

Reducing strawberry labour costs by increasing picking speeds and improving harvest efficiency

SF 71

Final Report

Report Produced By:

Chris Rose
Chris Rose Associates

Scott Raffle
ADAS UK Limited

March 2006

Project Title: Reducing strawberry labour costs by increasing picking speeds and improving harvest efficiency

Project Number: SF 71

Project Leader: Scott Raffle

Report: Final Report, March 2006

Previous Reports: Not Applicable

Key Workers: Chris Rose, Kathy Strong (Chris Rose Associates) and Chris Hoggart (Ergonomics consultant)

Locations of Project: Various farms and locations in England

Project Co-ordinator: Andrew Chesson

Date Project Commenced: 1 April 2005

Project Completion Due: 31 March 2006

Key Words: Strawberry labour costs, picking speed, harvest efficiency

Whilst reports issued under the auspices of the HDC are prepared from the best available information, neither the authors nor the HDC can accept any responsibility for inaccuracy or liability for loss, damage or injury from the application of any concept or procedure discussed.

©2006 Horticultural Development Council

The contents of this publication are strictly private to HDC members. No part of this publication may be copied or reproduced in any form or by any means without prior written permission of the Horticultural Development Council.

©2006 Horticultural Development Council

The results and conclusions in this report are based on a series of experiments, surveys and assessments conducted over a one-year period. The conditions under which the experiments were carried out and the results have been reported in detail and with accuracy. However, because of the biological nature of the work it must be borne in mind that different circumstances and conditions could produce different results. Therefore, care must be taken with interpretation of the results, especially if they are used as the basis for commercial product recommendations.

AUTHENTICATION

I declare that this work was done under my supervision according to the procedures described herein and that the report represents a true and accurate record of the results obtained.

Chris Rose
Chris Rose Associates

Signature Date

Scott Raffle
Senior Horticultural Consultant
ADAS UK Ltd

Signature Date

Report authorised by:

Andrew Fuller
ADAS Horticulture Group Manager
ADAS UK Ltd

Signature Date

CONTENTS

	Page
1. Grower Summary	
Headlines	1
Background and Expected Deliverables	1
Summary of the Project and Main Conclusions	1
Financial Benefits	5
Action Points for Growers	6
2. Science Section	
Introduction	7
Objective 1	9
Materials and Methods	9
Results and Discussion	11
Conclusions	19
Objective 2	20
Materials and methods	20
Results and discussion	20
Conclusions	34
3. Appendices	35

Grower Summary

Headline

This project demonstrated that growers have the potential to save 35% on strawberry picking costs and defined the 'best practice' methods to reduce costs in the strawberry harvest operation.

Background and Expected Deliverables

The financial margins being made by strawberry producers in the United Kingdom are currently being squeezed as production costs rise and returns fall.

The cost of picking strawberries by hand can amount to 45% of the total variable costs of production. In commercial practice, there is a wide spectrum of picking speeds and no work has been conducted to increase the average speed.

Observations and informal surveys have indicated that strawberry businesses continue to organise their harvesting operations through a diverse range of systems. Little previous work has been conducted to identify which of these is the most efficient in terms of labour resource and money.

There are two objectives of this project:

1. To assess the differences between fast and slow pickers and develop a model to enable the industry to train all pickers to attain the performance level of those who are currently fastest.
2. To determine the most efficient methods of organising strawberry harvesting operations from current industry practice.

The results of this project will directly lead to cost savings for growers. Two DVDs are being produced to help communicate the results and subsequent training courses will be available.

Summary of the Project and Main Conclusions

Objective 1 -Increasing picking speeds

Four farms were selected where strawberry pickers could be assessed for picking speed. All four farms employed their picking labour from Eastern Europe. This included a mix of students from the Seasonal Agricultural Workers Scheme (SAWS) and ex-SAWS returnees. Between them, the businesses employed a total of 900 harvest workers. Using available farm data, both the fastest and slowest pickers were identified. Observations were made to find patterns present in the fastest pickers that were absent in the slower pickers. Four pickers were selected that demonstrated the following patterns/characteristics:

1. Extremely fast
2. Consistently pick to an acceptable standard
3. Able to speak English

All four were studied through discreet observation, filming them picking and through interviews, which were also filmed. These individuals were referred to as 'champion pickers' and from studying them, the 'champion strawberry picker model' was created. Many other 'champion pickers' were also observed and spoken to and it was found that they also fitted the model.

Key features of the champion model - Champion strawberry pickers:

1. Have a structured and consistent search pattern. They do not miss fruit.
2. They are ambidextrous when picking. They pick berries directly and simultaneously into both hands.
3. They read the plant – they see how much fruit there is to pick and know how to pick it. For example, if they are grading fruit, and if there are sufficient berries of each class, they pick class one fruits with one hand and class two fruits with the other.
4. They move the sledge (all farms observed used sledges) accurately with the foot whilst still picking.
5. They listen to their bodies and alter picking posture based upon what their bodies are telling them. Often this becomes a pattern. For example, they may stand for three plants and kneel for one.
6. They have a strong desire to earn as much money as possible for a specific reason or reasons, such as wanting to buy a flat or apartment.
7. They are physically fit and strong - just being in good health is not sufficient.
8. They are good modellers themselves. They originally observed the best performers and copied them, changing their approach until they got results.
9. They set a sustainable pace and get into the rhythm and flow of picking, developing a consistent pattern.
10. They shut off from external influences specifically including time and the speed others are picking at.
11. They control their state of mind by always thinking positive thoughts, such as thinking of loved ones rather than how hot it is.

Some of the above traits cannot be taught directly (e.g. being physically fit and strong). Others improve over time (e.g. picking with both hands). Some can be changed instantly (e.g. listening to the body and controlling the state of mind).

Transferring the Model:

Having developed the model, one of the key workers (Chris Rose) learned the model. He was guided by the another key worker (Kathy Strong) and by one of the champion pickers called Vitali.

The next stage was to transfer the model to other pickers. Initially two pickers were chosen, one who had lost motivation and was well below average, whilst the other was a little below average and was lacking good motivation. A week later, two more pickers were selected who were slightly above average. One of these two was not motivated to improve. She was an agricultural student, principally wanting to gain work experience.

Approximately two hours was spent with each picker (including initial observations), transferring the model and observing changes. In all four cases the results achieved came from this one session without need for further intervention.

In a commercial situation, the supervisor would be available and able to provide further intervention, as needed, on a daily basis. This approach may increase the improvement in performance.

Specific techniques used to transfer the model:

1. Rapport – The necessary time was spent with each person to get on the same ‘wavelength’. This involved acknowledging and accepting how the individual felt.
2. Empathic listening – listening was employed rather than speaking. Listening was used with a view to understanding, rather than to reply.
3. Calibration – This refers, in this context, to noticing subtle changes in emotion through expression, voice and body language. This aided the understanding, particularly where the quality of spoken English was a limiting factor.
4. Questioning techniques – Carefully phrased open questions were used to elicit important information.
5. Anchoring – This is a technique that enables a person to capture the feeling(s) that would best serve them when picking, from some other part of their life. For example, a strong sense of believing that you will be successful.

Results:

Overall, the results demonstrated that a **20.3%** improvement in picking speeds was achieved against the control group. The control group was the 54 pickers that comprised the mid-80% of the gang.

Some improvement in performance came immediately after the model was applied and all the improvement came within two days. All four pickers that were trained sustained their improved performance throughout the remainder of their work period (typically around 4 weeks). They performed even better compared with the average of the control group in the last 25% of the period after the model was applied.

Pre-selection:

The project highlighted the problems with slow, unmotivated pickers. These pickers frequently came from wealthier families and were not primarily here to work. They were here for other reasons such as: a holiday, to improve their English or because their university or parents suggested it.

If these workers were to be removed, or preferably deselected before arrival, much greater improvements in average picking speed could be achieved. To this end, some form of procedure to pre-select labour is extremely desirable.

Conclusions:

The model can be used to train pickers to improve their picking speeds. The use of a pre-selection procedure to select pickers who are likely to respond to such training would further help to increase the average picking speed of a labour gang.

Objective 2 – Improving Efficiency of Harvest Operations

Information was gathered to elicit the current best practices used in strawberry harvest operations. The information was obtained in three ways:

1. A questionnaire was devised and put on-line, enabling growers to fill it in easily and quickly.
2. A number of visits were made to leading growers to observe harvest operations.
3. Growers were contacted by telephone.

The key components of the harvest operation that were studied and discussed in most detail were:

- Field layout and organisation
- Bed design
- Tunnel and bed configuration
- Alley width
- Cropping density
- Tunnel picking
- Picker organisation
- Picking
- Team picking
- Runners
- Gang size
- Supervisor's role
- Policing pickers
- Row checking
- The harvest day programme
- Collection point organisation
- Weighing fruit
- Data logging systems
- Fruit carting

Each of these was assessed and considered both through the initial survey and then through the more detailed site visits. The range of options and merits of each are discussed and best practice recommendations are offered in the Science Section of the report. An overriding requirement of best practice is to keep the picker picking at all times.

Financial Benefits

The table below (using real farm data) illustrates the improvement in picking speed (kg/h) that can be achieved by applying the model to pickers in different groupings in a gang of pickers. It is assumed that a small 'elite' of very fast pickers will not improve as they already have the techniques in place. It is also assumed that a larger percentage at the low end of the scale will not increase in picking speed as they are not interested in working hard to earn money. The 4th column shows the extra improvement that could be achieved by pre-selection.

Improvements in picking speeds (kgs/hour) gained through applying the model

	Pre- Model	Post -model	Post-model + pre-selection	Gain
Top 10%	20.1	20.1	20.1	0%
Mid 65%	12.2	14.7	14.7	20.3%
Bottom 25%	6.6	6.6	14.7	122.7%
Average	11.3	12.8	15.2	35%

--	--	--	--	--

Applying the model successfully could give a 13.3% improvement in overall picking speeds. This equates to a saving of £64.56 per tonne (based on £550/tonne). When savings on supervision costs are included this figure rises to **over £65 per tonne**. A grower producing 500 tonnes could reduce harvesting costs by £37,500 every year.

With pre-selection as well, a 35% improvement is possible, resulting in potential savings of £192.50 per tonne, or **over £200 per tonne** including supervisory savings.

Action Points for Growers

- Use the champion picker and supervisor videos that are being produced by the HDC to accompany this report.
- Consider methods of pre-selecting your labour to screen out the non-motivated members of a workforce.
- Ensure supervisors are trained in the specific techniques needed to maximise picking rates.
- Review harvest team roles to ensure there is time, ability and desire to implement the techniques highlighted in this project.
- Since harvesting is a seasonal undertaking, often with key staff changing from year to year, it is strongly recommended that all grower businesses have a comprehensive written harvest plan that is reviewed annually.

Science Section

Introduction

The financial margins being made by strawberry producers in the United Kingdom are currently being squeezed as production costs rise and returns fall. The cost of picking strawberries by hand can amount to 45% of the total variable costs of production.

Strawberry growers are obliged to pay a minimum wage of £5.05 per hour to their workers to harvest the crop. Coupled to employment costs, including additional holiday pay, overtime, NIC and administration, the average cost of picking labour is in the order of £6.20 per hour in 2006. Given that the true cost of employing harvest labour has risen over 50% during a period of static (and in 2004 declining) returns for strawberries sold in the UK, strawberry growers must find new ways of reducing their production and harvesting costs to survive in their business.

Almost all UK strawberry growers pay for fruit picking using a piecework system. This involves a price per tray of fruit set according to crop level. Slower pickers may not pick enough to reach the minimum wage and these pickers have their money made up to comply with minimum wage legislation.

Other ancillary harvest jobs such as ‘runners’ (removing trays from the field to the in-field collection point) and carting (removing fruit from the field to the packhouse) are sometimes paid by the hour or by piecework or a combination.

Several ergonomic studies have been conducted in the past to assess ways of improving harvest efficiency. These have focused on the collection and movement of fruit after the point of picking. To date, no work has been conducted on the actual task of removing fruit from the plant by picking staff.

In commercial practice, there is a wide spectrum of picking speeds. On UK strawberry farms, the fastest pickers can typically achieve a rate of 25 kg of fruit per hour, while the slowest achieve 6 kg per hour. A typical average rate for a farm in the UK is 10 kg per hour.

To ensure that strawberry pickers are paid the minimum hourly wage, strawberry growers pay their picking staff a sum of money for each kg of fruit they pick. This sum is based on the average picking speed and the minimum wage of the year. Based on an average picking speed of 10 kg per hour, in 2005 strawberry growers typically paid £0.55 per kg to their picking staff. As a result of further increases in the minimum wage in 2006, growers will either need to increase the sum they pay their pickers per kg or alternatively find ways of increasing their picking speed. Given the fact that returns for the product remain static or are declining, growers cannot afford to increase the picking price, so are forced to find ways of improving productivity. Assuming growers don't increase the rate paid/kg of fruit picked in 2006, to achieve the minimum wage strawberry pickers will need to pick at a rate of over 11 kg per hour.

The first commercial objective of this study was to demonstrate a method of increasing the average picking speed for strawberries. This needed to be achieved whilst retaining acceptable quality of picked product.

Previous strawberry harvesting studies conducted by ADAS on individual businesses have demonstrated that inefficiencies within harvest systems can substantially add to costs in many ways.

Observations and informal surveys have demonstrated that strawberry businesses continue to organise their harvesting through a diverse range of systems.

The second commercial objective of this study was to distil the best overall practice from individual components found across many businesses.

The remainder of this report will be split by these two objectives.

Objective 1

To assess the differences between fast and slow pickers and develop a model to enable the industry to train all pickers to attain the performance level of those who are currently fastest.

Materials and Methods

The project was conducted on four grower businesses:

- BR Brooks & Son, Langdon Manor, Goodnestone, Faversham, Kent
- SH Chesson, Manor Farm, Oldbury, Ightham, Sevenoaks, Kent
- E. Vinson Ltd, Ewell Farm, Graveney Road, Faversham, Kent
- Gaskains Ltd, Norham Farm, Selling, Faversham, Kent

The project involved modelling the fastest pickers from these four businesses using Neuro-Linguistic Programming (NLP) techniques to create what was termed the 'Champion Picker Model'. In preparation for this, the researchers studied a wide range of topics appertaining to this work (Appendix 3).

Definitions

Neuro-Linguistic Programming (NLP):

A therapeutic process that enables one to break old patterns and generate unlimited potential using posture, breathing, specific exercises, awareness and communication skills. The study of the structure of subjective experience. The process of creating models of human excellence in which usefulness, not truthfulness, is the most important criterion for success.

Model:

Model describes the essential distinctions of an experience or ability.

Modelling:

The NLP process of studying living examples of human excellence in order to find the essential distinctions of the thought and behaviours one needs in order to get the same results.

The Production of a Champion Picker Model

Strawberry pickers from the four farms selected for use in the project were assessed for picking speed. All four farms employ their picking labour from Eastern Europe. This includes a mix of students from the Seasonal Agricultural Workers Scheme (SAWS) and ex-SAWS returnees. Between them, the businesses employ 900 harvest workers. Using available farm data, both the fastest and slowest pickers were identified. Four pickers (from BR Brooks & Son, SH Chesson and Gaskains Ltd) were selected that demonstrated the following patterns/characteristics:

1. Extremely fast
2. Consistently pick to an acceptable standard
3. Able to speak English

These four individuals were referred to as 'champion pickers' and from studying them using NLP techniques and modelling, the champion strawberry picker model was created. It was produced through five different processes:

1. **Preparation** – This was undertaken to learn about the process of picking and to define the questions for pickers. A list of factors that may affect picker performance was drawn up from initial observations of harvesting and current knowledge. These factors were used to create a questionnaire for use in part 2 (information gathering).
2. **Information gathering** - The four champion pickers were observed whilst picking and were filmed. They were then interviewed using the factors drawn up in part 1 as a guide. A list of the type of questions used can be found in Appendix 1. A number of other very fast pickers and many slower pickers were also observed by the key workers Chris Rose and Kathy Strong. In addition, an ergonomics consultant, Chris Hoggart was commissioned to study the physical implications of current strawberry picking techniques. A random group of six pickers were studied in this process.
3. **Model building** – From the information gathered in part 2, the behaviours and qualities present in the champion pickers that were largely or totally absent in slower pickers, were isolated. The result produced a model.
4. **Testing** – This stage involved one of the key workers learning the model. It is usual that a creator of the model is used to test whether the techniques work as any results can be studied objectively and any necessary refinements made. The transfer process is also more effective when carried out by one who has learned the model. He was guided by Kathy Strong, who has many years experience of NLP modelling and by one of the champion pickers. Chris's picking speed was measured before and after learning the model and the improvement in speed recorded. His speed was also compared to a picking gang on one of the farms.
5. **Transferring** – This process involved transferring the model to four slower performing pickers. All four were chosen from the same picking gang at BRBrooks & Son. All four had the same length of picking experience and had received the same training package. The variability that could, therefore, arise between these pickers was reduced to a minimum.

Initially two pickers were chosen, one who had lost motivation and was well below average, whilst the other was a little below average and was lacking good motivation. A week later, two more pickers were selected who were slightly above average. One of these two (who was not motivated to improve) was an agricultural student, principally wanting to gain work experience. Approximately two hours was spent with each picker (including initial observations), transferring the model and observing changes. In all four cases the results achieved came

from this one session without need for further intervention. The following specific techniques were used in transferring the model to the pickers:

Rapport – The necessary time was spent with each person to get on the same ‘wavelength’. This involved acknowledging and accepting how the individual felt.

Empathic listening – listening was employed rather than speaking. Listening was used with a view to understanding, rather than to reply.

Calibration – This refers, in this context, to noticing subtle changes in emotion through expression, voice and body language. This aided the understanding, particularly where the quality of spoken English was a limiting factor.

Questioning techniques – Carefully phrased open questions were used to elicit important information.

Anchoring – This is a technique that enables a person to capture the feeling(s) that would best help them when picking, from some other part of their life. For example, a strong sense of believing that you will be successful.

The average picking speed for each of the four pickers was determined for a period of 30 days leading up to the transfer of the model. This was achieved using farm data acquired by the data logger system employed by the farm business. Having transferred the model to the four pickers, their average picking speed was recorded for another period of 30 days. The change in picking speed of each was compared to the top 5 pickers from the gang they worked in, and the mid 80% (total of 54 pickers).

Results and Discussion

1. Preparation

In preparation for information gathering, a list of factors that may affect picker performance was created from initial observations of harvesting and current knowledge and this list is given below. It is divided into two parts:

Extrinsic Factors (Definition: Lying outside, not belonging, operating or originating from without). These are global factors affecting all pickers in a gang. They may be applied equally (e.g. hot temperature) or unequally (e.g. an unpleasant supervisor may have favourites and pick on others). Individuals will be affected in different ways and to different degrees by extrinsic factors.

Intrinsic Factors (Definition: Belonging naturally, inherent, essential).

These are factors that come from individual pickers. Many factors that affect picking performance are likely to be intrinsic. They include aspects of a person that will dictate how they react to extrinsic factors.

Extrinsic Factors

- Living conditions
 - Quality of accommodation, quality of bed / mattress, cooking and washing facilities
- Leisure facilities / activities
 - Noise levels at night, timekeeping (e.g. late to bed on an early shift)
- Emotional support while on site
- Working conditions
 - Weather conditions- cold, hot, rainy, windy
 - Height of fruit above ground
 - Alleys – straw, grass, rough, smooth, wet, dry
 - Provision, proximity and state of toilets (clean, locking, serviced)
 - Provision of water/food
- Length of work
 - Hours per day, time of day, days per week, total hours worked if other work provided
 - Lack of sufficient breaks at appropriate intervals
- Training
 - Quality of induction; attitudes of trainers doing induction
 - Level and quality of teaching techniques
 - Focus on how to pick fast as well as quality (clarity of objectives)
 - On-going training, help, support
- Quality of fruit
 - Abundance of fruit, consistency of plantation (all rows equally good), size of fruit
 - Level of sorting (adequate training on search patterns)
 - Ease of finding fruit (size, density of plants)
 - Ease of detachment from plant (training of correct pull/twist pattern)
 - Level of weeds – nettles and thistles
- Organisation
 - Preparation, such as trays made up
 - Provision of trays and punnets to the picker (continuity of supply, proximity)
 - Use of runners (workers who collect picked trays and return empty trays to pickers)
 - Amount of non-picking time (walking, queuing, waiting)
 - Access, freedom from obstacles and obstructions (e.g. trays and packaging at end of row)

- Management
 - Attitude of supervisors
 - Level of pastoral care
 - Amount of help with motivation provided
 - Level of pay
 - Use of incentives
 - Keeping pickers free from distractions
 - Noticing problems as they arise
 - Voice tonality – especially where language is a problem
- Physical Placement
 - Best body posture (stand/sit/bend)
 - Push/Pull of trays
 - Number of trays for optimum performance

Intrinsic Factors

- Physical attributes
 - Fine motor skills
 - Deftness of movement
 - Hand/eye co-ordination
 - Flexibility
 - Height
 - Sex – female or male advantage?
 - Different physical postures and the advantages/disadvantages of these
 - Pain threshold
 - Aptitude at selecting and sorting
 - Robustness- consistent in varying conditions
 - Resistance to illness
 - General level of health (mental and physical) and fitness
 - Emotional wellbeing
 - Natural energy levels
 - Fitness levels and their importance
- Physical Care
 - Understanding and implementation of good diet
 - Sufficient hydration
 - Sufficient sleep
 - Listen to and act on signals from body
 - Level of alcohol and other drugs usage (performance enhancing drugs)
- Focus
 - Total immersion
 - Maximum time in immersion
 - Supervision intervention

- Thinking Process
 - Attitude
 - Goals
 - Beliefs
 - Values
 - Motivation
 - Internal conversation

- Mind matters
 - Positive attitude and enthusiasm
 - Optimist
 - Internal motivation
 - Need/desire to excel/be the best
 - Perfectionist and able to work to standards
 - Flexibility to embrace change
 - Curiosity to seek better methods
 - Able to switch off and disassociate
 - Unaffected by the collective mood
 - Positive internal dialogue
 - Mental toughness/resilience
 - Self-critical to the extent it improves performance

- Training
 - Responsiveness to training
 - Ability to listen and observe
 - Quick learner (ability to model)
 - Prepared to seek out and learn from the best
 - Able to sift information and extract key points
 - Believe in continual improvement

- Social
 - Avoid 'going with the flow' – late nights, alcohol etc;
 - Keep personal goals paramount
 - Avoid major distractions (e.g. falling in love)
 - Identify and mix with other top performers

- Socio-political
 - Nationality – work ethic varies from country to country
 - Poverty
 - Background - rural, farming vs. urban
 - Family – hard-working vs. lazy parents
 - Status – non-EU with visas are more likely to stay
 - EU citizens can move from farm to farm
 - Asylum seekers may have a different agenda

2. Information gathering

Following the preparation undertaken in part 1, a questionnaire was created for use in gathering information about the four champion pickers (see Appendix 1). They were also observed whilst picking and were filmed. A number of other very fast pickers and many slower pickers were also observed. In addition, an ergonomics consultant was commissioned to study the physical implications of current strawberry picking techniques. The full results of this study are summarised in Appendix 2

3. Model building

From the information gathered, behaviours and qualities present in the champion pickers were isolated that were largely or totally absent in slower pickers. The result produced the **champion picker model**, which identified that champion pickers have the following characteristics:

1. They have a structured and consistent search pattern. They do not miss fruit.
2. They are ambidextrous when picking. They pick berries directly and simultaneously into both hands.
3. They read the plant – they see how much fruit there is to pick and know how to pick it. E.g. if they are grading fruit, and if there are sufficient berries of each class they pick class one fruits in one hand and class two fruits in the other.
4. They move the sledge (all farms observed used sledges) accurately with the foot whilst still picking.
5. They listen to their bodies and alter picking posture based upon what their bodies are telling them. Often this becomes a pattern, such as: stand for three plants, kneel for one.
6. They have a strong desire to earn as much money as possible for a specific reason or reasons, e.g. wanting to buy a flat or apartment.
7. They are physically fit and strong - just being in good health is not sufficient.
8. They are good modellers themselves. They originally observed the best performers and copied them, changing their approach until they get results.
9. They set a sustainable pace and get into the rhythm and flow of picking, developing a consistent pattern.
10. They shut off from external influences including specifically time and the speed others are picking at.
11. They control their state of mind by always thinking positive thoughts, e.g. thinking of loved ones rather than how hot it is.

Some of the traits above cannot be directly taught, e.g. being physically fit and strong. Others improve over time, e.g. picking with both hands. Some can be changed instantly, e.g. listening to the body and controlling state of mind.

The conclusions of the ergonomics study undertaken as part of the information gathering exercise (part 2 above) broadly supported these findings. In particular it was noted that the main reason for the slower rate of some of the pickers was because their pattern of picking was not as efficient in the way that they moved through a plant to search for, pick and place the fruit into the punnets. Also their posture was often, though not always, more awkward (see Appendix 2).

4. Testing

For this stage, Chris Rose learned to use the model in practice. Even though Chris understood the model in theory, he was able to improve picking speed considerably through receiving coaching from Kathy Strong. Initially his picking speed was recorded at 20.9 kg per hour. This was faster than the average for the gang, reflecting knowledge of the model and shorter picking time. After coaching (on technique and mind-set) he achieved a rate of 34.1 kg per hour over a 30-minute period. The absolute speed compared with the whole gang is distorted due to the short time period and not needing to collect any empty trays.

The improvement in just two hours was 63.1%, though this in part incorporated natural improvement as with any new picker. A significant part of the coaching involved Chris setting himself a meaningful goal. This involved Chris acting as if he was being paid £10 per tray. Chris had thought that he was already motivated through wanting the project to work and yet the use of an imagined price as a motivator had a very significant positive effect.

5. Transferring

Having transferred the model to the four slow pickers, the average picking speed of each over a period of 30 days was compared to the average picking speed of the top five pickers and the average speed of the mid 80% of the gang. Overall, the results show that the transfer of the model achieved a **20.3%** improvement in picking speeds against the control group.

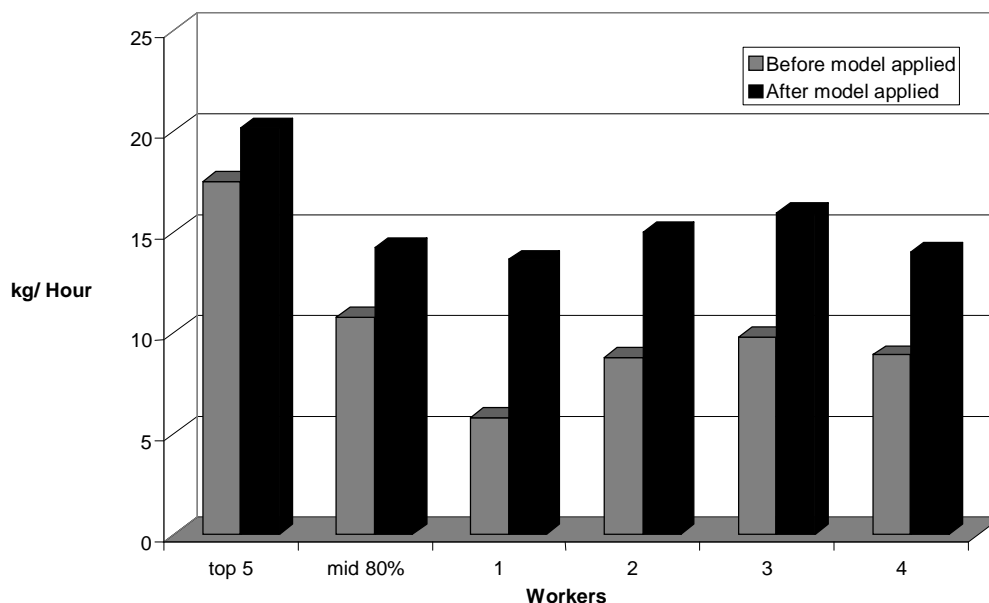
Some improvement in performance came immediately after the model was applied and all the improvement came within two days.

All four slow pickers that were trained sustained their improved performance throughout the remainder of their work period.

It is impossible in the transfer process to know exactly to what extent each of the eleven points of the model has caused any given improvement.

The chart below demonstrates the average picking speed of each of the four pickers both before the model was transferred and afterwards, compared with the overall average (mid 80%) and best (top 5) pickers. The model was only applied to the four pickers.

The effect of applying the 'champion strawberry picker model'



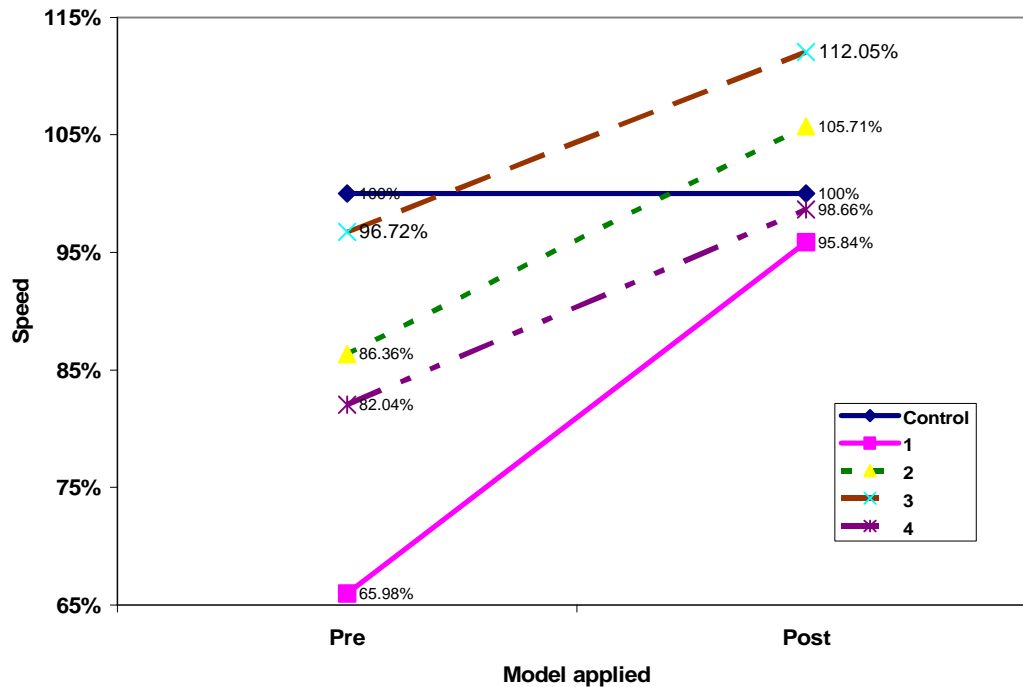
The gang that was worked with was significantly faster than the average gang for the United Kingdom. This could be attributed to the growing system employed by the business and resulting fruit presentation to the pickers. The high quality training methods employed by the business would also have contributed to this.

In the 4-week measurement period following application of the model, the control group picked at an average speed of 14.2 kg per hour. This control group comprised the 54 pickers that made up the mid-80% of the rest of the gang.

Although the four slow pickers increased their picking speed during the 4-week period, the control group also increased its speed of picking as there was more fruit to pick. However, the rate of increase of the slow pickers following the transfer of the model was greater than the control group. The chart below shows the increase the four pickers made over and above any increase in the control group.

The increase in picking speed of each picker compared with the control group is illustrated as a percentage of the group average. It can be seen that all four pickers improved relative to the group average and in the case of two, they increased their speed to a level that was higher than the group average.

Comparative picking speeds



Pre-selection of pickers

The project highlighted the problems with slow, unmotivated pickers. These pickers frequently came from wealthier families and were not primarily here to work. They were here for other reasons such as: a holiday, to improve their English or because their university or parents suggested it.

If these workers were to be removed, or preferably deselected before arrival, much greater improvements in average picking speed could be achieved. To this end, some form of pre-selection of labour is extremely desirable.

Potential financial benefit of using the model in commerce

The table below (using real farm data) illustrates the improvement in picking speed that can be achieved by applying the model to pickers in different groupings in a gang of pickers. It assumes that a small 'elite' of very fast pickers will not improve as they already have the techniques in place. It also assumes that a larger percentage at the low end of the scale will not increase in picking speed as they are not interested in working hard to earn money. The 4th column shows the extra improvement that could be achieved by pre-selection.

Kg per hour	Pre- Model	Post -model	Post-model + pre-selection	Gain
Top 10%	20.1	20.1	20.1	0%
Mid 65%	12.2	14.7	14.7	20.3%
Bottom 25%	6.6	6.6	14.7	122.7%
Average	11.3	12.8	15.2	35%

Applying the model successfully could give a 13.3% improvement in overall picking speeds. This equates to a saving of £64.56 per tonne (based on £550/tonne). When savings on supervision costs are included this figure rises to **over £65 per tonne**. A grower producing 500 tonnes could reduce harvesting costs by £37,500 every year.

With pre-selection as well, a 35% improvement is possible, resulting in potential savings of £192.50 per tonne, or **over £200 per tonne** including supervisory savings.

Conclusions

The project has demonstrated that it is possible to significantly increase strawberry picking speeds using NLP and modelling techniques.

Although most strawberry production businesses use a range of training methods and techniques to help their picking staff to pick faster, none have previously used this novel approach.

Although the finances and scope of this project only allowed the model to be applied to four pickers, the fact that all four showed higher increases in picking speeds in comparison with the gang average, signified that there is huge merit in this approach. The fact that at least three of the four slow pickers had low levels of motivation signifies that the approach is suitable for application to a wide range of picking staff.

The significant cost savings that can be made for strawberry businesses further highlight the merits of businesses applying the technique.

However, it should be acknowledged that a percentage of picking staff may not have any interest in picking strawberries to provide an income or an interest. This highlights the need for businesses to pre-select picking staff before they arrive at the farm. This would further improve the average picking speed of a workforce.

Objective 2

To determine the most efficient methods of organising strawberry harvesting operations from current industry practice.

Materials and Methods

Within this project report, the term ‘best practice’ is defined as ‘organising and working in the most efficient ways to harvest the crop in a timely and cost-effective manner’.

An initial survey of farm businesses, including use of a questionnaire, was undertaken by Chris Rose to ascertain the full range of systems employed by the strawberry industry within strawberry harvesting operations.

A checklist/questionnaire was created and posted on a dedicated web-site for growers to complete. An electronic (E-Mail) message was circulated to a large percentage of key strawberry growers in the UK asking them to look at the web-site and complete the questionnaire. In the initial proposal to do the work, it had been intended to achieve at least 20 responses, but unfortunately it was found difficult to persuade growers to complete the questionnaire. Following many phone calls to persuade strawberry producing businesses to do so, a final total of 12 businesses responded.

The questionnaire asked for information appertaining to field organisation, harvest equipment, gang size, role of supervisors, hygiene standards, picking systems, individual picking techniques, collection point organisation, recording systems, transport to the field etc. The full questionnaire is found in Appendix 4 at the end of the report.

Following completion of these forms and assessments, the 6 most progressive businesses were selected for more detailed studies, by visiting the site during the harvest operation and assessing the systems in operation. The visit, made by Chris Rose, included a brief interview with the owner/manager and a thorough observation of the harvest process.

Following these visits and assessments, ‘best practice’ for each parameter relevant to strawberry harvest operation was documented.

The advantages and shortcomings of table-top systems were deemed to be beyond the remit of this project as was the Haygrove harvesting machine. A few growers have also been conducting trials on an inflatable conveyor that may also have a place, however it is as yet unproven.

Results and Discussion

This section lists the full range of activities and considerations appertaining to the strawberry harvest process. Each of these was assessed and considered both through the initial survey and then through the more detailed site visits. The range of options and merits of each are discussed and best practice recommendations offered.

The report generally avoids or qualifies statements that are likely to conflict with best practice in other areas of production. For instance, it would be desirable to have all the fields adjacent to the packhouse, however there are often good reasons why this is not the case. Some areas of best practice have significant cost implications and where relevant this has been recognised. An overriding requirement of best practice is to 'keep the picker picking'.

Field Layout and Organisation

Sizes of fields vary greatly across UK strawberry businesses. Absolute size is not so relevant as individual block size within the field and size in relation to gang size. Moving a gang from field to field is downtime. A perfect set-up allows one gang to pick one field / block in one day. In practice, changing gang size daily is not desirable, however a gang may move far faster when there is a light pick. It is better to split a gang of 60 into two when picking over new fields.

Rutted headlands and central roadways slow down fruit transport and contribute to fruit damage.

Best practice:

- *Keep row-pick lengths to 40 metres. Typically this is achieved with a row length of 80 metres, taped at the halfway point.*
- *Headlands and central roadways need to be wide enough for the collection point(s) to function smoothly and collection vehicles to pass. Typically 6 metres is required.*
- *Grass down headlands and roadways and do all you can to keep them smooth. Consider the cost: benefit of gutter systems on tunnel blocks to avoid problems caused by rainfall runoff.*
- *Plan your field and block sizes to fit with gang size. Husbandry concerns such as irrigation and tunnel construction will be outweighed by the financial gains of more efficient harvesting.*
- *Alter gang sizes to suit the crop and minimise movement from field to non-adjacent field.*

Bed Design

Most growers currently use 2-row beds, although there is a move towards 3-row high beds to increase plant numbers. There are two methods of picking the beds generally used: picking up one side of a bed and down the other and picking half a bed either side of the alley.

One downside of single side picking is that more time is spent moving. Set against that, higher pick rates are achieved with simple plants (discrete plants where the fruit is well displayed and a lot of moving, compared with complex plants (larger plants which overlap) and little moving.

Simple plants are obviously easier to pick and this needs to be set against production costs of systems such as annual cropping.

Best practice:

- *High beds are an advantage to pickers. Although the speed of berry removal is the same, pickers can work for longer without rest on high beds and so productivity rises. (This is also a major part of the reason that table-top picking is so much faster).*
- *Picking to one side is preferable to picking either side because:*
 - a) *The less able pickers tend to miss fruit. They move forward whilst picking to their right side and when they move across to the left side, miss fruit that is already behind them.*
 - b) *Pickers have a preferred side and pick faster on that side.*
- *In this respect 3-row beds are an advantage as there is 50% more fruit to pick.*
- *Harvesting is faster and cheaper with simple plants and well displayed fruits.*

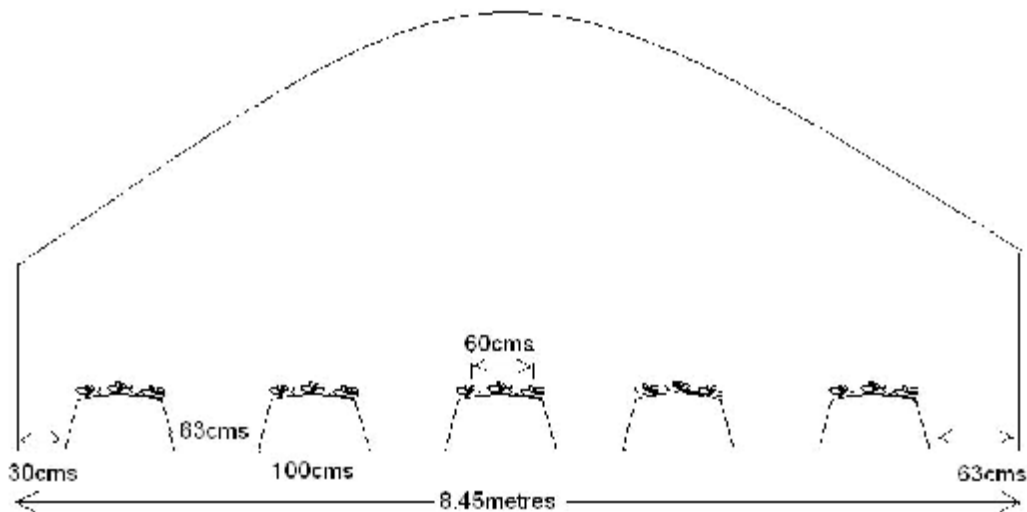
Tunnel and Bed Configuration

Most strawberries grown under tunnels (whether in soil or soil-less substrates) are planted in rows with tractor-wheel alleys between. The tunnel hoops are supported on tunnel legs, which are positioned between strawberry rows, known as 'leg-rows'. Since leg-rows cause problems with access for pickers less is better. 5-row tunnels reduce the number of leg rows compared with 4-row tunnels. To pick the leg rows efficiently, there must be sufficient room for a sledge or trolley to fit up the leg alley.

Best practice:

- *Have 5-bed tunnels and make the leg alley 30 cm wider, with all the extra on one side of the leg (see diagram below)*
- *Alternatively, with 3-row beds, the outside row can be left unplanted, negating the need to pick from the leg alley.*

Profile of a 5-bed spanish tunnel



Alley Width

The most common spacing of beds on UK farms is 1.50 metres (59") from bed centre to bed centre. The two rows of plants are typically planted 30 cm (12") apart. This frequently results in fruit hanging down into the alley, especially in vigorous and older plantations. There is often a significant level of damage to shoulder fruit from pickers, sledges/trolleys and trays. A wider alley is recommended to avoid mechanical damage to the fruit. This damaged fruit results in costs in several ways:

- Loss of yield and thus income
- Spread of disease as fruit rots
- Extra cost of removing fruit (even if not directly paid for)
- It sends a message to the pickers that damaging fruit is acceptable.

It is noticeable that where peat-bag strawberries are placed on bed-tops, there is seldom a problem. The two rows of plants are only 15-20cms apart and this would be a better spacing for soil grown strawberries. Higher beds also help minimise the problem.

Best practice:

- Check closely during harvest to quantify the problem. What is the distance in the alley between outermost shoulder berries hanging from each bed*
- Plan future plantations and harvesting sledges/trolleys to avoid the problem.*
- Where possible allow room for trays to be widthways on, particularly if two grades are going to be picked. The further tray is much more reachable.*

Cropping Density

There is potential for a conflict between maximising yield and maximising harvest efficiency. Covering a greater percentage of the ground area with plants may produce higher yields and the extra yield may more than offset increased harvest costs.

This is most frequently seen with older, more complex plants and results in very narrow alleys.

It is not sufficient to compare two plantations on yield and picking costs alone. The wider implications must be understood:

Is fruit being damaged during picking?

If pickers see damaged fruit is acceptable, indeed inevitable, they are likely to be less careful with all of the fruit.

Will you be able to keep on top of the picking if it is considerably slower?

What is the effect on picker morale?

More fruit is likely to be missed resulting in increased disease risk and increased over-ripe fruit in the punnets.

Best practice:

- *Aim for an optimum cropping density that enables efficient picking and minimises the potential for damage. If plant vigour is greater than anticipated, the crop should still be manageable.*

Tunnel Picking

Tunnel picking introduces questions of ‘who picks the leg rows?’ Typically leg rows are either picked separately, or pickers take turns to ‘cop the leg row’. Some businesses have grouped pickers into ‘tunnel teams’ of 5-10 people. There is no one blueprint, though some methods are fairer than others.

Best practice:

- *The method used needs to be seen as fair. Picking leg rows separately allows flexibility in changeable weather conditions.*
- *By putting one picker per row in half the tunnel length, several gains can be made:*
 - 1) *Supervision is easier as a smaller area is being picked.*
 - 2) *Picker walking distance is reduced.*
 - 3) *Less chance of part tunnels being left.*
 - 4) *It is a fairer system for pickers.*
- *Tunnel teams in which the team’s total is divided equally can work very well if all the pickers are of similar speed. Inter-team rivalry can help productivity and tunnel ownership, whereby the same team picks the same tunnels each time, can help crop clearance.*
- *It is also possible to have teams where pickers are individually paid. In this case they collectively decide how to deal with leg rows.*

Picker Organisation

The start of the day is chaotic on many farms. Time spent collecting packaging and making up trays is downtime.

Best practice:

- *Detail key staff (runners if you use them) to arrive at the field early to prepare a sledge/trolley with several trays and punnets for each picker, to be ready when they arrive.*
- *Ensure trays are ready, with the correct punnets and liners throughout the day. If runners are used, pickers should be supplied with packaging at all times, otherwise the correct packaging should be located conveniently on the headland.*

Picking

Some farms still pick with mixed punnets into one tray. This system causes more work at the headland, farm or packhouse.

Picking into separate trays is a more efficient system. Market fruit (if picked) is picked directly into the trays it will be sent away in. Every grower who has changed prefers separate tray picking.

Increasingly growers are choosing not to pick class 2 fruit for sale. This practice is more efficient. When there are only two grades (in or out), sorting is faster than when there are three grades (supermarket, class 2 and rubbish). This also avoids supermarket quality fruit inadvertently being graded into class 2.

The table below is based on supermarket fruit returning £2.80 / kg and class 2 returning £1.00 / kg. Given that 80% of the fruit in the field is of supermarket quality, it is not unusual to lose 5% to class 2 and / or to squeeze more borderline fruit into supermarket punnets.

Achieved s/mkt	Achieved class 2	Achieved rubbish	Price returned per kilo
75%	20%	5%	£2.30
80%	0%	0%	£2.24
82%	0%	0%	£2.30
85%	0%	0%	£2.38

Best practice:

- *Always grade fruit into separate trays. Consider carefully whether picking class 2 fruit is cost effective and review day to day as wholesale market prices returned and quality in the field alter.*

Picking Rots

Almost all growers instruct pickers to remove out grade and rotten fruit from the plants. In some cases it is dropped in the row. Others pick it into the bottom of the sledge or into a container. There is some variation in how effectively this operation is carried out.

Best practice:

- *Always remove damaged, rotten and out of grade fruit from the plants. This fruit must be removed entirely from the field to reduce spread of disease.*



Bulk tipper for removing out grade fruit from the field.

Tray Numbers

Pickers often take three or more trays and pick into the top one. This increases the distance from plant to punnet. Reducing this distance can significantly increase picking speed. The runner system (see below) allows pickers to have only one or two trays.

Best practice:

- *Pickers should take a maximum of two trays of each type, which also reduces fruit heating up post-picking. The aim should be for the top edge of the tray to be just below the height of the fruit on the plant.*

Team Picking

A number of growers are using or considering using picking teams. Those that have gone to team picking tend to prefer it.

The number of staff that can effectively pick one tunnel tends to dictate the number in a team. Thus teams vary from 4 – 10 people (1 per bed, 4 beds – 2 per bed, 5 beds). There are two main variants:

1. Team works and is paid collectively.
2. Team works together but members earn individually.

Guidelines for collectively paid team picking

- a. Choose pickers of similar speed to make up a team.
- b. Allocate tunnels to each team and aim to have the same team pick the same tunnels all season.
- c. The team is responsible for picking the tunnel and decides collectively the most acceptable and efficient way of achieving this.
- d. The team supplies its own runner to transport full and empty trays.
- e. The fruit is booked to the team, not the individual, and pay is calculated by dividing the total earned by the team by the number of people in the team. This engenders true teamwork and helps team spirit develop.
- f. Encourage competition between teams.

In teams where pickers are paid individually (d) and (f) above do not apply.

One of the biggest benefits of team picking is that the slowest pickers become more motivated and are pulled along by a sense of not wanting to let down the rest of the team. The variation between the fastest and slowest team will usually be significantly less than the variation between fastest and slowest individuals. It is estimated that team picking can increase average picking speeds by 5-10%, though this is difficult to accurately test.

Best practice:

- *Explain to pickers from the outset that they will be put into teams.*
- *Let pickers pick as individuals initially to determine speed.*
- *Establish teams as fairly as possible, taking speed, friendships and nationality into account.*
- *Make the teams large enough to be able to complete tunnels and avoid leaving lots of part-finished tunnels.*
- *Pay teams collectively.*
- *Replace any individual if the rest of the team falls out with them.*

Runners

Many growers have found that using runners increases output. The advantages of incorporating runners into a well-organised system are:

1. The system keeps the picker picking.
2. Field supervision is better controlled and more efficient (smaller area, less movement of people).
3. Those not suited to picking often make good and motivated runners.

4. There is no bottleneck or waiting time at the collection point.
5. Distance from picker to collection point is minimised.
6. Fruit is brought in sooner after picking.
7. Pickers only need a maximum of two trays, so distance from plant to tray is reduced.
8. Runners become mini-supervisors, and may not accept sub-standard trays.
9. The collection point becomes an objective quality control point, thus ensuring no favouritism/personality clashes between pickers and supervisors. It also avoids another worker sorting the fruit for the picker.

Using runners becomes more efficient when barrows are used (see below), allowing runners to bring in up to 20 trays at a time.

A downside of using runners in this way is that they are frequently stepping across beds, in a hurry. A close check needs to be kept to ensure fruit is not being damaged. This is particularly true in 3-row high bed systems.

Best practice:

- *Runners need to be strong, healthy and good at working in a team.*
- *They will be more motivated if paid piecework e.g total trays picked by the gang x £0.15 / number of runners.*
- *Runners supply empty trays and punnets, and take away full trays.*
- *Adapted wheelbarrows, as in the picture below, add to the efficiency of runners.*



- *Runners take full trays to the mobile collection point, but do not wait.*
- *The collection point person checks the fruit and books it, in the normal way.*
- *If a tray is not acceptable the runner takes it back to the picker to sort out.*
- *Pickers are kept in a block (e.g 15-20 beds) which is fully picked out before moving on.*

- *This can be achieved by picking the block from both ends at once ('topping and tailing'). The block is split by a tape and after picking the picker backs out to the end of the row.*
- *The stand or collection is sited centrally to the block, and moved when a new block is started.*
- *Runners take the fruit to the new collection point when a new block is started.*
- *Runners take it turns to prepare trays as a rest from carrying full trays.*

Gang Size

Gang sizes have tended to get larger as fruit yields increase and labour costs rise. Supervision tends to be more effective in smaller gangs where the supervisor knows every picker and has time to train, encourage, help motivate, cajole and reprimand to meet each individual's needs. A gang of 100 pickers with a supervisor and 4 row-checkers can be impersonal with pickers falling through the net. In larger gangs there is a danger that one supervisor's time will be spread too thinly across all the pickers. In such cases the supervisors find that they lose control and have no overall responsibility.

Set against this, non-picking harvest labour is expensive and grower's have a genuine concern that even when supervisors have the time to fulfil their duties adequately and conscientiously, they sometimes don't.

Thirty pickers is a good size for a gang, with one row-walking supervisor and one supervisor booking in the fruit.

With **smaller gangs** of ten to twenty pickers, having two supervisors can be expensive. The problem with only one supervisor is that they tend to spend most of their time at the collection point.

Using a runner system and booking the fruit in on the field is a good way around this.

Best practice:

- *Whatever the size of gang that is used, ensure individual pickers have one supervisor whom they get to know.*

Supervisor's Role

The importance of good supervision cannot be overstated. The best supervisors tend to have been good pickers themselves and have very good people skills. The season is long and tiring and a good supervisor motivates and maintains good morale every day. Efficiency drops and mistakes occur when there is too little supervision and / or the supervisor has too many roles such as also booking in or loading fruit. Some growers appear to be worried that supervisors are not doing enough and thus overload them. A good supervisor will always be busy as when they are not organising or checking the picking they can focus on improving output of slower pickers.

Best practice:

- *Choose supervisors very carefully, preferably from your experienced pickers.*
- *People skills and a positive outlook are more important requirements as technical aspects can be taught.*
- *Aim for a ratio of 1:15, excluding runners. E.g. gang supervisor, booker and two-row checkers to 60 pickers.*

Policing Pickers

Once pickers have learned how to pick correctly and know the quality standards, they should not need constant policing. A few growers have removed quality control from the field and replaced it with tray by tray QC at the packhouse intake. Any trays that do not meet agreed standards are not paid for, or paid a lower rate for minor problems. The pickers in the field are trusted to do the job correctly and are paid a little more for this. Pickers who betray this trust are 'demoted' into a nursery gang and either need to improve or are sacked.

There needs to be some check that fruit is not being missed in this system. It would work well with tunnel teams who always pick the same tunnel, because:

- a) If they leave fruit they know they will lose out next pick.
- b) Pickers know that they are always booked into the same tunnel and that management can check for incomplete clearance at any time.

If tunnel teams are not used, booking pickers into each bed is an option. A student gang could be instructed to do this themselves on a clipboard left at the headland. There could be a penalty for the whole gang if **any** bed is not booked in, perhaps coupled with a bonus if the field is well picked.

This system requires a positive approach. Businesses tend to get the results they focus on. If you focus on problems (constant policing) you will get problems. When you focus on (and reward) desired behaviours, you are much more likely to achieve desired results.

Row Checking

Where row checkers are employed, care should be taken to ensure the level of checking is appropriate. Frequently these people are given instructions to constantly police pickers. They would be more effective with a wider brief involving monitoring and improving efficiency as well as quality. They could help with picking technique and motivation.

The fundamental approach needs to be 'innocent until proven guilty'. I.e., most pickers are decent and honest and want to comply with rules. On many farms the approach tends to be 'everyone will cheat if they can get away with it'. Both beliefs tend to become self-fulfilling prophecies. In 'policing' terms, the traditional village bobby is a better role model than CID.

Best practice:

- *When planning harvest operations, detail how efficiency will be managed as well as quality control. Consider the section above in the planning process. Carefully define the roles of key harvest staff and make sure everyone fully understands their roles.*

The Harvest Day

Pickers are typically expected to work for 7 – 8 hours per day excluding breaks. Beyond this output tends to suffer, though at peak times this is sometimes unavoidable. Many farms have no set breaks, allowing pickers to decide when they want a break. An increasing number of growers are enforcing set breaks to ensure all harvest staff do stop to rest, eat and drink. Often the keenest pickers take a shorter break and this flexibility can be a good compromise.

High temperatures are a problem for pickers and the fruit. Most farms start early (6:00am) and aim to finish by 14:00 – 15:00. Where high temperatures are a problem, the hottest part of the day should be avoided.

Best practice:

- *Limit the picking day to 8 hours worked.*
- *Enforce regular short breaks, such as 3 x 20 minutes.*
- *In hot weather try two shifts, such as 05:00 – 10:00 and 17:00 – 21:00.*

Collection Point Organisation

Almost all growers aim to have a moveable collection point. The aim must be to minimise the distance that pickers or runners have to carry full and empty trays. Some growers have dispensed with a stand and fruit is booked in at the end of each row. This has the advantage of guaranteeing minimal walking. On the downside, ‘un-booked’ trays can be taken by other pickers.

To reduce the chances of trays being wrongly taken, there needs to be a point at which the tray goes from ‘responsibility of the picker’ to ‘responsibility of the farm’. This is usually when the runner takes the tray or when the picker passes the tray to the person who books it in. Where trays are left at the end of the row, ownership can be blurred risking disputes.

Some growers site a collection point at either end of the field. This allows pickers or runners to take trays to the nearest point or the least busy one. An advantage is that a gang can pick a row length (80-100 m) field in one pass and thus have to move fewer times across the field. A disadvantage is that many computerised recording systems cannot currently cope with multiple handsets.

Best practice:

- *Keep the gang to as few rows as is practical and the collection point central to the gang.*
- *If possible pick right through with a stand situated at either headland of an 80-100 metre row length plantation.*

Weighing Fruit

The stand can easily become a bottleneck. The aim should be to avoid queues at all times.

Many growers have dispensed with routine weighing on the field. Once pickers know what a correctly filled punnet looks like, they can generally get the weight right.

Avoidance of weighing will help to speed up the process of booking in fruit.

Best practice:

- *Growers should consider having a small set of digital kitchen scales (£20-£30) to check weigh light punnets. Pickers can be shown daily how full the punnets need to be.*
- *Avoid routine weighing of fruit on the field.*

A frequent problem is the trailer supervisor removing fruit from trays rather than giving them back to be sorted. As soon as this is done the message given to the picker is “Don’t worry about sub-standard fruit because I will sort it for you.” Again, the runner system helps this as quality control is distanced from the picker and can thus be more objective.

Data-Logging Systems

To improve efficiency and set targets it helps to know where you are. More and more growers are now using computerised data-loggers. These typically include bar-code scanning of a tray label or a picker’s number and they speed up the booking in process considerably.

Reports on the field should include:

1. Average £/hour earned, which reduces arguments over price.
2. If two grades are picked, % supermarket for every picker is required. This will help focus supervision on the pickers that are costing you money by poor grading.
3. Average kg / hour to help focus supervision on under-performers.

Best practice:

- *Use a data-logging system on the field.*
- *Encourage supervisors to make use of the reports to target pickers.*

Fruit Carting

There is no blueprint as different systems suit different circumstances such as number and size of gangs and distance from packhouse / cold store. The main systems in use are:

1. Low tractor-towed trailers that take two or three pallets and can be moved up the headland by hand if needed on occasion.
2. A pallet system where fruit is stacked on pallets in the field and loaded by tractor mounted fork-lift onto a truck or lorry.
3. Vans that service one gang and take 3 pallets. Fruit is stacked directly onto pallets on rollers. Pallets are taken off at the yard / packhouse by forklift truck.
4. A van or sided truck into which fruit is loaded by hand. It is then hand-stacked onto pallets at the yard or packhouse.

Best practice:

Pallet systems are inherently more efficient as they avoid double handling. Options include:

- Two trailers per gang, with fruit stacked directly on pallets. When one trailer is taken off to be unloaded, the other can be put where it is needed. This helps ensure the collection point is mobile.
- Removing fruit on pallets on the rear tractor forks. This is only workable over short distances.
- Pallets loaded by tractor forklift onto a flatbed truck. This can work well as long as the truck is not prone to getting stuck.



This system involves multiple handling of trays.



This system is more efficient for shorter distances.

Conclusions

Strawberry harvesting is an expensive, complex and labour-intensive undertaking. The best producers are achieving significant savings through better organisation and greater efficiency. The best are generally striving harder than the rest to gain even more efficiency.

Best practice recommendations can be used to guide grower's pre-season planning with key staff. Strawberry growers may disagree with some of the suggested 'best practice' recommendations if they have conceived a better method. However improvement will only come through challenging current practices. Strawberry production businesses should consider the adage: 'If you always do what you have always done, you will always get what you have always got'.

Appendix 1

Questions Used When Interviewing Fast and Slow Pickers

The following is a list of questions that were typical of the questions asked. During each interview, they were not necessarily all used, or used in any specific order. This list was only referred to if needed during interviews. They are conversational questions that were used with extreme caution and at all times, an interrogation style was avoided.

General background

- What is your nationality?
- What are you studying (if student)?

Help and supervision

- Were you welcomed and shown around when you arrived
 - If so, what do you think of the welcome you got?
- What do you think of the training you get?
- What do you think of the supervision you get?

Picking and motivation

- Why did you decide to pick strawberries?
- What makes you want to pick strawberries?
- How did you learn to pick strawberries?
- When you pick them, what are you thinking about?
- How do you know you have done a good job?
- Do you have a goal / purpose you are working towards?
 - What is your goal?
 - Do you think that you will achieve it?
- How long did it take you to learn how to pick fast?
 - How did you do that?
- As you pick strawberries, what do you focus on?
- What goes through your head (What do you think about)?
- What motivates you to pick strawberries? (If a fast picker add 'so quickly')
- How do you think you became a fast picker?
- If slow ask 'what would motivate you to be a faster picker?' or 'what stops you from being a fast picker?'

Picking techniques

- What side do you prefer to pick from, left or right?
How many strawberries do you hold in your hand before putting them in the punnets?

Attitude and relations with other people

- What do you think of the pay?
- What do you think of the supervisors?
- Are you an optimist or pessimist – positive or negative person?
- Are you a competitive person?
- Would you say you were a happy or a moody person?

- Are you affected by other people's moods?
- Do you get on with people on the campsite?
- Do you like people?
- Do you compare yourself to any of the other pickers?
- Do you have a lot of friends or just one or two?
 - Are they close friends?
 - Are they from your homeland or not?
- Do you have a girlfriend / boyfriend?
 - Is she / he from the campsite?
- Who do you mix and socialise with?
 - Are they also fast pickers? (If slow ask 'are they also slow pickers?')

Personal qualities

- Are you a determined person?
- Would you say you were focussed or disorganised?
- Are you a tidy, neat person?
- Are you self-disciplined or do you prefer to be told what to do?
- Are you a good listener?
 - How do you know?
- How do you respond to change?

Social activity and rest

- Do you go out in the evening?
- What time do you go to bed before a picking day?
- How many hours sleep do you typically get?
- Is your caravan / site noisy at night?
- How does that affect your sleep?
- Is your mattress / bed comfortable?

Facilities

- What do you think of being in the UK?
- What do you think of your living conditions?
 - If negative response, how does that affect you?
- What do you think of the facilities?
- What do you do if there are any problems on the campsite?
 - How do you cope with your own problems?
- What do you think of the field toilet facilities?

Picking weather and working conditions

- Does the weather affect your picking performance?
- What are the most ideal conditions for you (inc. weather, living, alleyways, height of fruit, supervisors, support)?
- Do you prefer to work in hot or cold conditions?
- Do you love your work?
- Do you prefer working alone or in a team?

Working breaks and sustenance

- Have you been told to drink lots of water throughout the day? Do you? How much / often?
- Do you take water with you?
- Do you take regular breaks?
 - How do you know when to take a break?

Likes/dislikes about the job

- What do you like about the job?
- What do you dislike about the job?

Improving your job

- What do you think can be done to improve picking speeds and quality?
- What key things would make your job easier for you?

Picking qualities

- What qualities do you need to be a good picker?

Back ache, fatigue and exercise

- Do you ever get backache? If so, how often do you get backache?
- What do you do to relieve backache?
- How do you decide whether to kneel or stand?
 - Which is better for you?
- Do you do any physical exercise and if so, how often?
- What sort of exercise do you do?

Health and diet

- What do you eat on an average day?
- Do you eat fruit and if so, how much?
- How good is your health. How often are you ill?
- Do you smoke? If so, how many a day?
- Do you drink alcohol? If so, how much and how often?

Appendix 2

Summary Report of the Ergonomics Consultant in Assessing Fast and Slow Pickers

Findings

After arriving at the tunnels I observed 6-8 strawberry pickers for approximately 15 minutes. It was clear that each picker seemed to have their own technique and their own way of standing or sitting to pick the strawberries. I then carried out a detailed observation of 6 pickers and my findings are summarised below:

- Picker one stood upright and bent from the waist over the plants, lifting the plants with her left hand and picking the fruit with her right. She put the fruit into the punnets and used her left hand to throw unsuitable fruit into the tray. Her tray was to her left and she worked towards her left-hand side. She picked the whole of the plant from one side, stepping onto the grow bags to reach the far side of the plants. She started picking from the top of the plants and lifted the leaves, moving from the right side of the plant in a circular movement picking the fruit as she went. She seemed to have quick hand speed but did not hold more than a couple of fruits in her hand before putting them into the punnets. She would pick three plants before moving the sledge and would sit back on her heels about every twelve plants which, I would assume, was to ease her back and legs. She was of slim build and seemed to have no problem being bent over for long periods.
- Picker two worked kneeling with his right knee on the mound just under the grow bag, wearing a knee pad, and his left foot on the ground. He had his trolley to his right and worked towards his right side. He started at the base of the plants using his left hand to move the leaves and search for fruit and his right hand to pick and place in the punnet. He knelt with the row of plants to his left and his punnet to his right, turning back and forth between the plant and punnet. He used both hands to pick unsuitable fruit but only his right was used to place good fruit in the punnets. He would pick two plants before moving his sledge up with one push. His left leg being higher on the mound enabled him to be able to pick both sides of the plant by transferring his weight onto his left leg. His hand movements seemed to be quite quick and as with picker one he used the same technique for each plant starting with the lower fruits then working around the plant in an anti clockwise movement before finishing off searching the top of the plant. Picker two was of stocky build and medium height.
- Picker three was standing with her left foot on the mound under the grow bags and her right foot on the ground. She worked in a stooped position facing along the row with her sledge in front of her and picking the plants to her left. She used her left hand to move the leaves and picked with her right hand. She then saved the good fruit in her left hand and put them into the punnets with her right hand after a second sorting process. The fruit that was discarded was thrown straight into the tray usually with her right hand and occasionally with the left.

This picker started with the lower fruits occasionally moving onto her knees, again facing along the row and twisting to her left. She usually picked two to three plants at a time before moving her sledge along. Although this picker did not pick using the most economical of movements, she had a pattern that she stuck to for each plant. This picker seemed to be older than the other pickers with a stocky build and of medium height.

- Picker four. When I started observing this lady she was kneeling on both knees facing the plants with her sledge to her left. She picked with her left hand predominantly putting the fruit into the punnets or threw the unsuitable fruit straight into the tray. She then sat back on her heels and started to pick with both hands but switched using one hand more than the other depending on where on the fruit she was picking was located; if it was to her left she would use her left hand etc. She picked from the bottom of the plants to the top and seemed to have very quick hand speed, always picking in the same direction for each plant. After about six minutes she would stand up and continue picking. Her legs were sometimes straight and sometimes crossed and she would bend from the waist. She seemed to change her posture at regular time intervals rather than every two or three plants. She moved her sledge along three plants at a time but would push this when she was sitting, kneeling or standing. She was of very slim build and was above average height.
- Picker five stood and bent from the waist, feet shoulder width apart. She picked with both hands whilst lifting the leaves to locate the fruit. She put the fruit straight into the punnets and tray in a swift easy movement; her hand speed was very quick. She moved along the rows from right to left facing the plants. After three plants she would crouch on her heels with her right knee raised. Her hand patterns were the same as when she was standing although she was almost always kneeling just before having to move the sledge along. When she pushed the sledge along she would usually move it five plants which was further than most of the other pickers but being quite tall was still able to reach her sledge easily. She would remain standing for three plants then move onto her heels for two plants. This picker seemed to move very easily and with a very smooth fast action she was obviously very strong.
- Picker six worked on his knees and heels facing the fruit in a slightly diagonal position with his sledge to his left, and moved along the row from his right to his left. He picked the fruit closest to him first using both hands with the right hand slightly more dominant. He worked in a circular movement around the plants moving from his heels onto his knees to reach over the back of the plants. His hand speed was very quick with a staccato movement, the fruit being placed straight into the punnets or tray with no wasted movement. He stood up to push the sledge along, usually two plants at a time unless there was clearly less fruit on one plant in which case he would move it three plants. The pattern around the fruit was the same for every plant and he moved very systematically and through the plant collecting all the fruit. It was noted that this picker had very broad shoulders and large upper body muscles.

Conclusions

- Whilst each of the pickers had their own individual technique and pattern they varied immensely from the way they stood or knelt to pick the fruit and place it in the punnets. It was revealed to me after my assessment of the pickers that pickers five and six were champion pickers and could pick considerably more than the other pickers in a day. These pickers had several similarities. Both worked in a very regular pattern, which did not change. Both had very fast hands and they were strong. From the way they worked they obviously had a great deal of stamina as their work rate did not vary and they continued to work at a very high speed. Both of these pickers faced the plants, although picker six was on a slight diagonal, rather than facing along the rows, and moved from left to right or right to left in a systematic manner. The way they moved along the rows had no relation to whether they were left or right handed. These pickers also started at the bottom of the plant and worked in a circular movement around the plant and from the bottom to the top. They also used both hands for sorting good and bad fruit although did have a more dominant hand.
- If the slower pickers could adopt some of the practices of the champion pickers they would increase the yield of fruit that they could pick. The main reason for the slower rate of some of the pickers was because their pattern of picking was not as efficient in the way they moved through a plant to search for, pick and place the fruit into the punnets. Also their posture was often, although not always, more awkward and as they were changing their position more frequently, they were not moving smoothly and economically between plants.
- Comfortable baggy clothes that do not restrict the pickers' movements are essential. It was noted that a number of the younger girls often had their lower back exposed (due to fashion trends) which is of some concern as the cooling effect from the wind could make the muscles cold and cause them to tear. Alternatively, they could get a chill in the kidneys. It was also noted that none of the pickers seemed to take time out to stretch or ease the stiffness in their muscles. This may be because of the way they varied their posture between plants e.g. standing for two plants and kneeling for two, but failure to stretch these muscles would affect the performance of the pickers towards the end of the day and could ultimately cause long term damage.
- Trying to find the perfect build for a picker proved difficult as the pickers varied greatly in height and stature. Clearly they need to be physically fit with good hand to eye coordination and stamina as the main muscle groups used during the day would tire and start to ache as the day wore on. The legs would need to be quite supple along with the lower back and shoulders. Large hands may be an advantage but speed more so. However, a good systematic method for picking seems to be more advantageous than the right build.

Suggested Stretching Exercises to be performed gently before picking starts and as appropriate after the start of picking, particularly at the onset of any stiffness.

Chest Stretch:

- Stand tall, feet slightly wider than shoulder-width apart, knees slightly bent
- Hold your arms out to the side parallel with the ground and the palms of the hand facing forward
- Stretch the arms back as far as possible
- You should feel the stretch across your chest

Upper Back Stretch:

- Stand tall, feet slightly wider than shoulder-width apart, knees slightly bent
- Hold your left wrist with your right thumb and forefinger around it and push your hands as far away from your chest as possible, allowing your upper back to relax. Repeat with the other arm
- You should feel the stretch between your shoulder blades

Shoulder Stretch:

- Stand tall, feet slightly wider than shoulder-width apart, knees slightly bent
- Place your right arm, parallel with the ground across the front of your chest
- Bend the left arm up and use the left forearm to ease the right arm closer to your chest
- You will feel the stretch in the shoulder
- Repeat with the other arm

Shoulder and Triceps Stretch:

- Stand tall, feet slightly wider than shoulder-width apart, knees slightly bent
- Place your right hand above your head and then slide your hand down the middle of your spine
- Use your left hand to push your elbow up and stretch your hand further down your spine
- Repeat with other arm
- You will feel the stretch in the shoulders and the triceps

Calf Stretch:

- Stand tall with one leg in front of the other
- Ease your back leg further away from you, keeping it straight and press the heel firmly into the floor, bending your front leg as you do
- Keep your hips facing forward and slowly bend the rear leg, keeping the heel flat on the floor
- You will feel the stretch in the calf of the rear leg
- Repeat with the other leg

Quad Stretch:

- Stand holding onto a secure object, or have one hand raised out to the side for balance
- Raise one heel up toward your buttocks, and grasp hold of your foot, with one hand
- Slowly pull your heel to your buttock while gradually pushing your pelvis forward
- Aim to keep both knees together, having a slight bend in the supporting leg

Chris Hoggart (MIGHT, MHFS)

Appendix 3

Areas of Research Undertaken for Strawberry Champion Picker Model

Before undertaking this project, the researchers Chris Rose and Kathy Strong studied a wide range of topics that were pertinent to the task of creating a model for strawberry pickers. Information was gathered from a wide range of sources including books, journals and the internet. Information was gathered under the following titles and headings:

A detailed reference list is available from the HDC?

Vine Pruning – On the Job Performance
Conflict and Disagreement
Labour Management – Agriculture
Creative Compensation
Creative Negotiation
Cultural Differences
Violence (domestic on site and diffusion thereof)
Piece Rate v. Hourly Pay
Exploitation and how to combat that
Financial incentives for Dairy Workers (as comparison to industry)
Firing with Dignity
Discrimination in Hiring
Handling Differences Productively
Resolving labour disputes
Musculoskeletal disorders
Piece rates and productivity
Termination agreements
Employee Communication
Tomato Picking – Selection
Values and Divisiveness
Vineyard Pruning Selection
Increased Worker Performance
Interpersonal Communication & Farm Supervisors
Grower Preferences vs. Farm Labour Contractors
Survey on farm workers concerns (Farm workers positive about their jobs but suggest improvements e.g. respect, pay, work conditions, communication)
Can you trust the selection interview – Georgio Billikopf
John A Miles – Musculoskeletal Disorders
Creative Recruitment
Conflict, Negotiation and Mediation
Motorised Assistance (Drangen and Easy Pick Harvest Assistant)
Pay methods affect Vineyard Pruner performance
Musculoskeletal Disorders and Workplace Factors
Motorized lay-down work carts
Ergonomics (Musculoskeletal injuries in agriculture) – Industries most widespread health and safety problem
Strawberries – Organic and IPM Options (Horticulture Production Guide – 28 pages)
Handling Differences Productively

Business Excellence Framework – for Small Horticultural Enterprises
Profitability of different technologies of Strawberry Cultivation
Health and Safety – Strawberries – North Agricultural Centres
Strawberry Harvest Technology – Emerging Change – Fewer Steps & other reports
Technology and Strawberry Harvest Work
Testing to predict tomato harvest worker performance
Validating the selection process
Predicting Vineyard Pruner Performance

Appendix 4

Harvest Efficiency Questions

Field Layout and Organisation

What is your typical gang size?

What is your harvest staff / picker ratio (Supervisors, stand staff, row-walkers, not carters)?

What is your typical field size in hectares?

What is your typical picking row length (metres)?

How are trays removed from the rows? / Do you use runners?

Use of Runners (Fill in if you use runners).

If used, how are runners paid?

How many hours do the pickers typically work for each day (excluding breaks)?

Harvest Costs

Costs – Maincrop Elsanta – per picked tonne.

Picking

Supervision

Runners

Carting

Performance

Average Kilos / hour / picker

Highest kilos / hour / picker

Lowest kilos / hour / picker

Av. Earnings £/Hour

Payment methods

Piecework

Piecework plus bonus

Hourly pay

Combination

Picker organisation

Do pickers work and get paid as individuals or in teams?

If they work in teams, what size are the teams?

Do pickers pick

- a. One row either side of the alley?
- b. Up one side of the bed and down the other?
- c. Or the whole bed from one side?

Picking in tunnels

How do you deal with differences between leg rows and centre rows?

- a. Take turns to pick the leg rows
- b. Pick all the leg rows separately
- c. Pick in teams
- d. Ignore the problem

Picking methods

How many trays do pickers take with them?

Do you pick class 2 fruit?

- a. Always
- b. If the market price is right
- c. If there is a lot of class 2 fruit
- d. Occasionally
- e. Never

When picking 2 grades do you pick in separate trays or mixed trays?

What carriers do you use?

- a. None
- b. Sledge
- c. Trolley
- d. Other?

Collection point organisation

Do you have (select one):

- a. A static collection point?
- b. A mobile collection point?
- c. Or no collection point? (fruit booked in at the end of every row)

How is the fruit booked in?

- a. Computer
- b. Punch card
- c. Other (describe)

Weighing

Do you (select one):

- a. Weigh every tray?
- b. Check weigh if it looks light?
- c. Not weigh in the field at all?

Fruit carting

Is the fruit palletised on field or hand-loaded onto a vehicle?

Describe the carting operation from field to cold store:

How long does it take, typically, to get booked in fruit into refrigerated storage?

Picker efficiency

What are you currently doing to teach best methods of picking?

Picking video

Group demonstration

1:1 demonstration

Nursery gang

Other (State)

Do the supervisors focus on increasing speed of picking?

If Yes:

They work towards agreed targets

It is part of their job description

It is part of their remuneration

Do you reward supervisors for achieving increased efficiency?

If Yes: Pay related to performance of pickers

Efficiency bonus

Other (state)