Grower Summary

FV 326a

Impact of irrigation practices on Rijnsburger bulb onion husbandry, quality and storability - II

Final 2013

Disclaimer

The results and conclusions in this report may be based on an investigation conducted over one year. Therefore, care must be taken with the interpretation of the results.

Use of pesticides

Only officially approved pesticides may be used in the UK. Approvals are normally granted only in relation to individual products and for specified uses. It is an offence to use non-approved products or to use approved products in a manner that does not comply with the statutory conditions of use, except where the crop or situation is the subject of an off-label extension of use.

Before using all pesticides check the approval status and conditions of use.

Read the label before use: use pesticides safely.

HDC is a division of the Agriculture and Horticulture Development Board.

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Project Title:	Impact of irrigation practices on Rijnsburger bulb onion husbandry, quality and storability - II
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Further information

If you would like a copy of this report, please email the HDC office (hdc@hdc.ahdb.org.uk), alternatively contact the HDC at the address below.

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GROWER SUMMARY

Headline

This project provides best practice guidelines for optimising bulb onion irrigation

Background

An estimated 85% of dry bulb onion crops in the UK are irrigated, following a drive in the industry for production on light soils to improve quality and aid crop management. However, there are concerns that existing irrigation practices may be compromising crop yield, quality and storability. Furthermore, there is little scientific evidence to support current practices, either for crop production or to justify irrigation water use and demonstrate efficiency for abstraction licence renewal in the future.

This project builds on findings from a 1-year HDC trial FV 326 (2007-8), which strongly indicated that irrigation practices had a significant impact on crop performance. However, due to inherent limitations of FV 326, further, large-scale field-based trials were required to fully evaluate the impact of irrigation regimes, particularly on crop quality and storability. This follow-on project proposes to address these issues by extending the original study to one commercial-scale field trial plus one rain-shelter trial over a period of 3 seasons.

Ultimately, this project will lead to the identification of optimum irrigation practices in the form of best-practice guidelines to help growers maximise marketable percentages and increase the storage period of bulb onions. Furthermore, the findings will assist growers at abstraction licence renewal and may show benefits for nutrient and weed management.

This report summarises the data from all 3 years of the trial. For specific data relating to individual years, please refer to the respective Annual Reports.

Summary

- Water stress up to egg-stage significantly reduces onion yields and profitability.
- Little and often irrigation from bulb initiation to egg-stage is worth prioritising to increase yield and size, unless the forecast is unsettled.
- Early or late season little and often irrigation may increase yields, but caution is advised to balance against risks.

A range of irrigation regimes, applied using over-head sprinklers, were tested during the 3 year project, both under rain-shelters and at an open-field commercial site. Irrigation treatments were based on combinations of different quantities and frequency of irrigation (see **Table 1**), applied during different stages of crop development:

- Early-season – from 2-3 true leaves (approx. mid May) to bulb initiation (approx. early July)
- Mid-season – from bulb initiation to egg-stage (approx. early August)
- Late-season – from egg-stage until irrigation stop timing
- Stop timing – at 50% or 100% canopy fall-over

Table 1 Irrigation practices used to determine irrigation regimes

Irrigation practice	Code	Typical trigger for irrigation*	Typical application depth*	Typical application interval**	Comment
Typical	T	~50% AWC used up	25mm	7-10 days	Standard practice for most onion growers during the main part of the season.
Little and often	L	~25% AWC used up	15mm	3-5 days	Effectively half as much twice as often, but note that the application depth is higher to account for evaporative losses at each event.
Stress	S	~75% AWC used up	25mm	10-14 days	This regime should maintain a soil moisture deficit – i.e. not return the soil to field capacity when irrigated. This is usually used during “Late” season to encourage uniform bulbing and maturity.
Excess (2010 only)	X	~12.5% AWC used up	10mm	2-3 days	In effect, this regime keeps the soil as wet as practically possible to achieve.
No Irrigation (2010 only)	N	-	-	-	Zero irrigation after wetting to field capacity at the start of the season.

*Assuming typical loamy sand or sandy loam soil, with rooting zone of 300mm

**Assuming crop with rapidly growing or full canopy under typical June/July/August conditions (subject to rainfall)

AWC = Available water content

Crop growth was measured during the season and harvested bulb samples were cured and stored in a commercial onion store for assessment in May the following year for post-storage yield, size and quality. The effect of the irrigation treatments on foliar pests and diseases,

weed flushes and nitrate leaching were also monitored through the season. The data was analysed to help identify optimal irrigation practices for bulb onion production, with the ultimate aim of producing a “best-practice” fact-sheet.

Overall, the results indicated that “little and often” irrigation applied during early season (to bulb initiation), and particularly during mid-season (from initiation to “egg” stage) significantly increased crop development and reduced thrip damage when compared to “typical” irrigation. However, although such practices led to some yield and bulb diameter increases, these were not always significant when compared to “typical” irrigation.

Late season irrigation after “egg” stage until irrigation stop (usually at 50% fall-over) and irrigation beyond 50% fall-over also significantly increased bulb yield and size compared to the normal practice of inducing stress during the late season and stopping at 50% fall-over.

However, the potential yield benefits of both “little and often” and late season irrigation need to be carefully balanced against the additional risks these practices pose. There was evidence that more frequent irrigation early in the season could increase weed levels and the risk of bolting where excess foliage development occurs. More frequent irrigation during the late season period increased foliar disease levels (especially downy mildew), delayed canopy fall-over and reduced bulb dry matter content. Furthermore, late irrigation could potentially jeopardise harvesting operations if further rainfall is received.

The project also showed that irrigation practices which maintain a level of water stress during the season were detrimental to crop production – with the period up to bulb initiation highlighted as critical. There were also indications that water stress may cause increased bulb diseases, internal disorders and perhaps also greater re-growth during storage.

Cost-benefit analysis and recommended irrigation practices are given below.

Financial Benefits

Onion production costs and gross returns for all the irrigation regimes tested were calculated using the assumptions in

Table 2 and **Table 3**.

Table 2 Irrigation costs assumed for cost-benefit analysis based on grower estimates and published figures

Element	Cost	Comment
Typical 25mm irrigation	£120 / *ha per irrigation*	Typically £85-£150, based on grower estimates and published figures
Of which "event" cost	£22.50 / *ha per irrigation*	Labour and tractor costs to move equipment
Of which water charge/pump	£32.50 / *ha per irrigation*	Volume-based EA abstraction charge and pumping costs, equivalent to £1.30 /mm/ha
Therefore typical "fixed" costs	£65.00 / *ha per irrigation*	Capital costs (infrastructure, equipment, maintenance etc)
Annual "fixed" costs	£390 /*ha per annum*	Assuming 150mm per annum applied (i.e. 6x 25mm applications)
Calculated costs for:		
Typical 25mm irrigation	**£55 /*ha per irrigation event***	**Plus annual fixed costs of £390 /ha**
Little and often 15mm irrigation	**£42 /*ha per irrigation event***	**Plus annual fixed costs of £390 /ha**
Excess 10mm irrigation	**£35.50 /*ha per irrigation event***	**Plus annual fixed costs of £390 /ha**

Table 3 Assumed farm-gate brown onion prices by size grade

Size grade	Price	Comment
<45mm	£25 / tonne	40-60mm price = £100/tonne. It is assumed that a small proportion of <45mm onions would fit in the 40-45mm size range and so achieve this estimated value per tonne.
45-60mm	£100 / tonne	
60-80mm	£250 / tonne	Range £240-260
80-90mm	£200 / tonne	Processing market – typically volatile prices
>90mm	£50 / tonne	Little market for over-size

Cost-benefit analysis reflected trial data, indicating that even relatively low stress conditions through the season could reduce profitability compared to “typical” practice by up to 150% in dry conditions. The analysis also suggested that “little and often” irrigation would be considerably more profitable by at least 50% in drier seasons when compared to “typical” practice, but less profitable by up to 17% in wetter seasons. Furthermore, the analysis indicated that late season irrigations could increase profitability by around 50%, particularly under dry conditions. However, these analyses did not take into account the additional risk posed by such practices which were highlighted earlier (e.g. potentially increased bolting, greater foliar disease and weed levels, delayed crop maturity and lower bulb dry matter).

Further analysis demonstrated that crop yields correlated strongly with total irrigation + rainfall up to a threshold of around 270mm total water applied during the period from 2-3 true leaves (approx. mid May) until harvest (Figure 1). This threshold level is likely to be higher in years with more solar radiation (i.e. less cloud cover) and consequently greater crop growth potential.

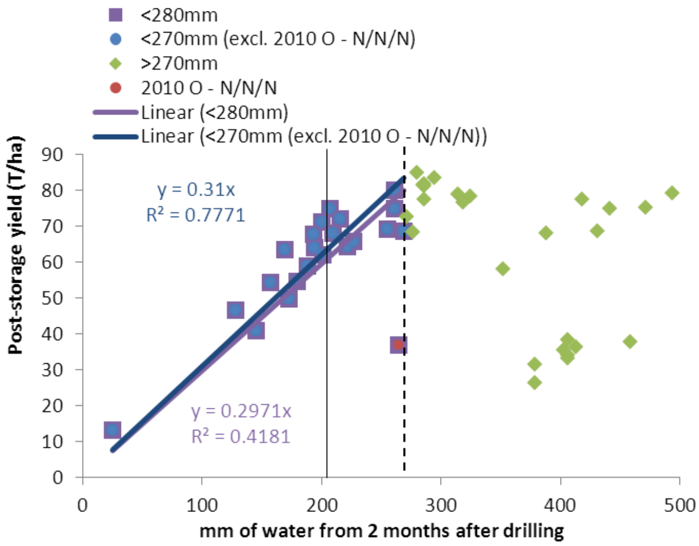

Figure 1 Correlation between total water received and crop yield. Solid line indicates mean East Anglia rainfall May-Aug (inclusive) 1970-2012. Dashed line indicates threshold level.

This analysis suggested that the average yield under rain-fed production (with no irrigation) was around 20 T/ha less than that achievable under irrigated production – equating to an average reduction in gross returns of around £3,400 (or higher if the effect on bulb size is taken into account). With production costs typically around £3,250 (plus irrigation and storage/grading costs), this highlights the critical importance of optimised irrigation to the industry.

Action Points

Based on the trial results and the cost-benefit analysis above, the irrigation practices in **Table 4** are suggested as a reasonable and practical balance between achieving optimum crop yield and quality while minimising agronomic and financial risk.

Note that **Error! Reference source not found.** has been generated with the assumption that weather conditions are predicted to remain dry for a period after irrigation has commenced. Consideration of forecast rain should always be given when programming irrigation in order to minimise the risks of drainage (and wasted irrigation effort/cost) by irrigating soil to field capacity when wet conditions are imminently forecast. Adjustments to application depths could be made to account for predicted rainfall if required.

"Best practice" guidelines, based on the recommendations from this project will be summarised in an industry facsheet, to be published by the HDC following this report.

Table 4 Suggested optimum irrigation regime for bulb onions (for sandy loam / loamy sand). Note that suggested applications are subject to individual soil characteristics and consideration should be given to forecast rain before scheduling applications.

Crop growth stage	ESTABLISHMENT Drilling to 2-3TL			EARLY SEASON 2-3TL to bulb initiation			MID SEASON Initiation to "egg" stage			LATE SEASON "Egg" stage to stop			STOP TIME		
Comment	If sufficient moisture in seed bed, irrigation only required under very dry conditions to aid establishment and pre-emergence herbicide activity.			Early season irrigation is important, becoming critical during particularly dry periods.			Mid season irrigation is critical to build crop biomass and promote bulb growth, becoming less important only under wet conditions.			During late season, controlled moisture stress should be allowed to develop to help promote bulbing and crop maturity. In particularly dry periods, more frequent irrigation will increase yields.			Under most circumstances, stop irrigation at 50% canopy fall-over. In particularly dry periods, irrigation up to 100% fall over will increase yields but should limit associated disease and quality risks.		
Weather	Dry	Normal	Wet	Dry	Normal	Wet	Dry	Normal	Wet	Dry	Normal	Wet	Dry	Normal	Wet
Importance of irrigation during period	Medium	Low	Low	High	Medium	Medium	High	High	Medium	Medium	Low	Low	Low	Low	Low
Description of irrigation trigger point and application	Low dose to minimise capping and cool shock potential.	Unlikely to be required	Not required	Return soil to FC when SMD reaches 25% of AWC	Return soil to FC when SMD reaches 50% of AWC	Return soil to FC when SMD reaches 50% of AWC	Return soil to FC when SMD reaches 25% of AWC	Return soil to FC when SMD reaches 25% of AWC	Return soil to FC when SMD reaches 50% of AWC	Return soil to FC when SMD reaches 50% of AWC	Apply approx. 50% of AWC when SMD reaches 75% of AWC	Apply approx. 50% of AWC when SMD reaches 75% of AWC	Stop at **50%** fall-over In extremes, further irrigation could be applied.	Stop at **50%** fall-over	Stop at **50%** fall-over
Estimated application for: Loamy sand (~35mm root zone AWC)	<10mm	-	-	12mm at 10mm SMD	20mm at 18mm SMD	20mm at 18mm SMD	12mm at 10mm SMD	12mm at 10mm SMD	20mm at 18mm SMD	20mm at 18mm SMD	20mm at 26mm SMD	20mm at 26mm SMD	20mm at 26mm SMD	-	-
Estimated application for: Sandy loam (~45mm root zone AWC)	<15mm	-	-	15mm at 12mm SMD	25mm at 23mm SMD	25mm at 23mm SMD	15mm at 12mm SMD	15mm at 12mm SMD	25mm at 23mm SMD	25mm at 23mm SMD	25mm at 34mm SMD	25mm at 34mm SMD	25mm at 34mm SMD	-	-

Green text indicates "little and often" practice; Blue indicates "typical" practice, Orange indicates "stress" regimes
FC = Field Capacity; SMD = Soil Moisture Deficit; AWC = Available Water Content