**BBRO Project 08/08**

**Mind the gap report**

**(excludes *Cercospora* work)**

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**Introduction**

In England, sugar beet must compete with wheat and oilseed-rape for a place in the arable rotation. At today’s prices for wheat (*c*. £160/t) and beet (*c*. £26/t) the competition is stiff: the costs per tonne of beet must decrease. There is little if any opportunity to reduce input costs, so yield must increase rapidly. Large differences exist between yields measured in experiments or simulated in mathematical models and those delivered to factories. This difference was 30% when it was last examined in detail in the 1980’s (Jaggard *et al.*, 1984) and much of it was ascribed to headland management and losses during harvesting. Despite improvements in harvesting (Brown, 2006) and headland management strategies, the differences between simulated or experiment yields and delivered yields remain close to 30% (Jaggard *et al*., 2007). This project sought to explain these differences.

**Object**

To quantify, in selected commercial fields and contracts, the factors causing:-

(a) the discrepancies between the potential yields (assessed from a model and from local experiments) and yields in the fields

(b) the discrepancies between yields in fields and delivered yields and how these relate to harvesting, storage and delivery practices.

**NOTE: It was not possible to complete many parts of the study. This was a result of funding shortfalls caused by the need for extra funding in the CLIMDIS LINK project.**

**Methodology**

The project was intended to be carried out for three years but no work was carried out in the final year (2010).

Broom’s Barn modelled the potential yield and storage losses of each beet field in eight reasonably-sized contracts on single farms; two in each of the four factory areas in year 1 and 10 fields in year 2. Weather data for the area was used in the models.

The contracts were chosen as representative of above–average and average yield classes. Modelling used the grower’s declared sowing date and soil type, and rainfall data collected locally. Harvest and delivery dates were be collected from participating growers for each field. In each contract, one field was to have been selected for more detailed study but this was not carried out.

British Sugar measured the plant population density and were to visually assess soil conditions, weed and pest populations and the incidence of disease and nutrient deficiencies in August. These latter were not recorded.

British Sugar measured biological yield and harvesting losses when fields were lifted. Yields and harvest losses were to be assessed separately on a central and a headland area of the field but this was only carried out in 2009. In 2008 the two sites (one high and one average yielding) were selected in each factory area.

The project was linked to the Technology Transfer ‘Quality of Harvesting’ project which measures biological yields and harvest losses in approximately 200 fields during the campaign. Delivered yields and tares for the selected fields and for the contract as a whole were measured at the factory. Part loads were estimated by the growers.

British Sugar recorded the declared area and measured the sown and headland areas of the selected fields in each contract in 2009 (but only the whole field in 2008) using hand-held GPS equipment, to support measurements made from aerial photography by Broom’s Barn (done in 2008 only – see Appendix).

The project teams intended to collect records of varieties used, agronomy and pesticide inputs and to survey foliage cover in July but it was not possible to complete these in either year.

**Results**

**Table 1. Site details 2008**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Site & soil type** | **Area (ha)** | **Date drilled** | **Date drilled** | **Uncropped area (%)** | **Headland area (m2)** | **Difference from declared (%)** | **Headland proportion (%)** | **Date of harvest** |
| Bury Av SL | **4.45** | **4.209** | **03/04/2008** | **5.42**  | **0.325** | 5.4 | 7.3 | **29/01/2009** |
| Bury Hi SL | **7.30** | **7.116** | **03/04/2008** | **2.52**  | **0.585** | 2.5 | 8.0 | **27/01/2009** |
| Cantley Av SL | **4.25** | **3.48** | **13/03/2008** | **18.12**  | **0.099** | 18.1 | 2.3 | **15/01/2009** |
| Cantley High CL | **11.42** | **11.141** | **21/04/2008** | **2.44**  | **0.343** | 2.4 | 3.0 | **15/01/2009** |
| Newark Av CL | **7.40** | **7.321** | **04/04/2008** | **1.07**  | **0.39** | 1.1 | 5.3 | **10/11/2008** |
| Newark High CL | **12.84** | **12.45** | **02/04/2008** | **3.04**  | **0.643** | 3.0 | 5.0 | **11/11/2008** |
| Wissington Av CL | **8.40** | **7.672** | **04/04/2008** | **8.67**  | **0.657** | 8.7 | 7.8 | **20/11/2008** |
| Wissington High Z | **10.00** | **\*** | **\*** | **\*** | **\*** | **\*** | **\*** | **\*** |

**Table 2. Growing days, plant population and harvest losses and yields 2008**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Site** | **Growing days** | **Plant pop (/ha)** | **Estab’t****(%)** | **Surface losses (t/ha)** | **Root breakage (t/ha)** | **Delivered (adj t/ha)** | **Harvested field****(adj t/ha)** | **Biological****(adj\_t/ha)** |
| Bury Av SL | **301** | **92,400** | **83.16** | **0.45** | **2.57** | **77.27** | **80.29** | **103.92** |
| Bury Hi SL | **299** | **\*** | **\*** | **0.62** | **2.34** | **72.47** | **75.43** | **71.78** |
| Cantley Av SL | **308** | **81,800** | **73.62** | **0.79** | **2.16** | **70.10** | **73.05** | **90.50** |
| Cantley High CL | **269** | **88,400** | **75.14** | **0.71** | **2.63** | **75.90** | **79.24** | **95.93** |
| Newark Av CL | **220** | **75,400** | **67.86** | **0.22** | **0.53** | **102.32** | **103.07** | **93.09** |
| Newark High CL | **223** | **107,400** | **93.98** | **0.72** | **2.15** | **87.38** | **90.25** | **98.89** |
| Wissington Av CL | **230** | **95, 435** | **87.8** | **1.71** | **2.06** | **46.80** | **50.57** | **\*** |
| Wissington High Z | **\*** | **\*** | **\*** | **\*** | **\*** | **\*** | **\*** | **\*** |

 **Table 3. Harvest yield comparisons 2008**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Site** | **Growing days** | **Modelled adj root yield (t/ha)** | **Delivered to harvest yield** | **Delivered to model yield** | **Field to model yield** |
| Bury Av SL | **301** | **84.13** | **96.2%** | **91.8%** | **95.4%** |
| Bury Hi SL | **299** | **84.13** | **96.1%** | **86.1%** | **89.7%** |
| Cantley Av SL | **308** | **91.96** | **96.0%** | **76.2%** | **79.4%** |
| Cantley High CL | **269** | **96.61** | **95.8%** | **78.6%** | **82.0%** |
| Newark Av CL | **220** | **99.10** | **99.3%** | **103.2%** | **104.0%** |
| Newark High CL | **223** | **100.69** | **96.8%** | **86.8%** | **89.6%** |
| Wissington Av CL | **230** | **101.82** | **92.5%** | **46.0%** | **49.7%** |
| Wissington High Z | **\*** | **\*** | **\*** | **\*** | **\*** |

**Table 4. Site details 2009**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Site & soil type** | **Declar-ed area (ha)** | **Date drilled** | **Perimeter (m)** | **Drilled area****(ha)** | **Headland area****(ha)** | **Difference from declared (%)** | **Headland proportion (%)** | **Date of harvest** |
| 1 SL | 21.7 | 22/03/09 | 1870 | 21.12 | 4.38 | -2.6 | 20.7 | 01/11/09 |
| 2 CL | 40.2 | 26/03/09 | \* | \* | \* | \* | \* | 03/02/10 |
| 3 SL | 11.6 | 01/04/09 | 1414 | 11.48 | 3.20 | -1.0 | 27.8 | 30/10/09 |
| 4 S | 9.7 | 20/03/09 | 1460 | 10.02 | 3.50 | 3.1 | 35.0 | 11/12/09 |
| 5 CL | 2.0 | 06/04/09 | 612 | 19.41 | 1.43 | -3.0 | 73.8 | 02/02/10 |
| 6 SL | 19.4 | 03/04/09 | \* | \* | \* | \* | \* | 19/11/09 |
| 7 SL | 3.2 | 18/03/09 | 825 | 27.18 | 2.18 | -15.9 | 80.2 | 11/01/10 |
| 8 SL | 16.0 | 16/03/09 | 2419 | 15.33 | 5.90 | -4.2 | 38.5 | 11/11/09 |
| 9 Med | 9.3 | 06/03/09 | 1371 | 8.81 | 3.29 | -5.3 | 37.4 | 15/01/10 |
| 10 S | 19.6 | 31/03/09 | 2216 | 17.99 | 5.23 | -8.4 | 29.1 | 30/10/09 |
| 11 Pt | 11.4 | 04/04/09 | 1444 | 10.80 | 3.55 | -4.9 | 32.9 | 25/02/10 |
| 12 SL | 5.2 | 03/04/09 | 1141 | 3.91 | 1.64 | -24.7 | 42.0 | 04/01/10 |
| 13 SL | 18.5 | 20/03/09 | 1840 | 17.46 | 4.27 | -5.7 | 24.5 | 02/12/09 |
| 14 SL | 16.0 | 19/03/09 | 2091 | 20.98 | 3.93 | 31.1 | 18.7 | 13/10/09 |
| 15 SL | 18.2 | 29/03/09 | 1724 | 17.47 | 3.93 | -4.0 | 22.5 | 28/01/10 |
| 16 SL | 8.2 | 20/03/09 | 1244 | 10.00 | 2.24 | 21.8 | 22.4 | 16/11/09 |
| 17 ZCL | 10.8 | 20/03/09 | 1383 | 10.99 | 3.40 | 1.7 | 31.0 | 26/10/09 |
| 18 CL | 6.0 | 23/03/09 | 964 | 5.59 | 2.56 | -6.8 | 45.8 | 20/10/09 |
| 19 CL | 8.3 | 30/03/09 | 1226 | 8.21 | 2.80 | -1.1 | 34.1 | 05/11/09 |
| 20 SL | 7.1 | 03/04/09 | 1409 | 9.53 | 2.42 | 35.0 | 25.4 | 25/09/09 |
|  |  |  |  |  |  |  |  |  |

**Table 5. Growing days and loss assessments 2009**

|  |  |  |  |
| --- | --- | --- | --- |
| **Site** | **Growing days** | **Surface losses (t/ha)** | **Root breakages (t/ha)** |
|  |  | Field | H’land | Difference | Field | H’land | Difference |
| 1 | 224 | 0.17 | 0.26 | -0.09 | \* | \* | \* |
| 2 | 314 | \* | \* | \* | 1.13 | 2.26 | -1.13 |
| 3 | 212 | 0.68 | 0.72 | -0.05 | \* | \* | \* |
| 4 | 266 | 0.56 | \* | \* | 3.20 | 3.92 | -0.72 |
| 5 | 302 | 0.23 | \* | \* | 2.07 | \* | \* |
| 6 | 230 | 0.16 | 0.16 | 0.00 | 4.19 | \* | \* |
| 7 | 299 | \* | \* | \* | 3.04 | 3.04 | 0.00 |
| 8 | 240 | 0.10 | 0.37 | -0.27 | \* | \* | \* |
| 9 | 315 | 0.26 | 0.26 | 0.00 | \* | \* | \* |
| 10 | 213 | 1.34 | 1.90 | -0.56 | 2.48 | 2.48 | 0.00 |
| 11 | 327 | 0.13 | 0.17 | -0.03 | 1.18 | 1.43 | -0.24 |
| 12 | 276 | 0.33 | 0.40 | -0.07 | 1.26 | 2.41 | -1.15 |
| 13 | 257 | 0.34 | 0.93 | -0.59 | 3.87 | 7.12 | -3.25 |
| 14 | 208 | 2.71 | 1.86 | 0.85 | 5.19 | \* | \* |
| 15 | 305 | \* | \* | \* | 2.26 | 1.61 | 0.65 |
| 16 | 241 | 0.13 | 0.15 | -0.02 | \* | \* | \* |
| 17 | 220 | 0.29 | \* | \* | 0.93 | \* | \* |
| 18 | 211 | 0.26 | 0.19 | 0.07 | 4.16 | \* | \* |
| 19 | 220 | 0.58 | 0.55 | 0.03 | 4.49 | \* | \* |
| 20 | 175 | 0.17 | 0.26 | -0.09 | 2.32 | 2.02 | 0.30 |
| Mean | 253 | 0.50 | 0.58 | -0.06 | 2.78 | 2.92 | -0.62 |

**Table 6. Plant population (000/ha) 2009**

|  |  |  |
| --- | --- | --- |
| **Site** |  | **Plant population (/ha)** |
|  |  | **Field** | **H’land** | **Difference** |
| 1 |  | 99,583 | \* | \* |
| 2 |  | 107,666 | 103,135 | 4,531 |
| 3 |  | 84,800 | \* | \* |
| 4 |  | 80,808 | 79,523 | 1,285 |
| 5 |  | 100,412 | \* | \* |
| 6 |  | 106,838 | \* | \* |
| 7 |  | 104,085 | 86,216 | 17,869 |
| 8 |  | 84,130 | \* | \* |
| 9 |  | 99,751 | \* | \* |
| 10 |  | 64,103 | 74,605 | -10,502 |
| 11 |  | 81,177 | 74,074 | 7,103 |
| 12 |  | 104,575 | 89,385 | 15,190 |
| 13 |  | 81,619 | 79,517 | 2,102 |
| 14 |  | 87,600 | \* | \* |
| 15 |  | 122,130 | 121,618 | 512 |
| 16 |  | 90,800 | \* | \* |
| 17 |  | 101,266 | \* | \* |
| 18 |  | 92,485 | \* | \* |
| 19 |  | 91,954 | \* | \* |
| 20 |  | 95,400 | \* | \* |
| Mean |  | 89,080 | 88,509 | 4,761 |

**Table 7. Yields 2009**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Site** | **Growing days** | **Estimated yields** **(t/ha)** | **Clean beet (field)****(t/ha)** | **Difference est vs measured****(t/ha)** | **Adj yield (t/ha)** |
|  |  | Field | H’land | Diff’nce |  |  |  |
| 1 | 224 | \* | \* | \* | \* | \* | *90.29* |
| 2 | 314 | 97.44 | 89.21 | 8.23 | 70.76 | -26.68 | 81.35 |
| 3 | 212 | \* | \* | \* | \* | \* | 74.17 |
| 4 | 266 | 109.50 | 101.99 | 7.51 | 77.90 | -31.60 | 97.9 |
| 5 | 302 | 90.87 | \* | \* | 67.74 | -23.13 | 84.64 |
| 6 | 230 | 104.30 | \* | \* | 72.44 | -31.86 | 90.82 |
| 7 | 299 | 119.70 | 87.29 | 32.40 | 63.77 | -55.93 | 71.87 |
| 8 | 240 | \* | \* | \* | 51.33 | \* | *40.91* |
| 9 | 315 | 109.98 | \* | \* | 74.59 | -35.39 | 90.79 |
| 10 | 213 | 68.59 | 53.72 | 14.88 | 47.50 | -21.09 | 59.3 |
| 11 | 327 | 88.38 | 75.09 | 13.29 | 80.01 | -8.37 | 83.65 |
| 12 | 276 | 94.64 | 81.79 | 12.85 | 55.78 | -38.86 | 68.001 |
| 13 | 257 | 116.92 | 110.94 | 5.98 | 50.20 | -66.72 | 60.1 |
| 14 | 208 | 85.34 | 85.34 | 0.00 | *56.60* | -28.74 | *66.41* |
| 15 | 305 | \* | \* | \* | 65.49 | \* | 75.19 |
| 16 | 241 | \* | \* | \* | *69.95* | \* | *82.83* |
| 17 | 220 | 88.46 | 89.87 | -1.41 | 65.80 | -22.66 | 86.1 |
| 18 | 211 | 79.77 | \* | \* | 55.70 | -24.07 | 71.8 |
| 19 | 220 | 97.53 | 78.39 | 19.14 | 71.10 | -26.43 | 88.19 |
| 20 | 175 | 112.23 | \* | \* | 88.20 | -24.04 | 112.23 |
| Mean | 253 | 97.58 | 85.36 | 11.29 | 65.83 | -31.04 | 78.83 |

**Table 8. Actual vs simulated yields 2009**

|  |  |  |  |
| --- | --- | --- | --- |
| **Site** |  | **Adj root yield (t/ha)** | **Adjusted compared to simulated** |
|  |  | **Field** | **H’land** | **Difference** | **Field** |  |  |
| 1 |  | 99.69 | 99.69 | 0 | 9.40 |  |  |
| 2 |  | 131.88 | 131.88 | 0 | 50.53 |  |  |
| 3 |  | 88.13 | 88.13 | 0 | 13.96 |  |  |
| 4 |  | 104.75 | 104.75 | 0 | 6.85 |  |  |
| 5 |  | 81.31 | 81.31 | 0 | -3.33 |  |  |
| 6 |  | 92.25 | 92.25 | 0 | 1.43 |  |  |
| 7 |  | 92.63 | 92.63 | 0 | 20.76 |  |  |
| 8 |  | 92.00 | 92.00 | 0 | 51.09 |  |  |
| 9 |  | 115.94 | 115.94 | 0 | 25.15 |  |  |
| 10 |  | 97.50 | 97.50 | 0 | 38.20 |  |  |
| 11 |  | 121.25 | 121.25 | 0 | 37.60 |  |  |
| 12 |  | 95.56 | 95.56 | 0 | 27.56 |  |  |
| 13 |  | 108.13 | 108.13 | 0 | 48.03 |  |  |
| 14 |  | 81.19 | 81.19 | 0 | 14.78 |  |  |
| 15 |  | 98.13 | 98.13 | 0 | 22.94 |  |  |
| 16 |  | 105.75 | 105.75 | 0 | 22.92 |  |  |
| 17 |  | 118.94 | 118.94 | 0 | 32.84 |  |  |
| 18 |  | 97.88 | 97.88 | 0 | 26.08 |  |  |
| 19 |  | 114.19 | 114.19 | 0 | 26.00 |  |  |
| 20 |  | 67.63 | 67.63 | 0 | -44.61 |  |  |
| Mean |  | 100.23 | 100.23 | 0 | 21.41 |  |  |

**Conclusion**

It was not possible to draw any conclusions from this work owing to the limited number of sites and lack of agronomy and pesticide information.

**References**

**Brown S.** (2006). The route to recovery at harvest. *British Sugar Beet Review* **74** (3), 28-31.

 **Jaggard K, Clark C & Bell S**. (1984). An analysis of yield from fields of sugar beet. *British Sugar Beet Review* **52** (3), 67-69*.*

**Jaggard KW, Qi A & Semenov MA** (2007). The impact of climate change on sugarbeet yield in the UK: 1976-2004. *Journal of Agricultural Science, Cambridge* **145**, 367-375.

**Appendix**

**Aerial photographs 2008**

*See separate PowerPoint file ‘Mind the Gap – Aerial photo appendix’*