 m) and three rows are planted. Theoretically, the 50 % fewer wheelings mean more useable land, though achievement of complete ground cover is often delayed by the very wide wheelings. Reportedly, output is increased by up to 150 % and fewer tractors and operators are required. However, it is a big step as growers have to convert their whole machinery system to suit the wider tramlines and therefore there is a

very high initial investment in machinery There have also been problems with burying the quantity of stones in very stony conditions.

Figure 2. Effective row and furrow widths for destoning systems.



Summary

The more even use of resources in bed systems makes them more suitable for fingerlings and seed and for varieties which produce few tubers. Narrow rows can still produce the same yield as wider systems but the ‘controlled’ wheeling system used in the UK can actually increase compaction and greening. Soil flow and separation issues at planting and in wet harvests results in beds being largely confined to sandy soils.

References

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