PUBLICATION DATE 31 AUGUST 2015

LATE-SEASON IRRIGATION FOR BRUISING AND SKINSET

INTRODUCTION

Potatoes receive 54 % of all water applied as spray irrigation in England & Wales[1]. The majority of the potato area is grown on lighter (sandy) soils to aid cultivations and harvesting. This increases the irrigation requirement.

Whilst there has been a focus on improving irrigation scheduling for control of common scab (see early season irrigation note). Irrigation management in the run-up to desiccation and harvest has been largely neglected. AHDB Potatoes Project R445[2], combined with information from Project R263[3], has provided growers with better information regarding late-season management of irrigation with respect to bruising and skinset.

Late-season irrigation management is key to avoiding bruising.

BRUISING

The various forms of tuber bruising cause losses in the region of £100M to all sectors of the industry every year. Mechanical defoliation of actively growing canopies can result in significant increases in bruising, particularly if the crop has been previously irrigated and then allowed to dry out prior to defoliation.

Roots die during crop senescence limiting the plants ability to take up water from the soil to tubers, so where crops are senescing naturally, late season irrigation can reduce the risk of bruising; but where crops have senesced completely, there is no effect of water on bruising. Four out of six detailed experiments in Project R445[2] assessing the effect of late-season irrigation on bruising, identified a reduction in bruising incidence where SMDs were maintained at c. 30-50 mm on sandy loam soils (i.e. just below the limiting SMD for yield) in the 3 weeks prior to desiccation than where SMDs reached 60-70 mm. The safe values would be slightly lower on sandy soils (e.g. 30-40 mm)

Growers should be aware if attempting to rehydrate tubers just prior to harvest that while pre-harvest irrigation aids soil management on the harvester, it does not appear to impact on the susceptibility to bruising.

SKINSET

Water and nitrogen management, play an important role in governing the timing and rate of canopy senescence and is closely linked with the rate of skinset. Correct nitrogen management should result in late season irrigation having negligible effect on skinset. However, for crops defoliated prior to active senescence water can still be taken up and this may slow skinset. Growers frequently have a perception that continuing to irrigate close to harvest will make harvesting conditions wet and will delay skinset. However, maintaining 30-50 mm SMDs close to harvest will allow for a buffer for extreme rainfall event and prevent yield loss.

LATE SEASON TUBER CRACKING AND SECONDARY GROWTH

Later in the season, growth cracks can form due to fluctuating environmental conditions (such as uneven soil moisture, soil and air temperature), and rapid water uptake (see overwatering technical note) and tuber growth[7,8].

Growth cracks increase when relatively poor growing conditions are rapidly followed by relatively good growing conditions, such as prolonged moisture stress or high temperatures followed by irrigation or rainfall[9]. Once rain or irrigation replenishes the water supply, rapid growth can cause tubers to crack. Severe cracking usually occurs at the height of the season (July or August) when the potential for rapid growth is at its peak and is therefore difficult to manage in unirrigated crops where the variety is prone to cracking on relief of water stress. In unirrigated scenarios, growers should select varieties with a low risk of cracking.

Even during wet summers, when the need for irrigation is limited, tuber cracking can still be a problem. Research at ADAS Gleadthorpe[10] on light sandy soils showed that cracking was 9 % where two irrigations were missed at the beginning of July compared with only 1 % where both scheduled

irrigations were applied. The proportion of tubers with growth cracks increased as irrigation decreased.

Secondary growth symptoms (including mis-shapes, sprouting, chain tuberization and secondary tubers) may also arise from periods of water stress followed by a return to normal, adequate soil water content[8]. Plants subjected to short periods of severe stress generally have a higher incidence of malformed tubers than those grown under continuous irrigation[13].

PRACTICAL RECOMMENDATIONS

BRUISE MANAGEMENT

Avoiding bruising should be the key to late-season irrigation management rather than the possibility of delayed skinset in late-watered crops.

Project R445[2] demonstrated reductions in bruising by maintaining moderate SMDs close to the limiting SMD for yield during August. Continued use of irrigation through the later season will therefore reduce bruising compared to crops left unirrigated and left to survive on soil reserves alone during dry periods. On sandy soils, SMDs should be maintained at 30-40 mm close to harvest, whilst on heavier soils, 40-50 mm should be adequate.

EFFECTS OF SOIL WATER CONTENT ON SKINSET

Growers should monitor SMDs later in the season and irrigate where necessary. The crucial objective is maintaining moderate SMDs, rather than wet soil, which can adversely affect other aspects of tuber quality (e.g. increased rotting diseases and lenticel eruption and decreased tuber dry matter concentration) and soil conditions for harvest. Correct nitrogen management is likely to have a greater effect on skinset than watering regime in these circumstances.

GROWTH CRACKING

To reduce the incidence of secondary growth cracks, it is important to maintain the correct soil moisture throughout the season. This is especially important during the bulking stage in July and August when canopy cover is complete and tubers are rapidly expanding. Allowing soil to dry to well beyond the limiting SMD and then irrigating (or receiving a late rainfall event) can cause secondary growth in some varieties. A late-season irrigation regime that maintains the yield potential of the crop and satisfies turgor status for bruising will reduce the risk of secondary growth. Conversely, late over-watering (more typically resulting from intense or prolonged mid-summer rainfall events rather than irrigation) generally has relatively little effect on crop growth and quality, with the exception of varieties where wet soils encourage tuber cracking centred on lenticels (e.g. Vales Sovereign) or where low soil oxygen concentration results in enlarged lenticels (most varieties).

PRE-DESICCATION IRRIGATION

Growers should focus on the lead-up to desiccation or harvest rather than immediately prior to the event. Irrigation post-defoliation, usually immediately before harvest, is commonly practised in dry summers/autumns in the UK to reduce bruising. The perceived view of the industry[14] of a single irrigation event immediately prior to harvest as a method to reduce bruising susceptibility has little supporting scientific evidence, its only use being to assist in keeping soil on harvester webs and improve soil conditions.

DEFOLIATION TIMING AND METHOD

Mechanically defoliating a crop just prior to the onset of senescence following a period of high evapotranspiration demand can cause a significant increase in bruising compared with crops allowed to senesce naturally. This can occur in all crops, irrespective of the SMD at the time of defoliation[3]. Obviously, defoliation timing can be critical for size specification, but if at all possible growers should time flailing or desiccation when the crop is likely to be at its most hydrated (i.e. early morning or on cooler, duller days) in order to avoid bruising.

CESSATION OF IRRIGATION

After crops have senesced to less than 50 % ground cover, there is little benefit in continuing irrigation. However, if senescence is variable in the field, thereby preventing targeted irrigation of areas with more complete canopy cover, best practice would be to irrigate overall to reduce the risk of bruising and accept some over-watering of areas of dead crop.

REFERENCES

1. ANON (2011). Water Usage in Agriculture and Horticulture. Results from the Farm Business Survey 2009/10 and the Irrigation Survey 2010. London: DEFRA. http://www.swarmhub.co.uk/index.php?dlrid=4088

2. STALHAM, M.A. (2014). *Late-season water management*. Final Report Potato Council Project R445. Stoneleigh: Agriculture and Horticulture Development Board. http://potatoes.ahdb.org.uk/sites/default/files/publication_upload/R445%20Late%20Season%20Water%20Management%20FINAL.pdf

3. STALHAM, M.A. (2008). *Management of tuber water status to reduce bruising*. Final Report Project R263. Oxford: British Potato Council.

4. ANON (2004). *BPC National Bruising Survey*. Oxford: British Potato Council.

5. SMITTLE, D. A, THORNTON, R. E., PETERSON, C. L. & DEAN, B. B. (1974). Harvesting potatoes with minimum damage. *American Potato Journal* **51**, 152-164.

6. GANDAR, P. W. & TANNER, C. B. (1976). Leaf growth, tuber growth, and water potential in potatoes. *Crop Science* **16**, 534-538.

7. JEFFERIES, R. A. & MACKERRON, D.K.L. (1987). Observations on the incidence of tuber growth cracking in relation to weather patterns. *Potato Research* **30**, 613–623.

8. HILLER, L.K. & THORNTON, R.E. (2008). Managing Physiological Disorders. In *Potato Health Management: Plant Health Management Series*, edited by D. A. Johnson, p. 235–245. St Paul, Minnesota: The American Phytopathological Society.

9. SELMAN, L., ANDREWS, N., STONE, A. & MOSLEY, A. (2008). *What's Wrong with My Potato Tubers? Diagnosing Tuber Abnormalities in Western Oregon and Washington*. Oregon State University.

10. BAILEY, R. & GROVES, S. (1994). *Irrigation and tuber cracking*. Project 808/140. Oxford: Potato Marketing Board.

11. REEVE, R.M., TIMM, H. & WEAVER, M.L. (1973). Parenchyma cell growth in potato tubers. *American Potato Journal* **50**, 71-78.

12. COREY, G.L. & MEYERS, V.I. (1955). *Irrigation of Russet Burbank potatoes in Idaho*. Bulletin 246, Idaho Agricultural Experimental Station.

13. RUF, R.H. (1964). The influence of temperature and moisture stress on tuber malformation and respiration. *American Potato Journal* **41**, 377-381.

14. FELLOWS, J. (2004). Factors associated with internal damage and bruising in potato tubers. *Project Report 807/227*. Oxford: British Potato Council.

Written by Mark Stalham NIAB CUF