Factors affecting tuber numbers per stem leading to improved seed rate recommendations

Introduction to the project and key findings from analysis of historic data

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Research supported by the Potato Council at Cambridge University Farm has enabled improved seed rate recommendations to be made by quantifying key factors that determine the number of stems produced by seed tubers. Further work is being carried out so that this approach can be applied to a wider range of varieties than has been studied so far and to enable future recommendations for new varieties to be made without the need for extensive experimental data. The new research also aims to extend guidelines to provide more accurate recommendations for specific conditions that affect the number of tubers per stem.

Quantifying key factors that determine the number of stems produced by seed tubers enables variation in tuber populations between crops to be reduced because the stem population is a major determinant of the tuber population but further control of the variation in tuber populations requires a better understanding of other important factors. An analysis of extensive historic datasets where the numbers of stems and tubers and other key data were collected has been used to identify factors that will be investigated further in the new research project at Cambridge University Farm.

Key findings from analysis of historic data

Fertiliser and irrigation

Effects of rates of fertiliser and irrigation on the number of tubers were examined by summarising results from experiments where these factors were included as treatments. Increase in the amount of applied P increased the number of tubers in a small number of experiments (13 %) where yield was also increased by P but in most experiments with P or K there was no effect on the number of tubers. Effects of N and irrigation on the number of tubers occurred more frequently than effects of P and K but in most experiments these factors also had no effect. Over the range of typical N application rates for potato crops, effects were often limited or absent. Where effects of N on the number of tubers were found, this was most often an increase with increase in rate of N application but the number of tubers decreased with increasing N application in some experiments. Decreases in the number of tubers with increase in N were generally relatively small whereas in some experiments application of N resulted in substantial increases in the number of tubers compared to application of no applied N. For the minority of experiments where irrigation affected the number of tubers, irrigation increased the number of tubers in more experiments than the number of tubers was decreased. In many experiments, effects of irrigation were relatively small and large differences were generally found only in experiments where rain covers were used to exclude rain early in the season. There was evidence that in some circumstances irrigation can occasionally result in a significant increase in the number of tubers over crops receiving only rainfall.

Varieties

Although the increase in number of tubers with increase in number of stems was represented by a similar form of relationship (exponential curve) for all the varieties examined, varieties were clearly characterised by differences in the number of tubers produced at high stem populations. This characteristic was generally consistent with expected rankings according to production of tubers per stem (e.g. many for Charlotte and Maris Peer and few for Hermes and Cara) and can be used to provide a useful quantification of differences in the number of tubers per stem between varieties. Collation of the data showed that whilst in many cases the number of tubers produced for a given stem population was close to the value predicted from an overall relationship, considerable variation in the number of tubers was found at all but very low stem populations. Determining and quantifying factors associated with this variation should enable improvements in seed rate recommendations to be made.

Planting date

Cases where the number of tubers produced was lower than expected (from the stem population) were generally associated with relatively late plantings (mid May onwards). The data indicated that on average, the earliest plantings (before mid April) resulted in slightly fewer tubers per stem than plantings up to early May and later plantings were associated with reductions in the number of tubers per stem. The implication of these findings for seed rate recommendations will be investigated in ongoing research.

Soil type and condition

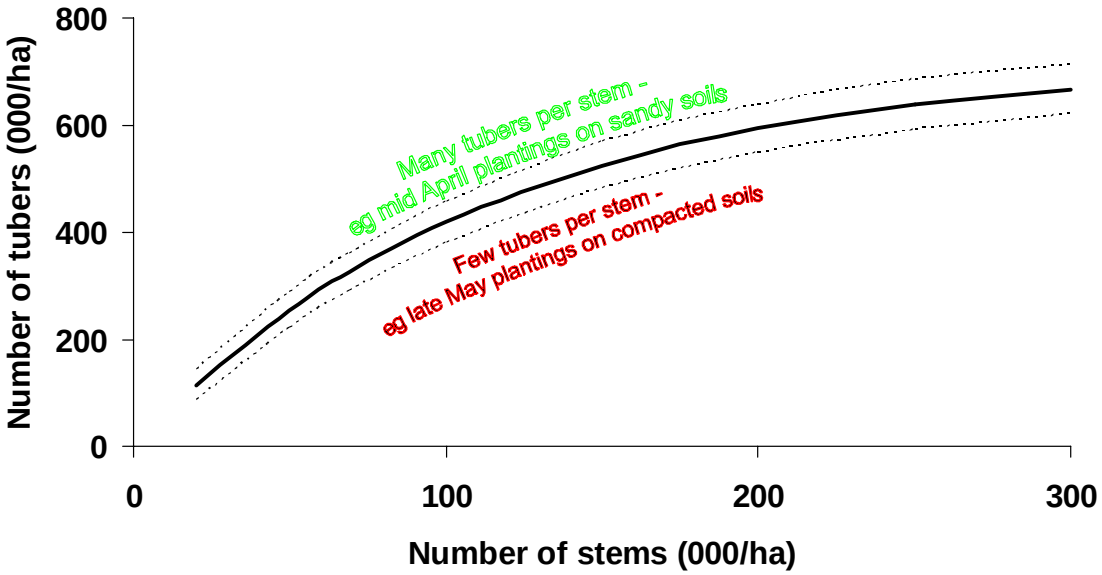
Most of the data examined was from coarse loams but analysis of the data provided some evidence that the number of tubers per stem may be affected by soil type. In some varieties (Maris Peer and Hermes) the number of tubers at high stem populations was greater for sands than loams. As plantings tended to be earlier on sandy soils, it is possible this effect may be confounded with differences in planting dates between soil types. On clay soils the number of tubers per stem was generally lower than average and there was evidence that poor soil

conditions (e.g. soil compaction) were associated with relatively few tubers per stem. Differences in soil type may affect the number of tubers per stem through several mechanisms and an objective of further research is to improve understanding of this to determine modifications for seed rates that may be appropriate.

Environmental conditions and crop development

Previous studies have shown that environmental conditions during tuber initiation, particularly the level of incident radiation, can affect the number of tubers initiated and retained. Analysis of a series of carefully documented experiments showed that although variation in the number of tubers per stem was not explained by differences in incident radiation alone, accounting for absorbed radiation during initiation did explain a considerable amount of the variation. The number of tubers per stem was generally increased with increase in the amount of absorbed radiation so that the most tubers were produced when plants had grown rapidly to achieve a relatively high ground cover by tuber initiation and incident radiation levels were also high (sunny weather).

It is likely the amount of radiation absorbed during tuber initiation is a major determinant of the number of tubers per stem and accounting for this should enable any direct effects of other factors (e.g. fertilisers, irrigation, planting date, soil type and soil conditions) to be separated from indirect effects resulting from changes in the size of the canopy at tuber initiation so that implications of such factors for agronomic decisions can be determined.



Understanding and quantifying factors affecting tubers per stem will enable more specific seed rate recommendations to be made to achieve the optimum tuber populations required. Identifying circumstances likely to result in fewer or more stems than usual will allow appropriate adjustment of seed rates.