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Team 20/20:

Report of the study tour of the Scania sugar beet growing region of Sweden

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Report of the study tour of the Scania sugar beet growing region of Sweden carried out by Armstrong Fisher Ltd. on behalf of Team 20/20 of Sockernäringens BetodlingsUtveckling.

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Background

During the study tour, seven farms were visited in Scania, the main sugar beet producing region of Sweden. These comprised two farms in the South West, North West and North East of Scania and one farm in the South East of the region. All the growers interviewed were typical of their sugar beet growing locality and would be classed as good, forward thinking sugar beet producers, following good attention to detail and producing very high sugar yields. Consequently, to achieve the Team 20/20 improvement in increased sugar yield and reduced growing costs will require considerable enterprise and initiative, the commitment to try new and sometimes untried agronomic practices (that may well fail) and the requirement to review and be prepared to change direction even on an annual basis.

From our initial study it appears that it may be possible to increase yields easier than reduce growing costs. However, one of the main conclusions from British Sugar's Crop Profitability Initiative, a costings model that underpins the 20/20 Vision, is that the most important driver for grower profitability and reducing the cost per tonne of roots produced is delivered beet yield. The greater the yield of beet produced per hectare, the more able the individual grower is to cope with falling beet prices. Therefore, the overall objective of the Team 20/20 could also be achieved by a 25:15 or indeed 30:10 approach, relying more on increasing output in terms of yield than reducing input in terms of growing costs.

The general agronomy practiced by each individual farmer will be collated and tabulated in the following report. Recommendations will then be listed as potential areas for improvement in terms of the Team 20/20 philosophy. However, there were a number of possible improvements in agronomy common to all the farms visited that merit initial discussion as follows.

Foliar leaf disease control

The majority of the fields examined had different combinations of late season leaf diseases ranging from Powdery Mildew, Rust, Ramularia and Cercospera with all four diseases being found on some fields. The levels of infestation ranged from mild to severe with yield losses estimated to be between 5 and 10%. The future use of triazole and strobilurin fungicides could help prevent such sugar losses, indeed recent work in Western Europe has measured a 4 to 8% increase in sugar yield in the absence of any disease. A realistic increase of up to 10% in national sugar yield could be envisaged depending upon annual level of infection and harvesting schedules. The additional yield benefits from the use of such products are accumulated throughout the late summer and early autumn, therefore, the longer the crop is grown the greater the yield advantage. There are also recent suggestions that as these chemicals delay the senescence of the leaf canopy, nutrients such as nitrogen and potassium are not mobilised and translocated to the roots to accumulate as amino N and potassium so early in the growing season. If proven correct, there would also be a further benefit in an improvement in beet quality and extractable sugar. The rapid testing and introduction of such active ingredients could go a long way to achieving the 20% increase in yield. The incorporation of tramlines alongside this initiative would facilitate effective application of these fungicides without damaging beet with the tyres on the spraying equipment as well as reducing seed usage.

Harvesting

Yield losses at harvest, in particular root breakages, were greater than generally measured in the United Kingdom. In addition, the beet appeared to be excessively bruised in many fields, exhibiting the pink discolouration of the skin soon after harvesting which had turned to a blackening of the outer surface of the beet in some of the beet storage piles examined. Bruising not only causes an immediate sugar loss in the field but also increases beet respiration rate leading to higher losses in store. In addition, the broken cells also facilitate invasion by microorganisms which cause a further sugar loss in store and in some situations root rots and clamp deterioration.

There is no doubt that more careful harvesting could attain a significant increase in yield. Unfortunately, the sugar beet contract between grower and processor heavily penalises soil tare in the loads of beet delivered to the factory. It is therefore necessary to use aggressive cleaning during harvesting to reduce soil tare to a minimum. There is always a trade off between reducing soil tares and increasing harvesting losses, which will be difficult to improve with the current contract. It would be prudent to carry out a desk study as to the future prosperity of the Swedish sugar industry comparing the current contract facilitating low soil tares but higher harvesting losses with a hypothetical contract that allowed gentler harvesting with higher field yields but with higher soil tares.

All the farms involved in the project should have their harvesting losses (surface and breakage) assessed on a field by field and annual basis as a matter of priority. If resources allow, this approach should be extended to as many additional farms as possible. This would not only allow national losses to be estimated but would also allow a comparison of the farmers in the study group with the national average to help evaluate the potential yield improvements that are possible.

Drilling, seed emergence and establishment

Drilling was a concern to the growers interviewed, the main issues being either a lack of moisture and/or cold soil temperatures in the spring. In many cases growers were reluctant to consider early drilling preferring to wait until conditions improved, and probably losing yield potential in the process. In the United Kingdom much of the sugar beet seed is primed or advanced under the commercial term ‘Advantage’. This gives the seed the ability to emerge more rapidly and evenly under difficult soil conditions. This seed treatment may have particular benefit for Swedish spring and soil conditions. The uniformity in terms of plant stand may also be an advantage in terms of easier management of herbicide timings and more efficient topping at harvest and lower root losses. Yield increases from 1%, calculated from the UK crop growth model and the extra days of growth from increased speed of emergence, to 10% from a combination of the above factors have been claimed from the use of advanced seed. It is suggested that a small quantity of a UK seed variety with (and possibly without) the ‘Advantage’ treatment is compared with the grower’s conventional seed as strips across all farms and drilling dates. In all cases drilling should be carried out as soon as conditions allow. Crop emergence would need to be assessed and, if possible, the areas treated separately in terms of weed control and harvesting.

Seed rates could also be slightly reduced by increasing seed spacing within the rows. Where soil conditions give good emergence, seed spacing can be increased. Moving from 5.5 seeds/m to 5 seeds/m would be a reduction of over 9%. There are additional seed savings

when using a tramlining system. A 24m system on 48cm rows would save another 4% (without compensating with closer spacing on rows next to wheelings).

Fertiliser inputs

One area that also deserves attention is the type of fertiliser applied, the rates and timing of applications and whether the product is broadcast or placed. It is difficult to compare the Swedish approach to rates of nutrients applied with that practiced in the UK because the soil extraction and analytical systems differ between the two countries. However, for a 60 t/ha root yield an input of 50 kg P_2O_5/ha and 100 kg K_2O/ha is required on soils of medium fertility. On more fertile soils no phosphate or potash inputs are required at all. In addition, for the soil types observed with associated organic matter contents and organic manure inputs, the sugar beet crops appeared to receive, in general, more nitrogen than would be recommended for optimum yield and quality. A maximum of approximately 100 kg N/ha, and in some cases even less, would be sufficient, as long as the timing of application minimises any leaching losses.

In the UK, the nitrogen is generally applied as a straight product (34% N) in the spring with the remainder of the fertilisers (potassium, sodium, phosphate and magnesium) applied to the cereal stubble as a blend or a mix of compounds in the previous autumn or early spring depending upon soil type and then ploughed down. The complex compounds used in Sweden, particularly those containing nitrogen, make this approach more difficult and the placement techniques common to the region are not practiced in the UK. It would be interesting to have the farm soils analysed in the UK for available nutrients and a fertiliser policy suggested for each trial field. If available, alternative fertiliser products could be applied at application rates and timings as practiced in the UK and compared with standard on farm practice. A comparison of cost, beet yield and in particular beet quality would prove a useful exercise. Practically, it is already too late to attempt this for the next sugar beet crop but should be a future consideration. However, different rates of nitrogen fertiliser can be compared this spring. Benefits are most likely to be reduced input costs and improved beet quality.

Cultivations and herbicide applications

In terms of reducing growing costs two further subject areas should be considered on the majority of farms. First, the growers visited generally carried out more cultivation passes than necessary to produce a suitable seedbed in spring. In most cases using combined operations of ploughing and levelling could attain a reduction of one pass.

Second, although all the growers had achieved very good weed control by using conventional pre and post emergence systems, in order to achieve the Team 20/20 targets, it may be necessary in the future to push such conventional systems to their limit to reduce the number of sprays applications required. One way to do this is to use a post-emergence regime and delay applications until weeds are larger, using a combination of active ingredients specific for the weed spectrum and size of weed to be controlled. Although it may not reduce the total amount of chemical applied, it may reduce the number of applications to two, or on very high weed pressure sites, three post-emergence sprays only. Although more difficult to achieve, as timing and choice of chemicals is critical, the growers (and advisors) visited are the perfect individuals to attempt this approach on the test areas. Water volume rates could also be reduced to 100 l/ha using fine droplets allowing more ground to be covered for each spray tank of chemical.

Headlands

The headlands where machinery turns never yield as well as the centre of a field. Yield reductions of over 50% have been recorded and can typically be over 30%. This makes such areas less economical for sugar beet production, particularly on heavier soils, and difficult to justify under the Team 20/20 objectives. Careful thought needs to be put into planning the crop area to achieve maximum production from as much of each field as possible which may mean not cropping these areas. Yield may be increased from 1% to 4% depending on field size and shape of existing turning headlands.

Recommendations

As discussed above a summary table is attached highlighting the main agronomic practices followed by each grower and suggested changes that may help towards achieving the 20/20 target. It is recommended that all the approaches discussed above are considered as core treatments across all farms. Therefore, the use of lower seed rates and the testing of 'Advantage' treated seed at drilling and the use of fungicide sprays against late season leaf diseases are suggested. A reduction in the number of cultivation passes and herbicide applications should be attempted and changes in harvesting practice discussed following harvester assessments. For some growers it has been suggested that 'turning headlands' are not cropped to maximise output per hectare. Conservative reductions in some nitrogen fertiliser rates have been recommended and future soil analysis would indicate whether further reductions are possible. Soil analysis in 2004 for other available nutrients would also allow a comparison of different fertiliser systems to be carried out on the farms. However, it is recognised that some active ingredients are not yet registered for use and that the current sugar beet contract makes changes in harvesting practises difficult. Even so, small areas of sugar beet could be used as test areas even if the beet could not be delivered for processing. The sooner these systems are investigated the sooner any potential benefits can be measured or the approaches discarded.

The concept of improving soil structure to aid water (and root) infiltration as well as building up organic matter contents of the soils by the use of green manures is sound. However, considerable trials experience over three years in the UK in the 1990's showed that establishing such crops prior to the sugar beet crop, usually under dry soil conditions in summer and early autumn, was extremely difficult. Indeed, the strategy was abandoned because of the poor establishment and seed costs. The same problem was observed in Sweden. Unless the green manure crops currently under investigation can be successfully established and possibly financially supported by Government or EU grants then they are unlikely to be of benefit to the project.

There are also areas of specific interest to individual farms and farmers. Both Lennart Nilsson and Staffan Gertzell use considerable amounts of irrigation. An evaluation of the true costs of irrigation should be made and a scheduling system for amounts and timings of water used considered. Not only would such an approach use water more cost effectively per tonne of roots produced but would also help in reducing the risk and spread of Rhizomania.

A number of the farms visited would be more suitable for investigating the benefits of using tramlines in the sugar beet crop. Sven Bramstorp was already considering its possibility, the drilling contractor for Staffan Gertzell uses a Kleine drill ideally suited for tramlining and the row spacing of 50 cm on Lennart Nilsson's farm also makes the approach easier. These farms could form a focus group for this aspect of the project.

On two farms, those of Per de Fine Licht and Mats Janström, many of the beet exhibited 'fangy' roots where the main tap root had split into two or more roots. This is usually, although not exclusively, caused by soil compaction restricting rooting depth and utilisation of nutrients and water in the subsoil. Yields can be reduced and soils tares increased under such circumstances. It is suggested that subsoiling of parts of these fields is attempted although this may be very difficult for Mats Janström because of the large number of stones in the soil profile. Indeed, it is possible that the stones themselves were causing the beet fanginess; unfortunately, this would prove difficult and time consuming to determine.

As discussed above, harvester assessments are essential to the progress of the project. A consideration of the effects of bruising on sugar loss and storage should also be made. The most severe bruising was observed on the farm of Staffan Gertzell with the outer surface of many of the beet having already turned black. A particular emphasis on less aggressive harvesting by the contractor would be worthwhile.

It is difficult to comment on the storage practices carried out by the growers as storage losses have not yet been evaluated and no comparisons made of the protective coverings available. Once further information is available possible improvements may be more evident. However, we would suggest that Christian Wraghe attempts to store beet on firmer ground than on the side of the field, if such area is available, and that Birger Bernhoff considers an improved storage area and clamp design. The beet are stored in one pile between barns on two sides and straw bales on the other two. This is likely to restrict ventilation and increase sugar losses in store.

There are many options available for testing during the projects life span. It is unlikely than any one, or two, agronomic initiatives will deliver the required changes in yield and costs of production. It will almost certainly be a combination of many improvements, however small, that will be necessary.

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Dr Michael Armstrong and Simon Fisher

Grower 1. Sven Bramstorp, Klagstorp

	Existing Practice	Recommendations for Team 20/20
Rotation	1:4	
Cultivations	Plough October Spring levelling prior to fertiliser – harrow Germinator after fertiliser	Plough and level in one operation – October Use Germinator once before drilling Cultivations reduced by one
Fertilisers	Spring NPK pre drilling, 500 kg/ha 17:4:13 130kg/ha Kieserite Nitrogen placement at drilling (total N 120kg/ha) pH 7.6	Test soil nutrient status before sugar beet Apply P, K, Mg and Na before ploughing Chilesalpeter is too expensive for the Team 20/20 approach Consider reducing total N fertiliser to 100 kg N/ha – apply all at drilling
Drilling	12 row Monocentra, 48cm rows	Wider seed spacing (5 seeds/m) Tramlining to save more seed and facilitate late season fungicide applications. 'Advantage' treated seed
Varieties	Sapparo – low bolting	
Weed Control	3 post emergence applications 200 L/ha spray volume 1 x inter-row cultivation Hand pick weed beet	Reduce water volume to 100-150 L/ha Control weeds with fewer applications
Pest Control	Montur seed treatment Aphanomyces index low	Montur
Irrigation	None	
Disease Control	Tachigaren seed treatment	Use fungicides to control leaf diseases in August/September
Harvesting	6 row Riecam – group ownership 3 harvest dates September, October, late October early November	Measure root losses when harvesting
Storage	Good. Uses straw and mats for frost protection	Monitor storage temperatures

Grower 2. Per de Fine Licht, Viken

	Existing Practice	Recommendations for Team 20/20
Rotation	1:3. Soil 15% clay, 35% silt, 50% sand	Widen rotation to reduce potential of disease (onto heavier soils)
Cultivations	Plough October Spring levelling, on frost, prior to fertiliser – harrow Väderstad or Crosskill harrow after fertiliser	Consider subsoiling in the autumn before beet ('fangy' beet evident) Combine ploughing and levelling into one operation Reduce spring cultivations – ideally only one Cultivations reduced by one
Fertilisers	Spring NPK pre drilling, 800 kg/ha 15:4:7 (+ Mg, Mn, B) Dolomite limestone pH ?	Test soil nutrient status before sugar beet Autumn P, K, Na, Mg. Consider reducing total N fertiliser to 100 kg N/ha. Consider omitting Mantrac as Mn is already in the fertiliser mix. Fertiliser placement at drilling
Drilling	18 row Monosem, 48cm rows, 5.5 seeds/m High plant populations 102,000/ha	Wider seed spacing (5 seeds/m) Closer evaluation of plant populations 'Advantage' treated seed
Varieties	Avance	Is there a history of rhizomania? Use varieties not susceptible to aphanomyces
Weed Control	3-4 post emergence applications. Low weed pressure. 180 L/ha spray volume Inter-row cultivation sometimes Hand pick weed beet	Reduce water volume to 100 L/ha Control weeds with fewer applications
Pest Control	Sumi-alpha	
Irrigation	None	
Disease Control	Tachigaren seed treatment Some aphanomyces early in season	Use fungicides to control leaf diseases in August/September
Harvesting	6 row Kleine SF10 – group ownership 3 harvest dates September, October, early November	Measure root losses when harvesting
Storage	Good. Straw for frost protection Up to 8 weeks	Monitor storage temperatures
Delivery		Improve group delivery system to reduce storage in early season

Grower 3. Mats Janström, Mörarp

	Existing Practice	Recommendations for Team 20/20
Rotation	1:4+. Soils 12% clay, 50% silt, 34% sand, 3% OM.	
Cultivations	Plough + packer December Spring levelling, on frost, prior to fertiliser – harrow Crosskill harrow after fertiliser	Subsoil in autumn 'fangy' beet widespread (big rocks could be a major problem!) Combine ploughing and levelling into one operation. Reduce spring cultivations – ideally only make one cultivation Do not crop beet on turning headlands Cultivations reduced by one
Fertilisers	Pig slurry December 27,000 L/ha (NPK 2.3:1:2) 60% available in spring Spring NPK 3 weeks pre drilling, 400 kg/ha 17:6:10 80kg/ha N34 June pH 7.6 Chilesalpeter for 2004	Test soil nutrient status before sugar beet Chilesalpeter is too expensive for the Team 20/20 approach Consider alternative products Apply P, K, Na, Mg pre ploughing Apply all nitrogen fertiliser by 4 leaf stage at a total rate of 90 kg N/ha
Drilling	12 row Monopill, 48cm rows, 5 seeds/m, moving to 4.5 seeds/m in 2004 3rd April 2003, normally 15th April	Drill as early as conditions will allow Closer evaluation of plant populations 'Advantage' treated seed
Varieties		Select varieties not susceptible to aphanomyces
Weed Control	3-4 post emergence applications 150 L/ha spray volume Hand pick weed beet	Control weeds with fewer herbicide applications Reduce spray water volume to 100 L/ha
Pest Control	Montur	Montur
Irrigation	None	
Disease Control	Tachigaren seed treatment Some aphanomyces early in season	Use fungicides to control leaf diseases in August/September
Harvesting	3 row Edenhall – owned by grower	Measure harvester losses
Storage	Good. Beet mats for frost protection Up to 8 weeks	Monitor storage temperatures
Delivery	3 delivery slots	

Grower 4. Lennart Nilsson, Kristianstad

	Existing Practice	Recommendations for Team 20/20
Rotation	1:4 or more	
Cultivations	Plough when dry in December after pig manure application. Harrow in spring before sowing. Some minimum tillage on light land	Do not crop beet on turning headlands
Fertilisers	Pig manure 30t/ha (nutrient content analysed) Spring N, Mg, S 1 or 2 days pre drilling, 30kg N Dolomite limestone. No Sodium applied. pH ?	Test soil nutrient status before sugar beet Consider alternative products Apply P, K, Na, Mg pre ploughing
Drilling	9 row Monocentra, 50cm rows, 5 seeds/m 3.5-3.8 kph, 7-10 April 80-85,000 plants/ha	Drill as early as conditions will allow Closer evaluation of plant populations Tramlining to save more seed and facilitate late season fungicide applications. 'Advantage' treated seed
Varieties	Avance	Rhizomania tolerant
Weed Control	3 post emergence applications 150 L/ha spray volume, 2 bar pressure Hand pick weed beet 1 x mid summer inter-row cultivation	Control weeds with fewer herbicide applications Reduce spray water volume to 100 L/ha
Pest Control	Montur	Montur
Irrigation	72m bout width 3 or 4 applications of 20mm	Evaluate the cost of irrigation Schedule water use to improve efficiency and reduce the potential spread of rhizomania
Disease Control	Tachigaren seed treatment Some aphanomyces early in season	See irrigation re: rhizomania Use fungicides to control foliar diseases
Harvesting	3 row Hilleshög start mid October, 2 or 3 harvest sessions	Measure harvester losses
Storage	Good. Use straw for frost protection. Temperatures monitored	Continue to monitor storage temperatures
Delivery	Haulier uses cleaner loader to remove stones	

Grower 5. Staffan Gertzell, Everöd

	Existing Practice	Recommendations for Team 20/20
Rotation	1:4 or more	
Cultivations	Plough end of October (+ packer on light soils) Light harrow in spring. 1 pass after packer 2 passes on silt soils	Excellent soil management Combine operations wherever possible – ploughing + levelling on heavy soils. Do not crop beet on turning headlands. Reduce spring cultivations - ideally only make one cultivation. Cultivations reduced by one
Fertilisers	Autumn – starch by product 25-30 t/ha 40-50 kg N, 120kg K/ha. Pro Beta N, 115kg N/ha after drilling 7t/ha of sugar factory lime, pH ?	Test soil nutrient status before sugar beet Consider alternative products Apply P, K, Na, Mg pre ploughing
Drilling	18 or 12 row Kleine, 50cm rows, 5.2 seeds/m 3.5-3.8 kph, 7-10 April 80-85,000 plants/ha	Drill as early as conditions will allow Wider seed spacing (5 seeds/m) Closer evaluation of plant populations Tramlining possible with Kleine drill – 50cm rows 'Advantage' treated seed
Varieties	Envol, Ymer	Rhizomania tolerant Do not use Ymer – aphanomyces susceptible
Weed Control	3-5 post emergence applications 200 L/ha spray volume Hand pick weed beet Inter-row cultivation sometimes	Control weeds with fewer herbicide applications Reduce spray water volume to 100-150 L/ha
Pest Control	Montur	Montur
Irrigation	Whatever the crop needs 25 – 30 mm – quite few times	Evaluate the cost of irrigation Schedule water use to improve efficiency and reduce the potential spread of rhizomania
Disease Control	Tachigaren seed treatment	See irrigation re: rhizomania Use fungicides to control foliar diseases
Harvesting	3 row Thyregod 3 harvest sessions completed by end of October	Measure harvester losses Harvest beet more gently and use cleaner loader to remove soil once it has dried sufficiently
Storage	Good. Use straw and sometimes plastic for frost protection. 'A' shape clamp	Monitor storage temperatures
Delivery	Haulier loads beet, through cleaner if necessary	

Grower 6. Birger Bernhoff, Gärsnäs

	Existing Practice	Recommendations for Team 20/20
Rotation	1:4 or more. Soils 13% clay, 56% sand, 29% silt	
Cultivations	Plough + packer just prior to drilling or a bit earlier if dry enough 1 x harrow to mark for fertiliser spreading	Cut stubbles shorter to aid shallow ploughing Do not crop beet on turning headlands
Fertilisers	pH 6.5 4t/ha Dolomite limestone Chicken manure. Pig slurry from 2004, 30t/ha total 100kg N/ha Pro beta N	Test soil nutrient status before sugar beet Use free manure from pig farm (analyse nutrient content before use, adjust application rate to crop requirement) as much as required by the crop.
Drilling	14 row Monocentra drill, 5.2 seeds/m, 48cm rows Approx 5 plants /m establish	Drill as early as conditions will allow Wider seed spacing (5 seeds/m) Closer evaluation of plant populations 'Advantage' treated seed
Varieties		
Weed Control	4 or 5 applications 100 L/ha	Control weeds with fewer herbicide applications – consider reducing by 2 applications
Pest Control	Montur seed treatment	Montur seed treatment
Irrigation	None	
Disease Control	Tachigaren treated seed	Use fungicides to control foliar diseases
Harvesting	2 row Tim September, early October and late October early November	Measure harvester losses Light soils could be harvested later to maximise autumn growth and yield
Storage	Between two buildings Frost protection with mats	Monitor storage temperatures Improve storage area and clamp design
Delivery	Use Thyregod cleaner loader	

Grower 7. Christian Wraghe, Staffanstorp

	Existing Practice	Recommendations for Team 20/20
Rotation	1:4 or more. Soils 22% clay, 43% silt, 35% sand	
Cultivations	Plough November + levels if conditions allow Spring – Light harrow pre fertiliser, Väderstad Rapide fertiliser placement, followed by Germinator pre drilling	Combine operations wherever possible – ploughing + levelling Do not crop beet on turning headlands Cultivations reduced by one
Fertilisers	Sugar factory lime 8t/ha. pH 6.7 – 7.5 PK pre ploughing, 33 kg P, 63 kg K/ha Spring, pre drilling, fertiliser placed with cereal drill - N34 + NaCl, 160 kg/ha NaCl, 110kg/ha N	Test soil nutrient status before sugar beet Consider applying Na pre ploughing Fertiliser placement machinery could cause soil compaction in seedbed. Reduce total N fertiliser to 90 kg/ha
Drilling	18 row Monopill, 48 cm rows, 5.1 seeds/m Start end March/early April	Drill as early as conditions will allow Wider seed spacing (5 seeds/m) Closer evaluation of plant populations 'Advantage' treated seed
Varieties		
Weed Control	3 post emergence applications 150 L/ha, 2 bar pressure, medium droplet, 24m 1 or 2 inter-row cultivations	Control weeds with fewer herbicide applications Reduce spray water volume to 100L/ha, fine droplets
Pest Control	Montur seed treatment	Montur
Irrigation	None	
Disease Control	Tachigaren seed treatment	Use fungicides to control foliar diseases
Harvesting	3 row Thyregod (also contract harvests for other growers). All beet harvested in October Harvesting losses average 10%?	Measure harvester losses Light soils could be harvested later to maximise autumn growth and yield
Storage	A shape clamp on field Straw used for frost protection	Monitor storage temperatures 'A' shaped clamp maybe vulnerable to frost damage consider a more rectangular shape. Position clamp on 'firmer' ground
Delivery	Group haulier.	