

Improving Harvest Productivity in Top Fruit

TF 171

Final Report

Report Produced
By:

Chris Rose
Kathy Strong

Chris Rose Associates Ltd

February 2007

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Project Title: Improving harvest productivity in top fruit

Project Number: TF 171

Project Leader: Chris Rose

Report: Final Report, January 2007

Previous Reports: Not Applicable

Key Workers: Chris Rose and Kathy Strong (Chris Rose & Associates Ltd)

Locations of Project: Various farms and locations in England

Project Co-ordinator: Giles Cannon

Date Project Commenced: 1 June 2006

Project Completion Due: 31 December 2006

Key Words: Top fruit labour costs, picking speed, harvest efficiency.

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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

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TF 171- Improving harvest productivity in top fruit

Grower Summary

Headlines

- By training pickers to adopt the techniques used by the best pickers, growers have the potential to save around 20% on apple picking costs whilst, equally important, maintaining quality.
- The bin train harvest technique can be more efficient than conventional harvesting, provided that it is properly managed.

Background and expected deliverables

The financial margins being made by top fruit producers in the United Kingdom are currently being squeezed as production costs rise and returns fall. Both the volume of fruit and the number of growers in the industry have significantly reduced over the last decade. Those remaining need every advantage they can gain to stay profitable.

In commercial practice, there is a wide spectrum of picking speeds and no work has been conducted to increase the average speed.

For many years most top fruit growers have organised pickers individually or in pairs, picking into one bin. Lately the bin train system utilising teams of six – ten pickers has attracted much interest. Growers are looking for guidance as to which of these is the most efficient in terms of labour resource and money.

The major aim of this project was to assess the differences between the best (fast and good quality) and slow pickers and develop a model to enable the industry to train all pickers to approach the performance level of those who are currently best.

In addition, the secondary aim was to provide feedback on the use of picking trains compared with conventional bin picking.

The results of this project will directly lead to cost savings for growers. It is expected that DVDs will be produced to help communicate the results and subsequent training courses will be available.

Summary of the project and main conclusions

Major objective - Increasing picking speeds

To reduce costs it is important to increase average picking speeds, however this must be achieved without any loss of quality. All growers that were asked placed quality above quantity, although in some cases the use of piecework and the prices paid compromised this and gave a mixed message.

When referring to the aim of 'increasing picking speeds' in this report it is accepted that this means to do so without negatively affecting quality.

It was decided to focus on apples only although much of the results will be applicable to pears as well. Five farms were selected where apple pickers could be assessed for picking speed and quality. All five farms employ their picking labour from Eastern Europe (A mix of SAWS and ex-SAWS returnees). The businesses varied from medium to large. Using available farm data, guidance from supervisors and our own observations, the best and contrasting pickers were identified. Observations were made to find patterns present in the fastest pickers that were absent in the slower pickers.

There was a significant variation in output within each gang on the farms we visited. The difference between fastest and slowest typically exceeded 100%. Some of this was due to the greater speed of more experienced pickers (returnees from the previous season) when compared with new pickers. As the season progressed this difference reduced but was still significant.

It quickly became clear that supervisory staff were predominantly focussed on quality and felt that quantity was up to the picker. There was often a belief that fast pickers must be cutting corners in some way and couldn't be trusted to pick to the required standard. A slower picker whose quality was excellent was always preferable to faster pickers who 'needed watching'.

It took many visits before we found a champion picker; that is someone who picked extremely quickly whilst maintaining a high quality. We observed and filmed discretely and interviewed a number of the best pickers. From this we were able to draw out the key features of a champion picker to create the champion apple picker model. We subsequently found other champions from pickers and from experienced supervisors who had been top pickers. They all agreed that the model fitted their experience and were not able to add anything to it.

Key features of the Champion Apple Picker model

Physical traits

Champion pickers:

1. Are fit and healthy. Champion pickers set a high pace that they can maintain for 8-10 hours.
2. Have excellent hand eye co-ordination. They pick with both hands and always appear purposeful and accurate. They do not fumble and very rarely drop fruit.
3. Consistently use superb technique. They lift each fruit upwards and away from the branch, adding a twist as needed. This bends the stalk back opening up the abscission point and avoiding broken stalks and bruts.
4. Continually read the tree. They look at the whole tree as they approach and decide where to go in, based upon how the fruit is presented. At each position they will pick the outside before going to the inside, then the bottom and finally the top.
5. Read each clump and string of fruit. Starting at the top, they work downwards, separating large clumps into singles, doubles, trebles and quadruples. They pick trebles and quadruples by picking with the dominant hand whilst supporting the remaining fruit with the other hand.

6. Pick and hold the fruit gently. They palm the fruit using minimal finger pressure. Those with dry hands wear thin rubber gloves for a surer hold.
7. Transfer fruit to the bucket and from bucket to bin without any fruit dropping or falling any distance.

The following photographs demonstrate the technique of starting at the top of a string of fruit and working down.



The picker is using her left hand to support fruit, whilst her right hand picks with a lift and twist action.



Mental traits

Champion pickers:

1. Are fully present, fully engaged and fully focussed. Every time their hands go in, they are making decisions and this requires total concentration. They ignore all distractions.
2. Do not talk. Talking is a distraction and champions prefer to work alone and in peace. They search for 'that quiet place to pick apples'.
3. Are motivated towards pleasure; they have a major goal. Champions are very committed to earning a lot of money for a reason (e.g. to pay for studies, to buy a flat, to support a family).

4. Are motivated away from pain; they get the job right. Champions work hard to avoid trouble. They pick carefully and avoid dropping fruit because they do not want to risk losing any money or their job.
5. Have a positive outlook. They see the potential in each situation and strive to achieve it. They focus on the up side and ignore the downside.
6. Work for themselves. Champions prefer to work alone and have control of their earning ability. They do not like teamwork, though they tolerate it.
7. Are pacemakers. When in a team, despite the above, they keep up a high work rate and maintain high standards. They pull others up rather than slow down to the pace of others.
8. Are strongly competitive, both with themselves and others.

Transferring the model

The next stage was to transfer the model to other pickers. This took place on two sites, one with conventional picking and the other using bin trains.

Approximately an hour was spent with each picker (including initial observations), transferring the model and observing changes. We were able to use a video clip of a champion picker to very good effect. We did not attempt to transfer every aspect of the model, rather just the traits which were most obviously missing. This was the only intervention we made.

Results

The results were an overall increase in picking speed of 11.4% on the first site and 19.0% on the second site. The improvements were measured against the rest of the gang as a control. They were based on a period of ten days before the model was transferred and ten and five days respectively after. The time after was restricted by the end of picking.

The increase of 11.4% on the first site was, in our opinion, significantly adversely affected by the negative attitude of the supervisor.

Selection and training of supervisors

It quickly became apparent that the calibre of supervisors, the training they receive and the expectations of them were very variable. The number of pickers under the supervisor's control on farms we visited varied from six to twenty-seven. Many supervisors gave only initial training to new pickers on the first day. After that pickers were told off if quality was unacceptable and, in most cases, if excessive numbers of fruits were missed. There did not appear in most instances to be any attempt to help pickers learn better picking techniques.

We frequently saw significant numbers of fruits dropped due to pickers not knowing how to pick complex clumps and strings of fruit. The (major) exception to this lack of ongoing coaching was when pickers caused noticeable levels of damage,

particularly bruising, to fruit. Most supervisors would then attempt to assess how the damage was occurring and teach better techniques to the picker.

Conclusions

- The model can be used to train pickers to improve their picking speeds whilst maintaining or improving quality.
- Good picking techniques will make an above average picker; this plus mental traits such as strong motivation and positive attitude make a great picker.
- Both physical and mental traits can be taught.
- The correct selection and training of supervisors is critical to the success of this endeavour.

Secondary objective – Comparison of bin train picking with conventional methods

Bin trains, first used commercially in the UK in 2005, involve one bin per trailer and up to 5 trailers connected in a train behind the tractor. The pickers, in teams of six – eight, pick the rows or beds either side of the alley and place the fruit into the nearest bin. They are paid collectively, either piecework or hourly.

Key advantages of the bin train

- The supervisor can spend much more time monitoring fruit going into the bins
- It removes the need for tractors racing around the orchard moving bins
- It results in less tractor damage to fruit in bins
- It can reduce the distance pickers walk with a full bucket
- Fruit is removed from the orchard faster so there is no end of day rush (on overtime)
- The picking environment is more pleasant in teams and with less tractor noise
- There is less likelihood of parts of rows being missed
- The team composition can ensure that there is at least one tall picker in each team
- Slower pickers are strongly encouraged to improve to keep up with the team

Key disadvantages of the bin train

- Once fruit is in the bin, it is not possible to tell which individual picked it
- Collective payment systems can de-motivate the faster pickers
- The fastest pickers may slow down
- The higher capital investment in tractors and trailers
- The potentially higher supervisor costs if one is allocated per train
- The potentially greater difficulties in wet weather and on slopes

Bin train systems

We studied three systems in use:

1. Teams of six plus a supervisor who also moved the bin train. Empty trains are brought in and full ones taken away by a dedicated driver serving two or more gangs.
2. Teams of six including a picker who could move the bin train and a supervisor between two or more teams. Empty trains are brought in and full ones taken away by a dedicated driver serving two or more gangs.

3. Teams of eight or ten with a dedicated tractor driver and a separate supervisor between two teams. In this setup there should always be one unit with each gang and the third unit emptying and reloading. It relies on good logistical management to keep the gangs finishing their bins at different times to avoid delays.

System 2 gives the pickers a greater sense of being trusted and when the level of remuneration is dependant on QC results, is both efficient and cost-effective. There is a potential health and safety issue with pickers driving tractors. No person should be allowed to drive a tractor without the appropriate training.

In any system the pickers must be constantly supplied with bins. Waiting times of ten – fifteen minutes were not uncommon and we witnessed waits of up to an hour.

When planning the harvest, suitable contingency plans must be included. One tractor getting a puncture or breakdown can derail the whole operation, particularly if it is the only one that is equipped to break down bin stacks or unload trailers.

Picker training

Whether using bin trains or conventional picking, the same basic training on what to pick and how to pick it must be provided. In addition, the champion picker model, as presented in this report, will help enormously. Pickers would also benefit from understanding good teamwork. Bin train system 1 has a high ratio of non-picking to picking labour.

One problem seen was when the supervisors moved the train up and then came back to oversee the fruit being picked into the bins but never went beyond the pickers to check that all fruit was being picked and how much was being dropped. The photograph below shows good fruit missed and we found up to 30 fruits on some trees. This problem is really one of supervision selection and training.



Conclusion

The bin train system is more efficient than conventional picking when:

- Logistical organisation of staff and equipment is first rate

- The ratio of pickers to volume of fruit is optimised
- A lower supervisor : picker ratio is allied to a good Q.C. system
- The whole team buys into the concept and is well trained
- The orchard layout suits it - multi-row good, trellis system poor

Financial benefits

It is beyond the remit of this project to provide a full costing of different systems. Typically, bin train picking requires twice the number of tractors that conventional picking requires. Tractors with four wheel drive are necessary on slopes and in wet weather. There is also a significant capital outlay required for the trailers. The table below, based on real farm data for 30 pickers in one gang, 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.

Table 1. Improvement in picking speed from model transfer

330 kg bins per 8 hour day	Pre- Model	Post -model	Gain
Top 10%	6	6	0%
Mid 70%	4.13	4.91	19.0%
Bottom 20%	2.83	3.37	19.0%
Average	4.06	4.90	17.1%

A 17.1 % increase in picking speeds equates to a potential saving of £7.70 per tonne (based on @ £45/tonne necessary to comply with minimum wage legislation). A grower producing 1,500 tonnes could reduce harvesting costs by £11,550 every year. Any financial comparison of the bin train system will be dependant on the particular system used and how efficient the current harvest methods are on any given site. As a broad guide, there may not be significant savings in the cost of harvesting. The gains come from better quality through better handling of the fruit. This results from closer supervision and slower tractor movements.

Action points for growers

- Attend the HDC Champion Picker event in your area to learn more about how to implement these techniques
- Consider methods of pre-selecting your labour to screen out the non-motivated members of a workforce
- 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

- In reviewing your harvesting operation, list and attempt to cost the weaknesses. Consider changing your system to one such as bin trains if this will overcome those weaknesses

SCIENCE SECTION

Introduction

The financial margins being made by top fruit producers in the United Kingdom are currently being squeezed as production costs rise and returns fall. Both the volume of fruit and the number of growers in the industry have significantly reduced over the last decade. Those remaining need every advantage they can gain to stay profitable.

Fruit growers are obliged to pay at least a minimum wage of £5.35 per hour to their workers to harvest the crop. The true minimum cost of picking labour is in the order of £6.50 per hour in 2006 after employment costs, including additional holiday pay, overtime, NIC and administration are accounted for. Given that the true cost of employing harvest labour has risen over 100% since 1996 during a period of static and at times declining returns for top fruit sold in the UK, fruit growers must find new ways of reducing their production and harvesting costs to survive in their business.

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 top fruit farms, the fastest pickers can typically achieve a rate of 250 kg of fruit per hour, while the slowest achieve less than 100kg per hour in the same orchard. A typical average rate for a farm in the UK is 160 kg per hour for apples.

For many years most top fruit growers have organised pickers individually or in pairs, picking into one bin. Lately the bin train system utilising teams of 6 – 8 pickers has attracted much interest. Growers are looking for guidance as to which of these is the most efficient in terms of labour resource and money.

The major objective of this project is to assess the differences between the best (fast and good quality) and slow pickers and develop a model to enable the industry to train all pickers to approach the performance level of those who are currently best.

In addition, the secondary objective is to provide feedback on the bin train system of top fruit harvesting compared with industry standard practice.

The results of this project will directly lead to cost savings for growers. It is expected that DVDs will be produced to help communicate the results and that subsequent training courses will be available.

Major Objective – Developing a model of picking excellence

Materials and methods

The project was conducted on five grower businesses:

- J I B Cannon & Son, Roughway Farm, Roughway Lane, Tonbridge, Kent
- F W Mansfield, Nickle Farm, Nickle Lane, Chartham, Canterbury, Kent
- Newmafruit Ltd, Howfield Lane, Chartham, Kent
- Gaskains Ltd, Norham Farm, Selling, Faversham, Kent
- Great Cheveney Farm, Goudhurst Road, Marden, Kent

It was decided to focus on apples only although much of the results will be applicable to pears as well. The project involved modelling the fastest pickers from these businesses using Advanced Behavioural Modelling techniques including NLP to create what was termed the 'Champion Picker Model'.

Definitions

Neuro-Linguistic Programming (NLP):

NLP is an applied psychology methodology that allows one to break old non-effective patterns and generate new behaviours. NLP may use using posture, breathing, specific exercises, awareness and communication skills. NLP studies what is implicit (in the mind) and makes it explicit for learning and sharing.

NLP in a knowledge era helps to make the process of creating models of human excellence achievable. Measuring performance and knowledge management are important tools for the 21st century.

Model:

A model describes the essential distinctions of an experience or ability.

Modelling:

The process of studying living examples of human excellence and the differences which make the difference, in order to make the model explicit for learning and sharing.

The Production of a Champion Picker Model

Apple pickers from the five farms selected for use in the project were assessed for picking speed and quality. All five farms employ their picking labour from Eastern Europe (A mix of SAWS and ex-SAWS returnees) with a small number of other itinerant pickers. Between them, the businesses employ over 1,000 harvest workers.

There was a significant variation in output within each gang on the farms we visited. The difference between fastest and slowest typically exceeded 100%. Some of this was due to the greater speed of more experienced pickers (returnees from the previous season) when compared with new pickers. As the season progressed this difference reduced and was still significant.

It quickly became clear that supervisory staff were mostly focussed on quality and believed that quantity was up to the picker. There was often a belief that fast pickers must be cutting corners in some way and couldn't be trusted to pick to the required standard. A slower picker whose quality was excellent was always preferable to faster pickers who 'needed watching'.

Using available farm data and guidance from supervisory staff, both the fastest and slowest pickers were identified. We observed, filmed and interviewed pickers from each of the farms that demonstrated the following patterns/characteristics:

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

The best of these were referred to as 'champion pickers' and from studying them using advanced behavioural modelling and NLP techniques, applied psychology the champion apple picker model was created. It was produced through four different processes:

- A. *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).
- B. *Information gathering* - The 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 number of other very fast pickers and many slower pickers were also observed.
- C. *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. The robustness of the model was tested by observing and interviewing further pickers and supervisors who had been top pickers. This stage enabled us to make minor refinements and to validate the model.
- D. *Transferring*– This process involved transferring relevant aspects of the model to two groups of slower performing pickers. The first five pickers were chosen from the same picking gang at Newmafruit Ltd. All five had a similar 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. The second group were a team of four pickers at F W Mansfield & Sons who had been picking for three months.

A. Preparation

The following list was created from initial observations of harvesting and current knowledge. It is divided it into two parts:

Extrinsic factors (Definition: Lying outside, not belonging, operating or originating from without). These are global factors applied to 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 elements that are part of an individual's make up. The differences that make the difference are likely to come from intrinsic factors. They include aspects of a person that will dictate how they react to extrinsic factors.

Order of importance of these factors will vary from person to person.

Extrinsic factors

- Working conditions
 - Weather conditions- cold, hot, rainy, windy
 - Height of fruit above ground
 - Ground – e.g. long wet grass, prunings, rabbit holes, nettles
 - Topography- steep slopes and banks or flatter
 - 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 and height of trees)
 - Ease of detachment from tree (training of correct lift and twist pattern)
 - Level of weeds – nettles and thistles
- 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
- Organisation
 - Proximity of bin(s) – length of walk to bin
 - Downtime through lack of bins, change of orchard etc
 - Time spent travelling and waiting for transport

- 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 camp
- Physical placement
 - Best body posture (stand/sit/bend)
 - Type of picking bucket – padding on shoulders
 - Carrying of picking bucket

Intrinsic Factors

- 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
- 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
 - Effect of distractions such as supervision intervention
- Thinking Process
 - Attitude
 - Goals
 - Beliefs
 - Values
 - Motivation
 - Internal Conversation
- 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

B. Information gathering

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 apples?
- What makes you want to pick apples?
- How did you learn to pick apples?
- 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 apples, what do you focus on?
- What goes through your head (What do you think about)?
- What motivates you to pick apples? (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 apples do you hold in your hand before putting them in the bucket?

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 here?
 - 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?

Fatigue and exercise

- Do you ever get so tired that it slows you down? If so, how often do you get is this?
- What do you do to relieve backache?
- 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?

C. Model building

We documented the traits that we discovered to be consistently present in the best pickers (champions) and that were absent or partially absent in poorer performers. Together they form the model.

Key features of the Champion Apple Picker model

Physical traits - Champions:

1. Are fit and healthy.
Champion pickers set a high pace that they can maintain for 8-10 hours.
2. Have excellent hand eye co-ordination.
They pick with both hands and always appear purposeful and accurate. They do not fumble and very rarely drop fruit.
3. Consistently use superb technique.
They lift each fruit upwards and away from the branch, adding a twist as needed. This bends the stalk back opening up the abscission point and avoiding broken stalks and bruts (missing stalks).
4. Continually read the tree.
They look at the whole tree as they approach and decide where to go in, based upon how the fruit is presented. At each position they will pick the outside before going to the inside, then the top and finally any low fruit.
5. Read each clump and string of fruit. (See pictures - Appendix 1)
Starting at the top, they work downwards, separating large clumps into singles, doubles, trebles and quadruples. They pick trebles and quadruples by picking with the dominant hand whilst supporting the remaining fruit with the other hand.
6. Pick and hold the fruit gently.
They palm the fruit using minimal finger pressure. Those with dry hands wear thin rubber gloves for a surer hold.
Fruit transfer to the picking bucket and from bucket to bin is done without any fruit dropping or falling any distance.

Mental traits - Champions:

1. Are fully present, fully engaged and fully focussed.
Every time their hands go in, they are making decisions and this requires total concentration. They ignore all distractions.
2. Do not talk.
Talking is a distraction and champions prefer to work alone and in peace. They search for 'that quiet place to pick apples'.
3. Are motivated towards pleasure; they have a major goal.
Champions are very committed to earning a lot of money for a reason (e.g. to pay for studies, to buy a flat, to support a family).
4. Are motivated away from pain; they get the job right.
Champions work hard to avoid trouble. They pick carefully and avoid dropping fruit because they do not want to risk losing any money or their job.
5. Have a positive outlook.
They see the potential in each situation and strive to achieve it. They focus on the up side and ignore the downside.
6. Work for themselves.

Champions prefer to work alone and have control of their earning ability. They do not like teamwork, though they tolerate it.

7. Are pacemakers.
When in a team, despite the above, they keep up a high work rate and maintain high standards. They pull others up rather than slow down to the pace of others.
8. Are strongly competitive, both with themselves and others.

D. *Transferring the model*

In the work that was carried out transferring the model it is worth outlining the following techniques that were used:

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.

To reduce costs it is important to increase average picking speeds, however this must be achieved without any loss of quality. All growers that were asked placed quality above quantity, although in some cases the use of piecework and the prices paid compromised this and gave a mixed message.

When referring to the aim of 'increasing picking speeds' in this report it is accepted that this means to do so without negatively affecting quality.

Transferring the model: Site 1

The next stage was to transfer the model to other pickers. On the first selected farm we were introduced to an experienced supervisor and five pickers were chosen in discussion with her. They varied significantly in speed and quality.

Approximately an hour was spent with each picker (including initial observations), transferring the model and observing changes. We were able to use a video clip of a champion picker to very good effect. We did not attempt to transfer every aspect of the model, rather just the traits which were most obviously missing. This was the only intervention we made.

Transferring the model: Site 2

The second transfer of the model involved 4 pickers from a gang picking Braeburn. They were picking together as a team, using the bin train system. By this stage in the season (Early November) all had a reasonable amount of picking experience.

CR & KS spent 4 hours with the team. Initially we observed the picking and noted individual areas for improvement. We then addressed them as a team, using the one English speaker to translate. We explained how we could help them earn more and established a trust and rapport. Each picker was shown how they could improve their technique and CR picked alongside each one.

Results and discussion

Site 1 initial results

Observations made on the day that we transferred the model were promising. Pickers who had been struggling to pick more complex bunches of apples were managing the task without dropping any fruit. Two pickers who were passing fruits from one hand to the other had stopped doing this. Though we were not able to measure improvement on that day, it did appear to be significant in all cases.

The major concern was that the supervisor did not believe that pickers could be motivated by anything other than money. She had a negative attitude and we were worried that this may affect the results.

Site 1 Results

All pickers improved against the rest of the gang (control), however the results were varied. The control group consisted of 22 pickers. The figures in the tables below are based on 2 weeks before and 2 weeks after elements of the model were transferred.

	Speed before as % of control	Speed after as % of control	% improvement
Pickers 1 & 2	86.8%	98.7%	11.9%
Picker 3	94.2%	101.3%	7.1%
Picker 4	99.3%	106.8%	7.5%
Picker 5	88.8%	107.4%	18.6%
Average	92.3%	101.2%	11.4%

Quality of fruit picked

	% picker damage before	% picker damage after	% improvement
Pickers 1 & 2	13.4%	9.2%	4.2%
Picker 3	11.3%	7.6%	3.7%
Picker 4	6.8%	5.1%	1.7%
Picker 5	9.1%	7.9%	1.2%
Average	10.8%	7.8%	3.0%

The quality results demonstrate that far from negatively affecting quality, using the champion apple picker model results in increased speed and increased quality.

In addition, once pickers learn how to read each clump and string of apples they drop far fewer fruits. We certainly observed this, though we were not able to

measure the difference as there was already fruit under the trees through natural causes.

It is natural that this would improve. Pickers do not like dropping fruit. It is inept, they may get in trouble for it and it earns them no money. Once they have learned the techniques to avoid this, they do not revert to former behaviour. In years gone by, the traditional local pickers with many years experience dropped very few fruits.

Another gain is through better clearance of the tree. Through better search patterns, less fruit is missed. Champion pickers realise that picking the whole tree systematically allows them to get more fruit from each tree. They do not have to travel so far to fill a bin. The above applies when clearing the tree, though not when select picking.

Site 2 Initial results

Measurements taken on the day, before and after applying aspects of the model, demonstrate a clear immediate improvement.

The time taken to fill and empty their picking buckets was recorded. Three measurements were made before the intervention and three after.

	Av. Time before intervention	Av. Time after intervention	% Improvement
Picker 1	2:28	1:43	30%
Picker 2	2:43	2:13	18%
Picker 3	2:41	2:14	17%
Picker 4	2:03	1:34	24%
Average	2:29	1:56	22%

Quality

Four samples of twenty-five apples were taken from bins picked before transfer of the model and again after transfer. Each sample was assessed for picker damage and fruit below class 2 standard.

Table showing percentage of out grade fruit from samples

	Before model transfer	After model transfer	Improvement
Sample 1	12%	0%	12%
Sample 2	16%	8%	8%
Sample 3	12%	4%	8%
Sample 4	8%	4%	4%
Average	12%	4%	8%

Note that as all pickers were picking collectively into each bin, it was not possible to ensure that each individual picker was sampled. The extent of the improvement is thus only an indication.

Site 2 Results

The team continued picking together for a further 5 days. The table below shows bins/ hour picked by the team for 10 days before and the 5 days after the model transfer. The control was the average of the 5 other teams picking the same crop.

	Speed before (Bins	Speed after (Bins	% improvement
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	per hour)	per hour)	
Model Gang	3.7	4.6	24.3%
Control	3.8	4.0	5.3%
Improvement over control			19.0%

Reports on the quality of fruit from the model group were very positive. All bins picked by the model gang were deemed acceptable by the supervisor. The farm did not use any formal quality control assessment.

Selection and training of supervisors

It quickly became apparent that the calibre of supervisors, the training they receive and the expectations of them were very variable. The number of pickers under the supervisor's control on farm's we visited varied from six to twenty-seven.

Many supervisors gave only initial training to new pickers on the first day. After that pickers were told off if quality was unacceptable and, in most cases, if excessive numbers of fruits were missed.

There did not appear in most instances to be any attempt to help pickers learn better picking techniques. We frequently saw significant numbers of fruits dropped due to pickers not knowing how to pick complex clumps and strings of fruit. The (major) exception to this was when pickers caused noticeable levels of damage, particularly bruising, to fruit. Most supervisors would then attempt to assess how the damage was occurring and teach better techniques to the picker.

All the supervisors we came into contact with were paid by the hour. They were not motivated to increase picking speeds as all the gain would go to the picker and the farm, whilst they run the perceived risk of increasing quality problems.

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.

Commercial experience in the soft fruit sector has shown that these pickers can and do improve through application of the champion picker model, however from a low starting point. They often take an inordinate amount of the supervisor's time for the improvements gained.

If these workers were to be removed, or preferably never arrive, much greater improvements in average picking speed could be achieved. To this end, some form of pre-selection of labour is extremely desirable.

Conclusions

- It was possible to significantly improve the productivity of pickers using the champion apple picker model, with only brief contact with the picker.
- In commercial use, the supervisor can transfer the model more fully over a period of days.
- The potential productivity gains are in excess of 20%.
- To realize this potential, supervisors need to be appropriately trained and to be motivated through remuneration or other means to achieve desired results.
- Pre-selection of pickers also has the potential to significantly increase productivity gains.

Objective 2 – Comparison of bin train and conventional harvesting

Introduction

Since the introduction of bulk bins for picking apples in the 1960s, individual bins have been filled by typically one or two pickers. The bins are placed on the orchard floor and moved up as necessary by a tractor with rear mounted forks. Pickers are most commonly paid per bin picked. In some cases an hourly rate is paid and a bonus dependant on quality.

Bin trains, first used commercially in the U.K. in 2005, involve one bin per trailer and up to 5 trailers connected in a train behind the tractor. The pickers, in teams of six – eight pick the rows or beds either side of the alley and place the fruit into the nearest bin. They are paid collectively, either piecework or hourly.

Materials and methods

The results presented in this section are based on observations carried out on sites of four different businesses that were using or trialling the bin train system. They were:

- J B Cannon & Son, Roughway Farm, Roughway Lane, Tonbridge, Kent
- F W Mansfield, Nickle Farm, Nickle Lane, Chartham, Canterbury, Kent
- Gaskains Ltd, Norham Farm, Selling, Faversham, Kent
- Great Cheveney Farm, Goudhurst Road, Marden, Kent

The observations were conducted objectively, however as this section was not in the original proposal, we did not have the scope to carry out detailed measurements of the different systems. The results serve a purpose as a guide.

Results and discussion

Key advantages of the bin train

- Supervisor can spend much more time monitoring fruit going into the bins.
- Removes the need for tractors racing around to move bins up.
- Less tractor damage to fruit in bins.
- Reduces the distance pickers walk with a full bucket.
- Fruit is removed from the orchard faster – no end of day rush on overtime.
- The picking environment is more pleasant in teams and with less tractor noise.
- Less likelihood of parts of rows being missed.
- Team advantages possible such as at least one tall picker in each team.
- Slower pickers may improve to keep up with the team.

Key disadvantages of the bin train

- Once fruit is in the bin, it is not possible to tell which individual picked it.
- Collective payment systems can de-motivate faster pickers.
- Higher capital investment in tractors and trailers.
- Potentially higher supervisor costs if one per train.
- Greater difficulties in wet weather.

Payment systems

Where pickers are brought in solely for the top fruit harvest, it is possible to pay hourly at the minimum wage rate and still have reasonable motivation. The advantage is that quality improves when there is no quantity based remuneration. Pickers are expected to keep working steadily and they know how much is expected of them.

Where pickers have already been working on piecework, paying hourly can meet with more resistance. A collective team piecework system results in higher productivity and the risk of poorer quality. This can be overcome by a thorough Q.C system and part of the payment based on quality achieved.

Because of the high cost of tractors, drivers and supervisors, there is a big benefit in maximising production from every team.

Size of team

We observed teams varying from four to ten. Because of the high capital and running costs, there is a temptation to have larger teams. The optimum size of team is dependant on orchard design (single or multi-row) and crop load. As a guide, in a single row Cox orchard with an 80% full crop, teams of six work best. Teams of ten caused pickers to get in each others way and encouraged a lot of walking. Teams of eight were more manageable, however, on piecework there was still too much frenetic activity and quality suffered.

With teams of six, there are three pickers each side of the train and they have more space around the trees. They can work one to a tree and each picker is more aware of where the others are picking. There is less chance of whole or part trees being missed.

Bin train systems

We studied three systems in use:

- E. Teams of six plus a supervisor who also moved the bin train. Empty trains are brought in and full ones taken away by a dedicated driver serving two or more gangs.
- F. Teams of six including a picker who could move the bin train and a supervisor between two or more teams. Empty trains are brought in and full ones taken away by a dedicated driver serving two or more gangs.
- G. Teams of eight or ten with a dedicated tractor driver and a separate supervisor between two teams. Two teams would have three 'tractor plus driver plus bin train' units. When the bins are full, the driver goes off to have them taken off and replaced with empties. The next driver should be waiting immediately behind so that there is no delay. In this setup there should always be one unit with each gang and the third unit emptying and reloading. It relies on good logistical management to keep the gangs finishing their bins at different times to avoid delays.

System 1 has a high ratio of non-picking to picking labour (1:4). One problem we saw was that the supervisors moved the train up and then came back to oversee the fruit being picked into the bins. They never went beyond the pickers to check that all fruit was being picked and how much was being dropped. The photo below shows good fruit missed and we found up to 30 fruits on some trees.



This problem is really one of supervision selection and training.

System 2 has a lower non-picking to picking ratio (1:6) and works well where there is a lot of fruit, so that the picker / driver is mostly picking. It does involve the supervisor walking some distance as the teams do not stay side by side. It works well where there is a separate Q.C. function. If the pickers know that fruit will be randomly checked after it has left them, a greater level of self-policing develops.

System 3 has the lowest ratio (1:3.2 if eight pickers, 1:4 if 10 pickers) despite having more pickers to each team. This can work well if there is not much fruit, for instance on a pick over; however even 8 pickers can be too many in this situation.

System 2 gives the pickers a greater sense of being trusted and when the level of remuneration is dependant on Q.C. results is both efficient and cost-effective.

In any system the pickers must be constantly supplied with bins. Waiting times of ten – fifteen minutes were not uncommon and we witnessed waits of up to an hour.

When planning the harvest, there have to be sufficient contingency plans. One tractor getting a puncture can derail the whole operation, particularly if it is the only one that is equipped to break down bin stacks or unload trailers.

Picker training

Whether using bin trains or conventional picking, the same basic training on what to pick and how to pick it must be provided. In addition the champion picker model, as presented in this report, will help enormously.

Pickers would also benefit from understanding teamwork. In a good team each picker is aware of the others. If picker 1 has a full bucket and there is a small amount of fruit left on the tree they are picking, picker 2 will see this and finish it for them. This is more efficient as otherwise picker 1 would have had to walk back some distance for very few fruits.

This does not happen automatically in many teams. We observed up to 4 pickers crowding around the same tree on many occasions.

Cost

It is beyond the remit of this project to provide a full costing of different systems. Typically, bin train picking requires twice the number of tractors that conventional picking requires. Four wheel drive tractors are necessary on slopes and in wet weather. There is also a significant capital outlay required for the trailers.

Conclusions

The bin train system is more efficient than conventional picking when:

- Logistical organisation of staff and equipment is first rate.
- The ratio of pickers to volume of fruit is optimised
- A lower supervisor: picker ratio is allied to a good Q.C. system.
- The whole team buys into the concept and is well trained.

Appendix 1: Photos showing picking a string of fruit

These pictures demonstrate the technique of starting at the top of a string of fruit and working down.



The picker is using her left hand to support fruit, whilst her right hand picks with a lift and twist action.



Appendix 2 – Research sources

The following sites and documents were researched and relevant and appropriate data was assimilated/compared in support of this project:

Behavioural modelling:

www.comp.leeds.ac.uk/vision/behaviour.html (university of Leeds - Dr. Needham)

<http://hbswk.hbs.edu> (Harvard Business School – study on MRI Scans & Decisions)

www.solutioneersnet.com/solutioneering/lateralthinking.html (Edward De Bono Lateral Thinking – The Way the Mind Works)

http://rebirthofreason.com/objectivism/applying_objectivism/benefits.html (benefits of adopting objectivism)

<http://www.qudiencedialogue.org/qualquant.html> (dialogue on qualitative vs. quantitative research)

<http://www.jr2.ox.ac.uk?bandolier/booth/glossary/qualres.html> (Bandolier - Evidenced based thinking and qualitative & quantitative research)

<http://edwebb.sdsu.edu/Courses/Ed690DR/Class01/AusQ.html> (Qualitative vs Quantitative)

<http://www.gifted.uconn.edu/siegle/research/Qualitative/Qualquan.html> (the assumptions of qualitative & quantitative design)

<http://www.wilderdom.com/research/> (Features of qualitative & quantitative research)

<http://www.writing.colostate.edu> (conducting observational research)

<http://www.fortwayne.com> (Thinking and the affect on the body)

<http://www.enneagraminstitute.com> (personality traits)

<http://www.opp.eu.com> (Psychometric tools)

General:

<http://www.hbswk.hbs.edu/item/5599.html> (Neuro Economics - Harvard Business School)

http://daf.csulb.edu/offices.univ_sves/gi/results/employee_2006/index.html (Balanced Scorecard Results - Employee Satisfaction – California State University)

Harvesting & production:

<http://defra.farmingandfoodscience.csl.gov.uk/usefullinks.cfm> (DEFRA)

<http://www.search.gov.on.ca:8002/compass?view-template-simple> (Ontario Ministry of Agriculture, Foods & Rural Affairs – Harvesting & Handling Apples)

<http://www.nsapples.com> (Nova Scotia Fruit Growers Association – Harvesting for Apple Pickers)

<http://eatwell.gov.uk> (Food Standards Agency)

<http://www.chelgate.com> (Articles & PR re Horticulture)

<http://www.ruralni.gov.uk> (agriculture & rural development Northern Ireland)

<http://www.sgsconsultancy.demon.co.uk> (SGS Environmental & Management Consultancy)

<http://www.Lantra.co.uk> (Lantra Skills Council)

<http://www.nfuonline.com> (National Farmers Union)

<http://www.hort-trades.com/prodev/> (Horticultural Trades Association Landscape Ontario _ Education & Training)

<http://www.abc.net.au> (Rural News re crop pickers)

<http://www.alp.org.uk> (International Association of Horticulture Producers _ Startseite)

<http://www.the-hta.org.uk> (HTR –Horticultural Trade Association)

<http://www.horticulture.org.uk/> (The Institute of Horticulture)

www.lantra.co.uk/productionhorticulture (Production Horticulture Action Plan 2006)
<http://www.lsc.gov.uk/national/documents/keyinitiatives/successforall/nms-qip.htm> (Learning & Skills Council Work based measures & new learning – WBL)
Publication Ref.LSC-P-NAT-060105 © LSC Feb 2006

www.legislation.hmso.gov.uk/legislation.uk/htm (National Training Standards - Agronomy)

www.lantra.co.uk/productionhorticulture (Production Horticulture Industry Action Plan 2006+)

Farm Management Research (Department of Agriculture, Nova Scotia by Robert Carter, University of Vermont) Cornell University

Increasing Labour Efficiency Through Worker Training & Improved Labour Relations (Cornell University by L.M. Vaughan United States Dept of Agriculture)

JSTOR (Researches Library)

Labour Productivity in Harvesting by Charles M. Cuskaden (American Journal of Agricultural Economics Vol. 55, No. 4, Part 1 [Nov. 1973] pp 633 – 636

doi: 10.2307/1238350

JSTOR: American Agricultural Economics Association

<http://links.jstor.org>

Labour Productivity & Apple Harvesting by Charles M. Cuskaden

Assistant Professor of Agricultural Economics, University of Tennessee, Knoxville

<http://www.rjcornish.com> (about fruit picking)

<http://uwex.edu/ces/media/catalog/fruit.html> (Videostraining of apple picking – University of Wisconsin – Media – Common Apple Picking Techniques – 20 min VHS Video)

<http://www.plunkettorchards.com/lau/work.htm> (seasonal work - fruit picking)

<http://www.egr.msu.edu/~timm/pub.htm> (Books and videos on apple picking)

<http://globald.aloqucenter.blogs.com/2006/11/index.html> (Picking apples without sight by Bill Tipton)

<http://eru.gmprc.ksu.edu/publications/documents/appleDamageP.A.pdf> (Apple damage during transport & storage)

<http://www.allaboutapples.com> (general apple information from enthusiast)

http://www.terhuneorchards.com/event_news.html (Tehune Orchards - picking, thinning etc)

Book available: Apples, Apples, Apples by Nancy Elizabeth Wallace

<http://www.hort.purdue.edu/fff/FFF96/FFF9612.txt> (Michigan State University - 2 Videos)

http://www.agr.ac.ca/malus/core_ehtml (Core information - tips on picking, buying and storing apples)

<http://www.omafra.gov.on.ca/english/crops/facts/00-003.htm> (Ontario - Harvesting & handling apples)

<http://www.nationalapplemuseum.com/book16.html> (all about apples)

<http://agepb:missouri.edu/mac/agoppoio.txt> (2 x videos available packhouse & picking)

Pdf documents on file:

Apple Picking by Gary Mount

Picking & Storing by Tammy Algood & David Lockwood

Picking the Best Apple by Mark Speight

Reducing Food Safety Risks in Apples by G. Baird Wireman, D. Granstein, E. Kirby & E. Adams – Washington State University Cooperative