Factsheet 01/14 Projects FV 326 and FV 326a

Field Vegetables

Irrigation in bulb onions

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This factsheet draws on HDC projects FV 326 and FV 326a, focusing on the irrigation requirements of onions on loamy sand and sandy loam soils, on which the majority of onion production is located.

Action points

- 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.

Background

Dry bulb onions are grown on approximately 9-10,000 ha in the UK, realising an annual market value of £50-80 million[1,2]. Typically, 95% of the crop is cured and stored, with over 60% being stored for more than 4 months before marketing.

The industry has seen a recent drive for production on light soils (sandy loams or loamy sands) to improve quality and aid crop management. Consequently, there is an increasing emphasis on irrigation with approximately 85% of the UK production currently irrigated.

Onions have a relatively sparse and shallow root system, typically with the majority of roots in the top 30cm of soil[3]. Unsurprisingly, therefore, onions are quite responsive to irrigation, and suffer significantly in drought conditions. On the other hand, there are increasing concerns in the industry over large variations in crop maturity and bulb size, high proportions of misshapes and high levels of latent bacteria and Fusarium basal rot that are commonly attributed to irrigation practices – especially over watering. Current estimates suggest that up to 40-50% of the gross stored onion crop could be downgraded or rejected by retailers due to such defects.

This factsheet aims to clarify the irrigation requirements of bulb onions in the UK and provide best-practice guidance to growers to support both their crop production and their irrigation abstraction licencing.

1. Irrigation in onions is vital, with timing of applications being critical

2. Excess water late in the season contributes to variable maturity

Effects of water stress

Restricting irrigation during dry conditions significantly reduces onion canopy development and promotes early stress bulbing and crop senescence with consequent severe penalties on yield and bulb size. Although water stress at any period during the season has an impact, the period up to bulb initiation (approx. mid May to early July) is critical since water stress in this stage limits the development of sufficient foliage to enable viable bulb production. Field experience suggests that early season stress can also increase expression of double bulbs and pink off-types, causing acceptance issues with packers.

Analysis during HDC project FV 326a indicated that relying solely on rainfall inputs in a typical season to grow onions in East Anglia could reduce gross farm returns by an average of around £3,400 per hectare (equivalent to 20 tonnes of yield) when compared to typical irrigation practice. This would effectively result in long-term net profits of little more than zero for rain-fed onion production, highlighting the critical importance of irrigation to the industry.

Irrigating bulb onions

Bulb onions are responsive to irrigation, but the timing of applications is critical.

Irrigation requirements in bulb onions can be split into four main crop growth phases with differing sensitivity to water inputs:

- Establishment – from drilling until 2-3 true leaves (approx. mid May)
- Early-season – from 2-3 true leaves until bulb initiation (approx. early July)
- Mid-season – from bulb initiation until egg stage (approx. early August)
- Late-season – from egg stage until irrigation stop

Irrigation applications during these growth phases are summarised in Table 1.

Irrigation during the establishment phase

Typically, seed beds are at or near field capacity at drilling and are therefore unlikely to require irrigation for crop establishment. However, if the soil is already quite dry at drilling, or if seeds have been drilled too shallow, or if extremely dry, warm and windy conditions occur, then limited irrigation applications (typically 10-15mm) may be required to assist establishment and enhance pre-emergence herbicide activity.

Alternatively, if soil capping has occurred (eg after heavy rainfall), re-wetting with irrigation may be required to assist seedling emergence.

In all cases, applications should be minimal to limit cool shock from cold water on delicate seedlings and to reduce the risk of further capping issues.

Irrigation during early-season

Although water stress up to bulb initiation severely reduces crop potential, there is little advantage in maintaining a very small soil moisture deficit (SMD) during this crop growth phase unless particularly dry and warm conditions are experienced. Optimum irrigation schedules during this period focus on maintaining the SMD at less than 50% of the available water content (AWC) in the rooting zone (30cm). Typically, this equates to 20-25mm applications every 7-14 days, subject to crop growth stage and weather conditions.

Over-irrigation during this period can lead to excess canopy development too early in the season, which can lead to increased bolting if a vernalisation event (eg a cold snap) occurs. In addition, frequent irrigation early in the season can promote greater weed establishment.

However, if onion thrip (*Thrips tabaci*) levels are high (eg during prolonged dry spells), more frequent irrigations through early and mid-season significantly help to reduce crop damage.

3. Excess early season irrigation can encourage bolting if the crop becomes too forward

4. Frequent irrigation significantly reduces onion thrip damage during prolonged dry periods

Irrigation during mid-season

Irrigation during the middle part of the season, from bulb initiation in early July to egg stage in early August is critical to build crop biomass and promote bulb growth. Where practical, little and often irrigation can be beneficial, rather than the typical practice of larger doses of 20-25mm every 7-10 days (ie irrigating at a SMD of 50% of AWC). However, in wetter seasons, extending irrigation intervals can be beneficial to allow better use of natural rainfall.

Table 1 Suggested irrigation regimes for loamy sand and sandy loam soils

The suggested irrigation applications below assume that the root zone for onions is 30cm and that the soil is in good condition to allow effective crop rooting. Excessively loose or slumped/compacted soils will adversely affect crop rooting and therefore the potential crop water uptake.

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	-	-
	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	-	-

- "little and often" practice applying 12-15mm
- "typical" practice applying 20-25mm
- "stress" regimes

FC - Field Capacity
SMD - Soil Moisture Deficit
AWC - Available Water Content

If ‘little and often’ irrigation is carried out, growers should be mindful that this practice can increase periods of leaf wetness with a subsequent greater risk of downy mildew (*Peronospora destructor*).

5. Onions are most responsive to irrigation from bulb initiation to ‘egg’ stage

6. Stop irrigating at 50% canopy fall-over, unless prolonged warm dry weather is forecast

Irrigation during late-season

In a typical season, a controlled moisture stress (maintaining SMD at between 75% and 25% of AWC) should be allowed to develop after egg stage, in order to help promote bulbing and ensure crop maturity. Irrigation should cease when crop fall-over reaches 50%.

Although more frequent irrigation during the late period and irrigation later than 50% fall-over will increase bulb size and yield in most years, there is an increased risk of foliar diseases (especially downy mildew – *Peronospora destructor*), delayed maturity, poor bulb initiation and reduced bulb dry matter leading to bulb compression in storage. Furthermore, late irrigation could potentially jeopardise harvesting operations if additional rainfall is received.

Therefore, more frequent late season irrigation to promote yield and size should only be considered in a particularly bright and dry period where bulbing and maturity are progressing naturally. In extreme circumstances, careful irrigation applications may be required to assist harvesting.

7. Frequent irrigation after egg stage increases the risk of foliar diseases, especially downy mildew

References

1 Defra (2013) *Basic Horticultural Statistics 2013*. https://www.gov.uk/government/publications/basic-horticultural-statistics Accessed 10th December 2013.

2. BOPA (2013) *British Onions Crop and Agronomy Report* July 2013. Issue 229. BOPA Ltd., Louth, Lincolnshire.

3 Brewster, JL (2008) *Onions and other Vegetable Alliums,* 2nd Edition. CABI, Wallingford

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