/ V / / L

File No. 20/ECT/

HDC-LEVY COMMISSIONED R & D - EXPERIMENT REPORT Date:

F/F3/VG11

Bulb onions from sets: effect of planting method on crop establishment and subsequent yield

Experiment Leader: Mr Robin Wood, Kirton Experimental Horticulture Station, Kirton, Boston, Lincs PE20 1EJ. Tel: Boston (0205) 722391.

Project Leader: Dr Robert Hiron, Kirton EHS, Kirton, Boston, Lincs PE20 1EJ. Tel: Boston (0205) 722391.

Status of work: Under review

Year of work: 3

Report number: 2

Period covered: Financial year 1988/9

Site: Kirton EHS

Abstract

Sets of two sizes: 12-15 mm and 15-18 mm were planted on 14 April by five methods with the object of determining a commercially applicable means of set planting to equate with hand planting upright at regular intervals.

The trial showed that as long as sets can be scattered in the row randomly, but at the required population, then simply pressed into the furrow and the bed rolled after covering to improve set to soil contact, they give the same yields as hand planted ones.

File No. 20/ECT/393

HDC-LEVY COMMISSIONED R & D - EXPERIMENT REPORT Date: November 1988

F/F3/VG11/032

Bulb onions established from sets: the effect of set size and planting density on subsequent yield and harvest date

Experiment Leader: Mr Robin Wood, Kirton Experimental Horticulture Station, Kirton, Boston, Lincs PE20 1EJ. Tel: Boston (0205) 722391.

Project Leader: Dr Robert Hiron, Kirton EHS, Kirton, Boston, Lincs PE20 1EJ. Tel: Boston (0205) 722391.

Status of work: To be reviewed

Year of experiment: 2

Report number: 2

Period covered: Financial year 1988/9

Site: Kirton EHS

Abstract

Crops of the varieties Balstora and Sturon were grown from sets of four sizes: 8-12, 12-15, 15-18 and 18-22 mm planted at five populations: 30, 50, 60, 70 and 90 plants/m^2 on 18 April. Considering their high cost, the establishment of the Balstora sets was disappointing at only 60%. Sturon was somewhat better at just under 80%.

The two varieties produced similar yields, around 45 t/ha. Although larger sets did produce the heaviest yields, the effect of set size was small. In this trial there was no appreciable bolting recorded, the known fact that large sets of Rijnsburger varieties can bolt would lead to the recommendation of 12-15 mm set for Rijnsburger varieties but 15-22 mm for Sturon.

The actual populations (not target) that achieved a 50:50 split in the 40-60 mm diameter bulbs and 60-80 mm size grades were 40 plants/m^2 for Balstora and 70 for Sturon, although a higher planting rate is suggested for Sturon which naturally produces a smaller bulb than Rijnsburger types.

Introduction

During the last couple of seasons onion growers, especially in Lincolnshire have shown an interest in growing Rijnsburger varieties from sets. This resulted in a small experiment programme in 1986 and a larger HDC funded programme in 1987 on this topic.

At planting, the trials are very labour intensive as the sets are hand planted at regularly spaced intervals in an upright position. Such trials indicated that crops from sets could compare favourably with glasshouse raised transplanted ones in terms of yield and earliness.

However, in commerce, crops are established by scattering sets in the row using a modified bulb planter. It was considered necessary to experiment to determine whether the commercial method of planting resulted in any yield density compared with the potential, achieved by careful hand planting.

In 1986 a straight comparison of the two methods showed that commencial plantings yielded up to 25% less than the hand plantings, which unless it could be explained altered the competitiveness of sets.

In 1987 the trial was repeated and extended to include pressing the sets into the furrow, to improve set/soil contact, prior to covering. Pressing in was shown to reduce the yield penalty from 27% to 17%, therefore a further trial was done to try to reduce the yield penalty even further.

Object

To determine how a simulated commercial planting of sets can achieve the yield potential of hand planting.

Treatments

1. Planting method:
   - i. Hand planted upright and regularly spaced
   - ii. Scattered in row and covered
   - iii. Scattered, pressed into row and covered
   - iv. Scattered in row, covered and rolled
   - v. Scattered pressed into row, covered and rolled
2. Set size:
   - i. 12-15 mm
   - ii. 15-18 mm

Field diary

Field/soil type:	Vicarage 1 - gley soils mainly fine silts
Previous cropping:	1986 winter wheat, 1987 grass
Soil analysis:	October 1987, pH = 7.9, nutrient indices N = 1, P =- 4, K = 2, Mg = 3

Fertiliser:	60:25:125 kg/ha, N:P:K applied as 16:5:23 all in base 6 April 1988	
Cultivations:	Ploughed November 1987 One pass of Lely Roterra prior to planting Sets pressed in and beds rolled as per treatments post-planting	
Planting date:	14 April 1988 variety Balstora sets heat stored at 27°C overwinter	
Insecticides:	Aldicarb as Temik at planting	
Fungicides:	31.3.88	Sets dipped in benomyl as Benlate (1 kg/1000 l)
	16.6.88	Basal drench of vinclozolin as Ronilan (10 g/5 l/100 m of row)
	24.6.88	Sprayed mancozeb + metalaxyl as Fubol (1.5 kg/ha)
	5.7.88	Sprayed mancozeb + metalaxyl as Fubol (1.5 kg/ha)
	19.7.88	Sprayed mancozeb + metalaxyl as Fubol (1.5 kg/ha)
Herbicides:	11.5.88	Sprayed chlorbufam plus chloridazon as Alicep (2 kg/ha)
	23.5.88	Sprayed chlorbufam plus chloridazon as Alicep (2 kg/ha)
Irrigation:	Nil	
Harvested:	Whole trial 12.9.88	

Results

Table 1 Effect of set size and planting method on total marketable yield t/ha 40 mm

Set size mm	Marketable yield t/ha 40 mm Planting method By hand	Scattered	Scattered + pressed	Scattered + rolled	Scattered + pressed + rolled	Mean
12-15	47.0	40.9	44.8	42.3	48.2	44.6
15-18	53.7	43.4	49.3	46.5	50.9	48.8
Mean	50.4	42.2	47.1	44.4	49.6	46.7

The yield depression caused by scattering when measured against the hand planted control was less in this trial than in previous two years, but the pattern was the same. A 16% yield penalty was reduced to 7% by improving the set to soil contact by pressing the sets into the furrow and most interestingly this penalty was virtually removed altogether by rolling the bed after covering.

There was very little bolting in this trial (0.5-2.0%) and all treatments were harvested at the same time.

Discussion

This trial demonstrates quite simply that commercial planters or sets can be equated to the artificial means of establishing set experiments by hand without the need for expensive machinery developments.

As long as a planter can meter the sets to give the required plant population (eg 60 plants/sq m) then simply ensuring good set to soil contact by pressing sets into the furrow and rolling the bed after covering is sufficient.

However, it is probable that some development work is needed on metering, delivery and farming systems for an accurate set planter.

Object

To investigate the effect of set size and planting density on subsequent yield and harvest date of Sturon, an early variety, and Balstora, a maincrop Rijnsburger variety.

Introduction

Although Lincolnshire is a traditional onion-growing area, it is rather too far north to achieve consistent high yields of good quality from a drilled crop. The investment in storage facilities and the need for a committed supply for marketing which developed in the early 1980s, led to the development and adoption of multi-seeded transplants for part of the Lincolnshire crop. This method of production gave good yields at an earlier harvest date which tended to coincide with good weather, and led to production of quality in store. The limitation of the transplanted crop is primarily one of speed of establishment, and this at present limits the transplanted area to about 30%.

Sets, especially those of Rijnsburger varieties, seem to offer a means of establishment an onion crop at the speed of the drilled crop but with yield potential nearer the transplanted crop, and this has led to a series of trials to produce a blueprint for ware onion production from sets.

This trial investigates the important aspect of set size, as sets are sold by weight, not number, and so the smaller the set that could be used without yield loss would be the most economic, and checks that plant density has a similar effect with a crop established from sets as that known for drilled and transplanted crops.

Materials and methods

Treatments

Varieties:	i.	Balstora) bought-in from local seed house
	ii.	Sturon) and graded-out on 28.3.88
Set sizes:	i.	8-12 mm
	ii.	12-15 mm
	iii.	15-18 mm
	iv.	18-22 mm
Plant densities:	i.	30 plants/m^2
(overall)*	ii.	50 plants/m^2
	iii.	60 plants/m^2
	iv.	70 plants/m^2
	v.	90 plants/m^2

* The plant density was based on 1.83 m wide beds and included the wheeling area.

Crop diary

Field/soil type:	Vicarage 1, gley soils, mainly fine silts
Previous cropping:	1987 grass 1986 winter wheat
Soil analysis:	October 1987 - pH 7.9, Indexes N = 1, P = 4, K = 2, Mg = 3
Cultivations:	Ploughed November 1987 One pass of Lely Roterra pre-planting
Fertiliser:	60 kg/ha N, 25 kg/ha P_2O_5, 125 kg/ha K_2O supplied as 16:5:23 in base on 6.4.88
Planting date:	18.4.88
Fungicide treatments:	31.3.88 Sets dipped in benomyl as Benlate (1 kg product/ 1000 l) 16.6.88 Basal drench with vinclozolin as Ronilan (10 g in 5 l per 100 m of row) 24.6.88 Sprayed mancozeb + metalaxyl as Fubol (1.5 kg/ha) 5.7.88 Sprayed mancozeb + metalaxyl as Fubol (1.5 kg/ha) 19.7.88 Sprayed mancozeb + metalaxyl as Fubol (1.5 kg/ha)
Insecticides:	Aldicarb as Temik at planting
Herbicides:	Chlorbufam + chloridazon as Alicep (2 kg/ha) 11.5.88 and 23.5.88
Irrigation:	Nil
Statistical design:	Randomised block, 3 replicates double banked for Squirrels

Results

Table 1 Actual plant populations achieved

Variety	Bulbs per sq m (including now marketables achieved at target densities of:					
	30	50	60	70	90	Mean
Balstora	20	30	39	43	49	36
Sturon	25	37	49	58	66	47

As the crop was established by hand using marked slats for set position, losses can be confidently calculated, only 60 plants of Balstora sets produced a bulb whilst percent of Sturon established losses were similar with all four set sizes. Considering the high cost of Rijnsubrger sets this represents an unacceptable loss.

Table 2 Effect of set size on total marketable yields t/ha 40 mm

Variety	Total marketable yield t/ha >40 mm 8-12 mm	12-15 mm	15-18 mm	18-22 mm	Mean
Balstora	40.05	42.17	48.27	50.36	45.21
Sturon	39.97	44.72	46.42	47.23	44.59

The two varieties yielded very similarly for each set size. This is different to the previous trial where Balstora outyielded Sturon in all except the largest set size where bolting of Balstora reduced the marketable yield to below Sturon. In this year's trial there was very little bolting of Balstora. The table shows that Sturon can yield as well as Balstora with comparable or better skin quality.

Table 3 Effect of planting density on total marketable yield t/ha 40 mm

Variety	Total marketable yield t/ha >40 mm Target populations (plants/m^2) 30	50	60	70	90	Mean
Balstora	38.74	43.83	48.42	47.78	46.33	45.02
Sturon	42.28	45.16	44.26	45.60	45.12	44.49

Again the two varieties yielded similarly at all spacings and yields were similar for target populations of 50-90 plants/m^2, there being a slight yield depression at the lowest (30 plants/m^2) population. This is similar to earlier results where populations between 40-90 plants/m^2 have had the same yield but of course varies in grade-out.

Table 4 Effect of set size on percent by number of total recorded sample in size grade

Set size mm by variety	% by number onions - grade mm 25-40	40-50	50-60	60-70	70-80	>80	Total % marketable <40 mm
Balstora							
8-12	11.7	13.7	31.3	17.7	20.2	4.5	87.4
12-15	11.3	15.2	30.8	17.2	19.3	4.7	87.2
15-18	7.8	11.1	32.0	18.7	21.2	7.1	89.7
18-22	6.1	10.9	29.8	20.1	24.0	6.2	91.0
Sturon							
8-12	9.7	23.3	44.0	11.1	7.1	0.8	86.3
12-15	6.3	18.2	47.7	12.7	10.6	2.2	91.4
15-18	5.1	20.2	51.1	12.5	8.3	1.1	93.2
18-22	4.7	17.4	50.3	12.6	10.9	1.8	93.0

Within each variety there was no difference in breakdown by percentage number of bulbs in grade due to set size. Between the two varieties Sturon had a higher percentage in the 40-60 mm range and Balstora in the 60-80 mm range, this probably reflects the differences of percentage establishment of the two varieties (see Table 1).

Table 5 Effect of planting density on percent number of onions of total recorded sample in size grade

Density plants/sq m by variety	% by number onions - grade mm 25-40	40-50	50-60	60-70	70-80	80	Total % marketable >40%
Balstora							
30	2.6	4.2	13.6	11.6	35.6	28.3	92.3
50	4.4	8.6	24.2	19.6	33.5	7.7	85.9
60	8.6	13.1	31.3	21.0	21.8	3.1	90.3
70	11.0	15.0	35.6	19.9	15.5	1.2	86.4
90	13.6	16.4	38.3	17.2	12.2	0.9	85.0
Sturon							
30	1.9	3.5	12.6	18.7	50.2	10.1	95.1
50	3.4	7.7	40.7	27.6	17.3	2.0	95.3
60	5.4	17.0	58.8	13.1	3.3	0.5	92.7
70	7.6	23.2	56.9	8.5	1.5	0	90.1
90	9.5	31.5	53.0	3.8	0.4	0	88.7

From the table Sturon appears to be more responsible to the known effect of plant population manipulating size grade out, but again this is merely a reflection that the Balstora sets did not establish the target treatments.

Table 6 Effect of set size on 80% die-down date

Variety	80% die-down date set size mm 8-12	12-15	15-18	18-22
Balstora	29 Aug	27 Aug	25 Aug	24 Aug
Sturon	12 Aug	13 Aug	5 Aug	7 Aug

Table 7 Effect of planting density on 80% die-down date

Variety	80% die-down date planting density plants/m^2 30	50	60	70	90
Balstora	1 Sept	27 Aug	27 Aug	23 Aug	23 Aug
Sturon	21 Aug	13 Aug	10 Aug	5 Aug	2 Aug

Tables 6 and 7 indicate that larger sets and high populations lead to slightly earlier crops.

Discussion

Although there was very little bolting in this year's trial with the variety Balstora which in the previous year had been high with large sets, this trial basically confirms the findings and recommendations of the previous report that as Sturon sets are relatively cheap to buy and not prone to bolting and over the two years trials there is evidence that larger sets give larger yields it is sensible to use sets in the 15-22 mm range. However, as Balstora sets are expensive and can bolt excessively from large sets, then the most economic set size to use would be 12-15 mm.

The trial shows that size grade out can be manipulated by population to a high degree of precision but that this is dependant upon achieving three densities. In fact considering that the trial was hand planted and therefore populations guaranteed, the low survival rate of both varieties, but especially Balstora, was a cause for concern and a topic that requires further investigation.

F/F3/VG11/032.88

File No. 20/ECT/

HDC-LEVY COMMISSIONED R & D - EXPERIMENT REPORT Date:

F/F3/VG11/

Bulb onions from sets: effect of planting date on crop establishment and subsequent yield using Rijnsburger sets

Experiment Leader: Mr Robin Wood, Kirton Experimental Horticulture Station, Kirton, Boston, Lincs PE20 1EJ, Tel: Boston (0205) 722391

Project Leader: Dr Robert Hiron, Kirton EHS, Kirton, Boston, Lincs PE20 1EJ. Tel: Boston (0205) 722391

Status of work: Ongoing

Year of work: 1

Report number: 1

Period covered: Financial year 1988

Site: Kirton EHS

Abstract

Four set sizes: 8-12, 12-15, 15-18 and 18-22 mm of the variety Balstora were planted by two planting methods: upright by hand at regular intervals as per experimental practice and scattered in the row and covered to simulate commercial practice, on four dates: 7, 14, 22 and 29 April to determine the optimum planting date for Rijnsburger sets.

The trial must be re-planted using a wider range of planting dates, particularly earlier ones, and in a year of normal bolting as in this trial, levels were very low. However, the indications of the trial are that yields will decrease with sowings later than the third week of April.

Introduction

In recent years the Rijnsubrger set has been seen as an alternative to the transplant from multiseeded modules to obtain early high yielding quality onion crops. The major drawback of the transplanted crop is the present low speed of crop establishment. This problem is compounded by the fact that experimentation on the transplanted crop has shown that the planting period for achieving full yield potential is quite small. If it is planted before the first week of April the crop is at risk from bolting and if planted after the middle of the fourth week of April yields decline rapidly.

Sets can be established much faster than transplants but even so it is necessary to determine the planting window to achieve yield potential, which is the main object of this trial but it also looks at the interaction of planting date with set size and planting method which are examined in greater detail in other experiments in this HDC funded project.

Object

To determine the planting date limits to achieve total yield potential of Rijnsburger sets.

Treatments

1. Target planting dates:
   - i. Mid March
   - ii. End March
   - iii. Mid April
   - iv. End April

   The above were the intended planting dates at the planning stage of the trial but inclement weather and soil conditions delayed the start of the trial and so the actual treatments became:

   - i. 7 April
   - ii. 14 April
   - iii. 22 April
   - iv. 29 April

2. Set size:
   - i. 8-12 mm
   - ii. 12-15 mm
   - iii. 15-18 mm
   - iv. 18-22 mm

3. Planting methods:
   - i. Planted upright by hand at regular intervals
   - ii. Scattered in the row and covered

Field diary

Field/soil type:	Vicarage 1, gley mainly fine silts
Previous cropping:	1986 Winter wheat, 1987 Grass
Soil analysis:	Oct 1987 pH = 7.9, nutrient indices N = 1, P = 4, K = 2, Mg = 3
Fertiliser:	60:25:125 kg/ha N:P:K applied as 16:5:23 all in base on 6 April
Cultivations:	Ploughed November 1987 One pass Lely Roterra prior to planting on appropriate dates
Planting dates:	As per treatments with variety Balstora which had been kept at 27^{o}C over winter
Insecticides:	Aldicarb as Temik at planting
Fungicides:	Sets dipped in benomyl as Benlate 31/3/88 (1 kg/1000 l) Basal drench of vinclozolin as Ronilan 16.6.88 (10 g/5 l/100 m row) Sprayed mancozeb plus metalaxyl as Fubol 24 June, 5 July and 19 July 1988 (1.5 kg/ha)
Herbicides:	Chlorbufam plus chloridazon as Alicep 6 May and 23 May 1988 (2 kg/ha)
Irrigation:	Nil
Harvest date:	Whole trial 12 September 1988

Results

Table 1 Effect of planting date (mean of method and set size) on established population (target 60 plants/sq m), percentage bolters and total marketable yield t/ha >40 mm

Planting date	Plant population pl/sq m at harvest	% Bolters	Total marketable yield t/ha >40 mm
7 April	39.7	2.8	52.2
14 April	39.4	2.1	49.9
22 April	37.3	1.2	44.9
29 April	33.3	0.9	40.8
Mean	37.4	1.8	47.0

Table 1 shows a trend of declining yields with later planting dates. There is even a reasonably large yield depression in delaying planting from 7 until 22 April. 1987 was a year with low bolting levels but there was more bolting at the earlier dates and it is essential to repeat this trial to examine dates from mid March to end of April to determine optimum planting date, especially in years with more normal higher bolting levels.

There is a suggestion of poorer establishment with later plantings.

Table 2 Effect of set size (mean of planting dates and methods) on established population (target 60 plants/sq m), percentage bolters and total marketable yield t/ha 40 mm

Set size mm	Plant population pl/sq m at harvest	% Bolters	Total marketable yield t/ha >40 mm
8-12	33.7	0.3	40.2
12-15	36.8	0.3	47.2
15-18	39.9	1.6	51.6
18-22	39.3	4.7	48.7
Mean	37.4	1.7	46.9

This table supports previous work which demonstrates optimum yield in 12-18 mm grade. Taking establishment into account in the 8-12 mm size grade, and work done in years of more normal bolting in the 15-22 mm size grades, the optimum set size is looking to be 12-15. All we need to do now is be able to grow sets with a high proportion in this size grade.

Table 3 Effect of planting method (mean of set size and planting date) on established population (target 60 plants/sq m), percentage bolting and total marketable yield t/ha >40 mm

Planting method	Plant population pl/sq m at harvest	% Bolters	Total marketable yield t/ha >40 mm
Hand planted	42.5	2.4	52.5
Scattered in row	32.4	1.0	41.4
Mean	37.5	1.7	47.0

Table 3 shows that the present commercial method of planting sets by scattering in a furrow and just covering with soil results in a considerable yield penalty, in this case 21%.

Discussion

It has been demonstrated elsewhere in the project that this can be overcome by pressing the sets into the furrows and rolling the beds after covering to ensure good set to soil contact.

This is the first batch of results looking at optimum planting dates of Rijnsburger sets. It must be repeated as this year the full potential range could not be achieved due to weather and soil conditions in March. Also the level of bolting in this year's trial was atypically low which must be masking any hazards of early April planting.

However, the indications are that the optimum planting dates for sets may be very similar to those for transplants, ie late March and the first two weeks of April.

F/F3/VG11/

File No. 20/ECT/

HDC-LEVY COMMISSIONED R & D - EXPERIMENT REPORT Date:

F/F3/VG11/

Bulb onions, a comparison of crops established from sets, transplants and direct sowings

Experiment Leader: Mr Robin Wood, Kirton Experimental Horticulture Station, Kirton, Boston, Lincs PE20 1EJ. Tel: Boston (0205) 722391.

Project Leader: Dr Robert Hiron, Kirton EHS, Kirton, Boston, Lincs PE20 1EJ. Tel: , Boston (0205) 722391.

Status of work: To be reviewed

Year of experiment: 2

Report number: 2

Period covered: Financial year 1988/9

Site: Kirton EHS

Abstract

Crops of three varieties of onions: Augusta, Balstora and Hyton were established in the field on 13 April from seed, sets or transplants and grown for maturity and yield assessment.

In this trial yields of drilled crops were good (45 t/ha) and compared similarly to set and 308 cellular tray established crops. Peat blocks outyielded the other systems (55 t/ha).

All three varieties gave similar high yields and little bolting was recorded in any treatments. Onions grown from sets and transplants had a similar early maturity date whilst drilling delayed harvest by two weeks.

This trial is the last in a series which have shown that transplants give consistent high yields at an early harvest date whilst drilled crops are variable and later but that the set crop has the potential to achieve the performance of the transplanted crop.

Introduction

Because of its light silt soils and low rainfall, Lincolnshire attracts a large proportion of the country's onion acreage. This was traditionally a drilled crop. However, Lincolnshire is near the northern limit for successful onion production from seed as demonstrated by recent yields from Kirton EHS which over the past decade, have ranged from only 10 t/ha to 50 t/ha with a norm of 30-35 t/ha. Soil capping has contributed to the poor yields recorded. A further problem is that the larger yielding Rijnsburger varieties tend to be late maturing from seeded crops which can lead to harvesting during or following inclement weather resulting in a loss of skin quality.

Improvements in storage techniques leading to an improved product out of store resulting in a greater acceptance of English onions in the marketplace meant that reliably high yielding crops were required. Therefore the multiseeded transplant was developed and adopted for use in Lincolnshire. The advantage of this technique is the reliably consistent high yield of 45-55 t/ha and an earlier harvest date which should mean harvesting under generally better weather conditions.

The disadvantages are the cost of the transplants and most importantly the slow speed of transplanting. These disadvantages have limited the potential area of the drilled crop that could be switched to transplants.

Sets have long been used by the amateur gardener for early high yielding crops but the quality and shape of traditional types have been too poor for the commercial market. However, the production of Rijnsburger sets encouraged the industry to think that this could be a means of rapidly establishing high yielding crops of good quality. This trial therefore compares the three production methods and is the <u>third</u> year of the trial, the later two years being funded by HDC.

Object

To compare yield and harvest data for three varieties of onion when grown from sets, drilled or transplanted.

Treatments

1. Production method:
   - i. Drilled
   - ii. Sets
   - iii. Multiseeded 27 mm^3 peat block transplants
   - iv. Multiseeded 308 cellular tray

2. Varieties:
   - i. Augusta
   - ii. Balstora
   - iii. Hyton

The target density for all systems was 60 plants/m^2. The sets were produced at Kirton EHS in 1987 and were heat stored at 27^oC from mid October to mid March when the temperature was reduced to 9^oC until planting.

Field diary

Field and soil type:	Vicarage 1, gley mainly fine silts
Previous cropping:	1986 winter wheat, 1987 grass
Soil analysis:	pH 7.9, nutrient index N = 1, P = 4, K = 2, and Mg = 3
Cultivations:	Ploughed November 1987 One pass Lely Roterra prior to planting
Fertiliser:	N = 60, P = 25, K = 125 kg/ha applied as 16:5:25 in base on 6 April
Sowing/planting:	Transplants sown end of January Kirton EHS raised sets plus all treatments planted 13 April
Insecticides:	Aldicarb as Temik at planting
Fungicides:	18.9.88 Sets dipped in benomyl as Benlate 1 kg product/1000 l and fan dried 16.6.88 Basal drench with vinclozolin as Ronilan (10 g/5 l/100 m of row) 24.6.88 Sprayed mancozeb + metalaxyl as Fubol (1.5 kg/ha) 5.7.88 Sprayed mancozeb + metalaxyl as Fubol (1.5 kg/ha) 19.7.88 Sprayed mancozeb + metalaxyl as Fubol (1.5 kg/ha)
Herbicides:	13.4.88 Propachlor + chlorthal dimethyl as Albrass + Dacthal on drilled plots 6.5.88 Chlorbufam + chloridazon as Alicep on transplants (2 kg/ha) 11.5.88 Alicep on sets 23.5.88 Alicep on whole trial (2 kg/ha)
Irrigation:	Nil
Statistical design:	Randomised block, three replicates

Results

Table 1 Plant populations achieved (target 60 plants/sq m) figures in parenthesis are the percentage population bolted plus waste plus bulbs less than 40 mm

Variety	Establishment method Plant populations pl/m^2 Drilled	Sets	Peat blocks	Cellular trays
Augusta	54.2 (14)	46.4 (15)	56.1 (14)	46.2 (20)
Balstora	62.8 (17)	43.3 (10)	57.8 (12)	52.5 (16)
Hyton	73.9 (16)	46.4 (11)	58.7 (8)	54.8 (17)

Bolting levels were very low (approximately 1%) and consistent across all production methods as was other waste (approximately 2%) so figures in parenthesis in Table 1 represent the percentage of the crop undersized, and it is quite high across all treatments. The sets gave a lower population than the other establishment methods even though it was carefully hand planted at the correct population.

Table 2 Total marketable yield t/ha bulbs >40 mm

Variety	Establishment method Yield t/ha >40 mm Drilled	Sets	Peat blocks	Cellular trays	Mean
Augusta	44.1	48.2	52.9	39.4	46.2
Balstora	43.8	50.4	57.7	49.5	50.4
Hyton	47.4	47.3	55.4	42.4	48.1
Mean	45.1	48.6	55.3	43.8	

Unlike previous years of this trial the drilled crop gave a very acceptable yield (45 t/ha compared with 29 t/ha 1987) whilst the other systems produced similar yields to 1987. Although this trial does not dramatically demonstrate the advantages in yield of sets and transplants over the drilled crop the two years results show the consistency of these latter systems and the fluctuations that occur with the drilled crop.

All three varieties have similar high yields.

Table 3 Effect of production method on percent, by number, of total recorded plot, in size grade

Production method	% by number size grade mm 25-40	40-50	50-60	60-70	70-80	>80	Total % marketable >40 mm
Drilled	12.2	30.1	44.3	8.0	2.0	0.1	84.5
Sets	7.8	15.6	37.2	18.0	15.3	1.8	87.9
Peat blocks	6.2	16.8	45.8	17.5	8.6	0.4	89.1
Cellular trays	12.6	22.5	37.9	13.4	8.1	0.8	82.7

Although the drilled crop produced the greatest proportion of 40-60 mm bulbs and sets the highest percentage 60-80 mm bulbs, this is thought to be more likely a reflection on the percentage establishment of the three systems rather than the systems themselves.

Maturity and harvest date ranged from 26 August to 19 September in the expected order of Augusta transplants and sets first and Balstora and Hyton drilled plots being the latest.

Discussion

Differences in yield in this trial were not dramatic, due to the good yields produced by all systems. But results from the series, 1986-88, show that transplants give consistent high yields and an early harvest date; the drilled crop is variable and later. Crops from sets have the potential to match the performance of transplants although whether this can be achieved in commerce still needs to be determined.

F/F3/VG11/1

File No. 20/ECT/

HDC LEVY COMMISSIONED R & D - EXPERIMENT REPORT Date:

F/F3/VG11/

Bulb onions from sets: interaction of set size and set storage temperature on subsequent ware onion yields, maturity date and percent bolting in the field

Experiment Leader: Mr Robin Wood, Kirton Experiment Horticulture Station, Kirton, Boston, Lincs PE20 1EJ. Tel: Boston (0205) 722391.

Project Leader: Dr Robert Hiron, Kirton EHS, Kirton, Boston, Lincs PE20 1EJ. Tel: Boston (0205) 722391.

Status of work: Under review

Year of experiment: 2

Report number: 2

Period covered: Financial year 1988/9

Site: Kirton EHS

Abstract

For a trial planted at a population of $60/m^2$ on 12 April, sets of the variety Balstora were graded into four sizes: 8-12 mm, 12-15 mm, 15-18 mm and 18-22 mm. Sets of each size grade were subjected to 10 different storage temperature regimes between October 1987 and planting April 1988, the treatments were:-

i. 27°C from mid October until planting

ii. 27°C for 5 months then ambient until planting

iii. 27°C for 4 months, 5°C for 1 month then ambient until planting

iv. 27°C for 3 months, 5°C for 2 months then ambient until planting

v. 27°C for 2 months, 5°C for 3 months then ambient until planting

vi. 27°C for 1 months, 5°C for 4 months then ambient until planting

vii. 20°C for 5 months then ambient until planting

viii. 10°C for 5 months then ambient until planting

ix. 5°C for 5 months then ambient until planting

x. 1°C for 5 months then ambient until planting

Imposing ambient until planting was done to simulate warehouse and on-farm storage. Set survival in the field was similar for all treatments at about 70% of those planted. Survival rate was slightly lower for sets that had

been kept for more than two months at temperatures of 5 or 10°C. But yield was considerably depressed by treatment over two months at 5 and 10°C.

The most striking effect was that treatments which suffered a yield depression matured up to 25 days earlier than the control (27°C until planting). The implications of this observation and suggested future work are discussed.

Introduction

The majority of onion sets used in this country are imported, although there is no real reason why they could not be grown in the UK. Sets of Rijnsburger and hybrid varieties require special high temperature treatments during storage, between lifting August/September in year one and planting in April in year two, to prevent bolting the subsequent crop, and this is a large factor in the high cost of such sets.

Onions are a biennial species and the warm storage treatment is given to prevent vernalisation of the sets and so keep the plants in a non flowering juvenile state. However, onion plants have to be of a certain size before they can respond to vernalising temperatures which leads to an exciting possibility that small sets may be able to be stored at ambient or low temperature and still not bolt.

Object

To assess the effect of various set storage temperature regimes on the subsequent yield, maturity rate and bolting of four sizes of Rijnsburger sets of the variety Balstora.

Treatments

1. i. $27^{o}C$ from mid October until planting

ii. $27^{o}C$ for 5 months then ambient until planting

iii. $27^{o}C$ for 4 months, $5^{o}C$ for 1 month then ambient until planting

iv. $27^{o}C$ for 3 months, $5^{o}C$ for 2 months then ambient until planting

v. $27^{o}C$ for 2 months, $5^{o}C$ for 3 months then ambient until planting

vi. $27^{o}C$ for 1 months, $5^{o}C$ for 4 months then ambient until planting

vii. $20^{o}C$ for 5 months then ambient until planting

viii. $10^{o}C$ for 5 months then ambient until planting

ix. $5^{o}C$ for 5 months then ambient until planting

x. $1^{o}C$ for 5 months then ambient until planting

The sets were imported from Holland in early October 1987. Treatments commenced 16 October and finished 18 March. They were placed at ambient until planting to simulate warehouse and on-farm holding. The sets were stored in insulated cabinets with the relative humidity maintained at 75%.

2. Set sizes

i. 8-12 mm diameter

ii. 12-15 mm diameter

iii. 15-18 mm diameter

iv. 18-22 mm diameter

Statistical design:

Main plots (storage treatments) were planted in three replicate randomised blocks. The main plots were sub-divided into sub-plots for the four set sizes. Main plots were 16 m x 1.83 m with sub-plots of 4 x 1.83 m.

Field diary

Field/soil thype:	Vicarage 1, gleys mainly fine silts	
Previous cropping:	1986 winter wheat, 1987 grass	
Soil analysis:	pH 7.9, nutrient indices N = 1, P = 4, K = 2 and Mg = 3	
Cultivations:	Ploughed November 1987 One pass of Lely Roterra prior to planting	
Fertiliser:	N = 60, P = 25, K = 125 kg/ha supplied as 16:5:23 in base on 6 April	
Sowing/planting:	Planted 12 April 60 sets/sq m	
Insecticides:	Aldicarb as Temik at planting	
Fungicides:	Oct 87	Sets dipped in benomyl as Benlate (1 kg/1000 l)
	16 June 1988	Basal drench of vinclozolin as Ronilan (10 g/15 l/100 m row)
	24 June 1988	Sprayed mancozeb plus metalaxyl as Fubol (1.5 kg/ha)
	5 July 1988	Sprayed mancozeb plus metalaxyl as Fubol (1.5 kg/ha)
	19 July 1988	Sprayed mancozeb plus metalaxyl as Fubol (1.5 kg/ha)
Herbicides:	11 May and 23 May 1988	Chlorbufam plus chloridazon as Alicep (2 kg/ha)
Irrigation:	Nil	

Results

Table 1 Plant populations at harvest (all treatments planted at 60 sets/sq m)

Treatment	Plant population at harvest Set size mm 8-12	12-15	15-18	18-22	Mean
27°C until planting	43.7	44.1	48.1	46.6	45.6
27°C (5 months)	37.5	46.6	50.1	46.4	45.2
27°C (4 months) 5°C (1 month)	43.9	45.2	48.3	N/A	45.8
27°C (3 months) 5° (2 months)	43.3	N/A	48.1	47.4	46.3
27°C (2 months) 5°C (3 months)	41.7	44.3	44.8	37.0	42.0
27°C (1 months) 5°C (4 months)	40.1	40.8	40.5	34.4	39.0
20°C (5 months)	39.0	42.1	45.2	46.0	44.0
10°C (5 months)	35.3	45.4	45.4	34.6	40.2
5°C (5 months)	41.2	40.1	45.5	25.7*	41.7
1°C (5 months)	40.8	42.3	41.2	39.0	40.8
Mean	40.7	43.4	45.7	41.4	42.8

N/A = Two treatments that were not planted due to high losses in store

* = Figure not included in means as appears to be isolated anomaly

Although there are differences within the table, populations were fairly consistent around the grand mean of 42.8. There is an indication that long storage at 27°C or 20°C gives slightly higher establishment than long periods at lower temperatures, also that the middle two size grades establish slightly better than the two extremes.

Table 2 Effect of treatment on total marketable yield t/ha 40 mm

Treatment	Total yield t/ha 40mm Set size mm 8-12	12-15	15-18	18-22	Mean
27^oC until planting	38.5	36.7	44.4	40.6	40.1
27^oC (5 months)	27.3	38.5	51.6	47.4	41.2
27^oC (4 months) 5^oC (1 month)	38.4	40.3	39.6	N/A	39.4
27^oC (3 months) 5^o (2 months)	33.8	N/A	47.5	36.2	39.2
27^oC (2 months) 5^oC (3 months)	33.5	25.8	26.0	27.9	28.3
27^oC (1 months) 5^oC (4 months)	26.4	29.0	30.7	26.2	28.1
20^oC (5 months)	30.3	41.4	42.0	36.8	37.6
10^oC (5 months)	24.6	30.1	34.1	24.1	28.2
5^oC (5 months)	28.5	27.4	33.0	20.5*	29.6
1^oC (5 months)	31.2	33.4	37.2	28.2	32.5
Mean	31.3	33.6	38.6	33.4	

* Omitted from means - see Table 1

Highest yields were obtained from sets that had received at least 3 months at 27^oC or 5 months at 20^oC; storage for any significant length of time at temperatures less than 10^oC lowered yield. Sets in the size grade 15-18 outyielded other set sizes.

Table 3 Effect of set size and storage temperature regime on harvest date

Treatment	Harvest date (80% die down) Set size mm 8-12	12-15	15-18	18-22	Mean
27°C until planting	29/8	19/8	23/8	19/8	23/8
27°C (5 months)	23/8	22/8	23/8	20/8	22/8
27°C (4 months) 5°C (1 month)	22/8	9/8	11/8	N/A	14/8
27°C (3 months) 5°C (2 months)	9/8	N/A	7/8	10/8	9/8
27°C (2 months) 5°C (3 months)	7/8	31/7	28/7	29/7	1/8
27°C (1 months) 5°C (4 months)	30/7	28/7	26/7	29/7	28/7
20°C (5 months)	20/8	20/8	19/8	19/8	20/8
10°C (5 months)	2/8	28/7	29/7	28/7	30/7
5°C (5 months)	31/7	31/7	29/7	31/7	31/7
1°C (5 months)	6/8	2/8	2/8	5/8	4/8
Mean	12/8	7/8	7/8	7/8	9/8

Set size had no effect upon harvest date with the exception that the smallest set size was slightly later. However storage treatment had a large effect upon harvest date. Any period of storage less than 2°C promoted early maturity with, as seen in table 2, a subsequent loss of yield in some instances. The degree of earliness is roughly proportional to the amount of time spent in cool storage with the exception that 1°C is not as severe as 5 & 10°C storage both of which give similar effects. The most severe treatments which were 27°C (1 month) plus 5°C (4 months), 10°C (5 months) and 5°C (5 months) matured 3½ weeks before those sets kept at 27°C until planting.

Table 4 Effect of storage treatment on percent by number of total recorded sample in size grade

Treatment	% By Number onions Size grade mm 25-40	40-50	50-60	60-70	70-80	Total % Mktable >80	>40mm
27^{o}C until planting	7.2	13.5	37.7	16.4	9.8	0.7	76.6
27^{o}C (5 months)	5.4	13.6	37.5	18.7	9.5	0.4	79.7
27^{o}C (4 months) 5^{o}C 1 month)	8.5	15.3	41.4	16.4	6.6	0.5	80.2
27^{o}C (3 months) 5^{o}C 2 months)	6.8	13.9	40.5	17.8	7.7	0.2	80.1
27^{o}C (2 months) 5^{o}C 3 months)	12.2	19.2	39.4	12.1	5.5	0.2	76.4
27^{o}C (1 month) 5^{o}C 4 months)	13.2	20.7	42.1	11.0	3.3	0	77.1
20^{o}C (5 months)	7.6	11.9	38.8	17.3	8.6	0.2	76.8
10^{o}C (5 months)	13.5	23.6	38.0	11.5	3.5	0	76.6
5^{o}C (5 months)	12.1	21.5	38.6	11.4	4.4	0.1	76.0
1^{o}C (5 months)	11.5	18.5	38.1	13.3	7.5	0.3	77.7

Table 4 shows that those storage treatments which have lower earlier yields have smaller bulbs.

Table 5 Effect of set size on percent by number of total recorded sample in size grade

Set size mm	% By Number onions Size grade mm 25-40	40-50	50-60	60-70	70-80	Total % Mktable >80	>40mm
8-12	14.3	19.7	38.4	12.6	5.4	0.4	76.5
12-15	10.7	19.0	41.6	13.2	5.3	0.2	79.3
15-18	7.3	15.5	40.8	15.9	7.5	0.2	79.9
18-20	6.3	14.0	34.6	16.9	8.9	0.3	74.4

Although larger sets tend to produce slightly larger bulbs, the difference in size grades is slight with the exception of the proportion in the marketable 25-40mm size grade which was highest from the two small sizes of sets.

Table 6 Effect of set size and storage temperature on percent by number bolting

Treatment	% Bolting Set size mm 8-12	12-15	15-18	18-22	Mean
27°C until planting	0.8	0.4	0.7	5.5	1.9
27°C (5 months)	0	0.8	4.7	7.5	3.3
27°C (4 months) 5°C (1 month)	0	0	3.4	N/A	- (missing value)
27°C (3 months) 5° (2 months)	0	0	5.3	18.3	5.9
27°C (2 months) 5°C (3 months)	0	0.1	3.2	9.4	3.2
27°C (1 months) 5°C (4 months)	0	0.1	0	0.1	0.1
20°C (5 months)	0.1	0.1	4.8	10.7	3.9
10°C (5 months)	0	0.3	2.0	0.6	0.7
5°C (5 months)	0	0.1	2.4	0	0.6
1°C (5 months)	0	0	2.7	14.0	4.2
Mean	0.1	0.2	2.9	6.6	

Unlike the 1987 trial bolting levels, even with the largest sets kept cool through the winter, were fairly low. However, the trend seen in the 1987 trial is repeated in the above table with very little bolting in the 8-15mm size grades but significantly higher levels in the 15-22 mm size grades.

Discussion

The object of this and the previous 1987 trial was to demonstrate that small sets would not respond to a cold flowering stimulus over winter and thus could be stored at lower (ie cheaper and as far as disease is concerned, safer temperatures from set lifting in year one to set planting in year two.

The 1987 trial with high levels of bolting dramatically proved this point. However this year, with lower levels of bolting, other major effects of storing Rijnsburger sets at cool temperatures can be seen.

The effects can be summarised as more than two months at 5 or 10^{o}C leads to a lower yield of smaller bulbs but at a much earlier harvest date. On first consideration, this might suggest that the advice should be that small Rijnsburger sets should be treated at high temperatures for high yields. But what should now be investigated is the effect on quality of ware onions from hot and cool set storage out of ware storage, as quality out of long term storage is now more important than bulb yield.

It may well be that the smaller earlier onion produced from 8-15mm cool stored sets will produce a higher quality product. This trial will not capture this data as the harvested plots were not put in for storage assessment and so this will be done next year.

One other possibility that should be investigated is the use of cool stored 15-18mm sets of higher quality varieties to compete with the over-wintered onion crop.

F/F3/VG11/2