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GLASSHOUSE TOMATO GROWING

A STUDY OF STRINGING TOMATOES

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SUMMARY

This report describes an investigation into the use of labour in tomato stringing in glasshouses and suggests some improvements in the method. The existing methods are described and the time required to string a house, on the holdings observed, is shown to vary from 3.1 minutes to 7.7 minutes per 10 plants.

Methods are considered for saving time in measuring and cutting strings and it is suggested that putting out strings could be combined with tying the strings to the plants. Tying strings to the high wires from a pair of steps took half as long again as tying to the low wires when standing on the ground, and tying from a scaffolding took twice as long. It is considered that there may be a case for lowering the centre wires to 7 feet from the border, so that all stringing can be done from the ground, and the work completed more quickly with a consequent reduction in cost.

INTRODUCTION

The growing of tomatoes in glasshouses is one of the most important horticultural enterprises in the West of Scotland. In the whole of Scotland some 200 acres of glass are devoted to the crop and the greater part of this is found in the Clyde Valley area, including parts of Ayrshire. The area of glass on most individual holdings is comparatively small, but the tomato crop, in many cases, represents the major part of the grower's livelihood. Costs of production have increased in recent years, but the price of tomatoes has not generally kept pace, so that it is becoming difficult for the grower to maintain a satisfactory profit.

Of the items which make up the total cost of production of tomatoes, labour accounts for from a third to a half of the annual expenses, so that any reduction which can be made in the labour requirements of the crop will help to reduce the cost of the crop. In recent years the comparatively new techniques of work study have been used in industry for the purpose of reducing labour costs and more recently still, work study has been successful in making more effective use of labour in agriculture. It seems likely that it could be used to reduce costs in tomato growing and, as a start, an investigation was made of the work involved in stringing tomatoes. This report describes the investigation and discusses possible improvements in method which have arisen from it.

PRESENT METHODS

The Gardens and Glasshouses

During the spring of 1957 and 1958, studies were made at eight market gardens in Lanarkshire and Renfrewshire. The method of stringing was examined at each holding and studies were made of the work involved. All the houses on a holding were generally of the same size but the sizes varied at the different holdings. They were all 16 feet wide but the length varied as follows:-

Length of House	Number of Holdings
200 feet	2
150 "	2
120 "	1
100 "	3

The steam pipes ran the length of each house and were situated below the roof valleys so that the borders were clear. Wires for attaching the top strings were strung along the house, hung on short metal strips attached to the rafters, so that they ran roughly parallel to the roof. The number of wires varied at different holdings from 4 to 9 on each side.

In some houses the tomatoes were planted in the border but in others they were grown in whalebide pots set in the border. The latter system was

favoured where a crop of early lettuce was taken in the border, because the plants could be brought forward in the pots and set out after the lettuce had been harvested.

Two alternative systems of spacing were used. In some houses the plants were set out in three rows running the length of each border. The distance between the back and the middle rows was from 3 feet to 3 ft. 6 ins. and from the middle row to the centre row - next to the path - 1 ft. 6 ins to 1 ft. 9ins. The spacing between plants varied from 1 ft. 2 ins. to 1 ft. 6 ins. In the second method the plants were set out in 4 rows in the border. Spacing between rows was from 1 ft. 6 ins. to 1 ft. 9 ins., but between plants the spacing was 1 ft. 6 ins. and 2 ft. 2 ins. alternately, which left a narrow cross passage between every two plants.

The height of the houses varied on different holdings but the height of the top wires from the border was within the following ranges:-

Back Wire	4 feet to 6 ft. 9 ins.
Second Wire	5 feet to 6 ft. 6 ins.
(where plants were grown in 4 rows only)	
Middle Wire	6 feet to 8 ft. 6 ins.
Centre Wire	6 feet 10 ins. to 9 ft. 6 ins.

General Description of Stringing

The object of stringing is to provide a support for the plants as they grow up to the roof. Thereafter they are supported across the wires at the roof and down the other side.

In all houses visited, one end of the string was attached to the plant and the other fastened to the appropriate wire at the roof, so that the plant could be twisted up the string. Other systems of stringing are used in which the strings are attached at the foot to a peg knocked into the ground at each plant, or alternatively the strings are fastened to wires running the length of the house at each line of plants and set just above ground level. Neither of these systems was used by the growers visited and, in fact, they are not common in this area.

When stringing is being carried out, the height of the wire at the row to be strung is measured and approximate lengths of string are measured and cut. The balls of string have 12 ends each so that a hank of 12 strings is pulled out and cut at a time. After the string has been cut the worker passes down the row putting out a string at each plant. Then a worker moves down each row and ties one end of the string to the plant and the other end to the wire above. Usually the back row is completed before beginning the middle row, the middle before the centre and so on.

Because of the slope of the roof, only at the back, second and middle rows can the worker reach the wire when he is standing on the ground, and for the centre row another method must be used. When stringing the centre row, strings are first tied to all the plants. Tying at the top wire is done either from a pair of steps which are moved every few plants or from scaffolding which may be composed of planks set on boxes and which is moved along the house as stringing proceeds.

After the strings have been fixed they may have to be twisted once or twice round the stems to support the plant. With young plants this is not necessary at the time of stringing and the extent to which it has to be done depends on the stage of growth of the plants.

As the plants grow, they are supported by twisting the strings round the stem till they reach the roof. Thereafter they are trained over the roof wires to the central wires at the ridge and down the other side. Where the wires at the roof are numerous (6 or 7) the stems may be fastened to the wires with string. Where only 3 or 4 wires are present, the roof is strung by tying strings from the lower wire to the top wire securing them at the intermediate wires and twining the plants round these. The roof may be strung at the time the strings are fastened to the plants or it may be done later, when the plants have reached the roof wires.

The present study is concerned with the initial stringing of the plants and the stringing of the roof is not included.

Time Taken to String a House

It should be explained that many of the times recorded in this report are expressed as man-minutes. This represents simply the work of one man for one minute. It is a convenient measure of the time taken for any job or part of a job. For example if an operation is said to take 30 man-minutes it might be done by one man working for 30 minutes, 2 workers working for 15 minutes or 3 workers working for 10 minutes.

It was usual for any number from 1 to 4 workers to be engaged in stringing a house, and it was, therefore, not possible to study continuously all the work done in a single house. Instead, samples of the work done at each operation were studied and from this, the total time taken for each operation and for stringing the whole house was estimated.

The work was split up into the following operations.

A Measuring and cutting string.
B Putting out strings.
C Tying strings to plant and wire - Low wires.
D " " " " " " - High wires.

Low wires are those which could be strung from the ground and high wires are those which required steps or scaffolding for stringing.

The estimated times per house taken for these operations is shown in Table I. The number of plants per house varied according to the size of the house and the spacing used.

The varieties of tomatoes grown were generally either Moneymaker or Discovery, but it has not been possible to draw any distinction between the times taken for different varieties. The times taken on Holding D are not shown, as at the time, the worker was unable to work at a normal speed because of a disability.

The estimated total time , in man-minutes, required to string each house is shown in line 9. Allowing for the number of men at work in each house, the time required for stringing a house was calculated and is shown in line 11. These figures cannot however, be used for the comparison of performance at the different holdings, because they relate to different sizes of houses containing different numbers of plants. If, however, the time required to string 10 plants is calculated for each holding then a rough comparison is possible. These figures are shown in line 10. They range from 3.1 minutes to 7.7 minutes per 10 plants. This wide variation suggested that there might be differences in the efficiency of the methods used. These have therefore been investigated and the principal factors concerned are discussed below. Four of the houses came within the range of 3.1 minutes to 3.8 minutes for 10 plants and it may well be that this figure was typical of normal performance.

DISCUSSION OF METHODS USED IN STRINGING

The different methods used for stringing varied considerably and one might differ from another only in small details. They are discussed below, classified under their more important characteristics.

A. Measuring and Cutting Strings

The methods used for measuring and cutting depended to some extent on the methods used in putting out the strings. It is convenient to discuss the measuring and the cutting separately.

Measuring. Two distinct methods were used for measuring the height of the wire from the plant. In the first, measurement was made at a single point and a number of skeins of string cut to the right measurement allowing for the length required to tie the knots. The point at which the height of the wire was measured might be at the end of the house or at some intermediate point in the row, and up to 3 or 4 measurements were often made in one row. In the second method the height of the wire was measured at intervals of about 5 to 7 yards along the wire - representing 12 plants - and a skein of string cut and hung on the wire.

TABLE I

TIME TAKEN FOR STRINGING HOUSE

		A	B	C	E	G	D	F	H
1	Length of house - ft.	200	200	150	150	120	100	100	100
2	No. of plants per house	790	840	640	620	570	444	432	450
3	Av. Height of High Wire	8'0"	8'1"	8'2"	7'10"	8'5"	9'1"	7'3"	8'6"
4	No. of Workers	4	4	2	2	2	1	2	2
	Time taken for Stringing								
5	Measuring and cutting	9	15	19	25	25		17	25
6	Putting out	50	49	25	45	24		22	8
7	Tying - Low wire	136	140	83	109	(241		68	206
8	Tying - High wire	127	60	109	53	(		57	108
9	Total	322	264	236	232	290		164	347
10	Average time per 10 plants (minutes)	4.1	3.1	3.7	3.7	5.1		3.8	7.7
11	Time taken to string a house using number of workers shown in line 4 (minutes)	83	66	118	116	145		82	173
12	Approximate distance walked per house - yards	4743	1000	1187	1608	1792		1127	967

Using the second method, it took about twice as long to measure the string required for a row as by the first method. It may however, save some string, because the measurement is more exact and the ground surface may be undulating. The question arises as to whether the value of the string saved is worth the extra cost of the labour required. Valuations made from figures from some of the holdings suggest that the value of the string saved would just about balance the extra cost of labour if an average of 3 inches were saved on every string. This figure is given for illustration only and should not be taken as being generally applicable.

Cutting. On all but one holding, a skein of 12 strings was drawn from the bale, the correct length measured - including an allowance for making the knots - and then cut. On Holding A however, 4 balls were used and 4 skeins of string were drawn out at a time and cut, giving 48 skeins of string. In this way, in a 200 ft. house, the work of cutting could be reduced to nearly a quarter. A strong knife was required for this method.

Much time was wasted on some holdings because the knife used was blunt and the worker had to saw at the string to cut it. This could be avoided by sharpening the knife each morning before starting, and, if necessary, again in the afternoon. On some holdings the knife used was too small for the job and a larger one would have made cutting easier and quicker. Where the knife was small, it was liable to fall out of sight and time was wasted looking for it.

The balls of string were usually kept at the end of the house beside the entrance and the cutting was done there. On holdings where more than two measurements were made along the length of each row, the string was usually carried along the row and deposited at the point where the measuring and cutting was done, from where it was collected and carried to the next point.

B. Putting out Strings

After the string had been cut, the worker took a bundle, walked down the row and pulling out a single string at a time, dropped one at each plant. It was usual first to string the outside row nearest the valley in the roof, then the middle row or rows and finally the centre row on each side of the path. The number of strings put out at a time varied and might be any number from 12 to the whole row. Often a few strings were put out and tied, and the worker walked back to where the ball had been left to get more strings.

Some reduction in the time taken for putting out strings could, perhaps be made if a more definite method were adopted. In the first place, as many strings as can conveniently be carried should be put out at a time to reduce the amount of walking needed to go back for more string.

There is some advantage, too, in working down one border, crossing over to the other border and working back along the corresponding row on the other side. For example, supposing a worker can conveniently carry enough string for one row of 100 ft. house, if he finishes stringing the row on one side, walks back to the end for more string, and strings the other side walking back to the start, he will have walked 400 ft. Alternatively, using the same number of strings, he could string to the half way point in the house, cross over to the opposite row and work back to the start. From there he could take another bundle of string, walk to half-way and string the second half of the rows, again working down one side and back the other. By this method the worker would walk only 320 feet when stringing the two rows. This would amount to a saving in walking of 240 feet in a house where the plants were set out in 3 rows on each side and 320 feet where the plants were in 4 rows.

The same distance would be walked if the base for cutting the strings was sited at the middle of the house instead of at the end, and the strings put out first to one end and then to the other. The difficulty of this is that in many houses there is not room to have a supply of twine etc. in the passage, at the middle of the house.

It will be shown later, however, that, more time could be saved be eliminating this as a separate operation and combining it with the next operation.

C. Tying Strings to Plant and Wire - Low wires

The normal procedure in this operation was to walk down each row, tie one end of the string to each plant, if necessary twist the string round the stem, and finally tie the other end to the wire at the top. When tying the string to the plant it was usually fixed round the stem by means of a loose loop and tied with a reef knot. The knot used for tying the string to the wire was a half-hitch with a loop, so that it could be easily untied at a later stage, when it became necessary to tighten the string or train the plant over the top wires.

So long as the height of the wire was about 7 feet or less from the ground, the string could be tied by a worker standing on the ground but when the height was more than 7 feet the wire could not be reached from the ground and a different method had to be used. (See Section D which follows). To some extent the height of the worker who tied the knot affected the method, because a tall worker could tie wires higher than 7 ft. while a short worker had difficulty in reaching up to that height.

On Holding E a different method of tying the string to the wire was sometimes used. The string was passed over the wire and the strands were opened out about 2 or 3 inches below the wire. The loose end was then inserted into the opening and pulled tight so that the twisting of the strands kept it taut. In order to tighten the string all that was necessary was to pull the loose end. This fastening was easy to untie and facilitated training the plants at a later stage of growth.

It took appreciably longer to fasten the string by the insertion method than with a knot on the wire. The difference in time is estimated to be about ten minutes in a house of 432 plants. In considering which method to use, therefore, the grower must decide whether, by using the insertion method, he can save 10 minutes per house or more in the subsequent operations: if not, then the half-hitch knot is the better one to use.

On Holding D, a method was used which avoided the need to put out the strings. After cutting, the worker tucked a bundle of about 120 strings into his belt, and proceeded direct to string the plants, pulling out a string from his belt to tie each plant. On Holding H, a similar method was used but the worker hung a bundle of string round his neck, instead of at his belt. It was not possible to compare this method exactly with the more common one but it is estimated roughly that it would save about 10 or 15 minutes in a 100 ft. house, and would also save some walking.

D. Tying Strings to Plant and Wire - High wires.

This was probably the most time-consuming of all the operations. When the worker could not reach the wires in order to tie the string to the top ones, he had to stand either on a pair of steps or on scaffolding. When central wires were being strung, one end of each string was first tied to the plants, and the string was then dropped and coiled on top of the plant.

Where steps were used to tie the strings to the top wires, the steps were first put in position beside the first two plants. The worker then took two of the strings from the top of the plants in his hand, mounted the steps and tied first one string and then the other to the wire. He dismounted, moved the steps to the next two plants on the same side of the path and repeated the process. On some holdings an oil drum or stool was used instead of steps.

In the above method each worker usually worked independently but on some holdings two workers worked together. One mounted the steps and tied the plants and the other handed up the strings. In this way the rows on both sides of the path could be strung at one time and from 5 to 8 strings could be tied without moving the steps. While the presence of the second worker helped to speed up the work, it was wasteful of man power, because the worker who picked up the strings spent much of his time waiting for the one on the steps to finish tying each string. When two men were working together the total time in man-minutes required to tie the top strings of the two central rows was 35 minutes. Where the man worked independently the work could be completed in 25 man-minutes, so that the saving of time was about 10 minutes.

Where scaffolding was used it consisted of 2 or 3 planks supported on boxes or drums which were set up at the end of the house and then moved down the path as required. Two or more workers were required to move them. One, or sometimes two men mounted the scaffold while one or two workers handed up the strings for them to tie. The number of strings which could be tied from one position of the scaffold depended on the length of the scaffold. On Holding A, in a 200 foot house, 5 moves of the scaffold were required per house.

On Holding G, the planks of the scaffolding were supported on 2 U-shaped pieces of metal having hooks at the ends by which they were hung on the joists. Only one side of the bay between the joists could be reached at a time, so the hooks and planks had to be moved across each bay to string the other side.

In order to make a true comparison of the different methods of stringing it would be necessary for all the houses compared to be the same size but, in fact, the size of houses varied. To overcome this difficulty, data obtained from each of the holdings has been used to estimate the time that would be taken on each holding if the houses were 100 feet long and contained 432 plants in 3 rows. It is therefore estimated that the average time taken to tie the strings for 2 rows of plants would be as follows:-

Low rows	20 minutes
High rows - from steps	30 minutes
" " - from scaffold	40 minutes

The times are given in terms of two rows, because in some cases the two central rows were strung at the same time.

Tying at the top wire of the high rows from a scaffold takes 10 minutes longer, per two rows, than from steps, therefore some 10 minutes per house can be saved when steps are used in preference to a scaffold.

Tying the top wire of the high rows from a scaffold takes twice as long as tying the low rows from the ground, and tying from steps takes half as long again as tying from the ground. If the high rows could be eliminated altogether and all the wires kept down to 7 feet high or less, from 10 to 20 minutes could be saved in stringing a house. This would result in saving time not only during stringing but also during the subsequent training of the plants over the roof and in picking the tomatoes. A similar method to this is used in the Guernsey system of growing tomatoes which is now being tried by growers in some parts of the country. It is claimed that by keeping the plants away from the roof, ventilation is better and the quality of the crop is improved.

In the Clyde area it would probably be desirable to experiment with lowering the top wires to 7 feet, in order to make sure that there was no appreciable loss of yield, before the method could be generally adopted. If the central wires were lowered, it would probably also be necessary to lower the middle wire or wires so that the plants could be properly arched over the top.

Some reduction in the cost of string would be expected as a result of using this method.

Other Factors Affecting Stringing

During the investigation a number of other points came to light which affected the time taken for stringing.

Stage of Growth of Plants

Tomato plants were generally strung when they were about one foot to two feet high. At this time it was easy for the workers to move between the plants and little time had to be spent in twisting the string round the plants. When the plants were older it was not so easy for the worker to pass between them and greater care had to be taken not to damage the plants. When the plants were at an older stage, two or three turns of the string had to be made round them, before it was fixed to the wire, which added to the time required for the stringing. This would, in any case, have to be done at a later stage, but when a large number of houses have to be strung there may be an advantage in completing this operation as quickly as possible.

This was well shown on Holding H where the plants were about 3 to 4 feet high when stringing took place. A crop of early lettuce had been grown in the house but because of low prices and poor demand, there was some delay in harvesting it. The tomato plants were grown in whalehide pots, and, although they were placed in the border as soon as the lettuce was removed, they had to be supported with canes stuck in each pot, and it took extra labour to remove these. It was estimated, very roughly, in this case, that the extra time needed was over 1 man-hour per house.

While it may not be possible to find a general remedy for delays caused by marketing conditions, when the effect of this on the cost of the tomato crop is appreciated, it may be found desirable to make adjustments in the cropping.

Number of Rows in Border

It might be expected that the time required for stringing would be affected by the layout of the rows in the border - i.e. whether the plants were in 3 or 4 rows. Again, owing to the different conditions in the different holdings, the effect of this could not be assessed by straight comparison of the holdings. A situation was therefore assumed in which there would be two 100 ft. houses each containing 432 plants. In one of these, the plants would be set out in 3 rows on each side, 72 plants to a row, the distances between the two rows being 3 ft. and 1 ft. 6 ins. respectively. In the other house, the plants /1ft.6' were assumed to be in 4 rows, 1 ft. 9 ins, 1 ft. 6 in. and/apart, each row containing 54 plants. The method of stringing was taken to be the same for each house.

From the data obtained in the investigation an estimate was made of how long the operation would take in each of the two houses. The results are shown in Table II.

TABLE II

Operation	Time taken in man-minutes	
	3 Row House	4 Row House
Measuring and Cutting	11	13
Putting out Strings	17	18
Tying Strings - Low wire	58	66
Tying Strings - High wire	48	36
	134	133

The time taken for stringing by the two methods of layout is almost exactly the same. Because of the additional low row, in the 4 row house, compared with the 3 row house, more time would be taken for measuring and cutting strings, putting out strings, and tying strings to plant and wire on the low rows, but this would be made up by a saving of time on tying at the high wires, where only 54 plants have to be tied instead of 72.

Cost of String

The twine used for stringing tomatoes is supplied in 7 lb. balls each containing 12 ends of string. Three thicknesses are available, - 4 ply, 3 ply and 2 ply. Most of the holdings used 4 ply for all stringing from plant to wire. Some of the holdings used 3 ply or 2 ply for stringing the plants to the low wire but this was usually where the height of the wire was less than 6 feet.

Based on November 1959 figures, the cost of 3 and 4 ply twine was quoted at 1/6½d per lb. for quantities less than 1 cwt and a 1d less, when the amount purchased was over 1 cwt. 2 ply twine was quoted at 1/6½d. per lb. for all quantities. The following table shows the approximate lengths of twine quoted as being contained in a ball, together with the corresponding price per 100 yards.

TABLE III

Cost of Twine

Thickness	Length of Twine per ball	Cost per lb.	Cost per 100 yds.
4 ply	945 yds.	1/6d.	13.3d.
3 ply	1260 yds.	1/6d.	10.0d.
2 ply	1890 yds.	1/6½d.	6.5d.

The average height of the wires from the ground, on the holdings observed, was as follows:-

TABLE IV

Average Height of Wires

Row	3 Rows per Border	Row	4 Rows per Border
Back	5 ft. 7 ins.	Back	4 ft. 10 ins.
Mid	7 ft. 1 in.	Second	5 ft. 10 ins.
Centre	8 ft. 2 ins.	Mid	7 ft. 1 in.
		Centre	8 ft. 2 ins.

The length of string required for making the knots at the plant and the wire is approximately 1 ft. 6 ins.

From this, it is calculated that 1220 yards of twine are needed to string from plant to wire in a 100 ft. house with 432 plants in 3 rows in each border. The cost of twine when stringing with 4 ply twine would be 13/6d per house. Similarly the quantity of twine required to string from plant to wire in a house with 4 rows in a border would be 1150 yards and this would cost 12/9d. When 3 ply twine is used for the two outside rows of each border in a 4 row house, the cost of twine would be 11/4d. - a saving of 1/5d. per house.

Such comparatively small savings in cost may not be very significant where only a small number of houses have to be strung, but where there are many houses, saving in the cost of string would appreciably reduce the total cost. Where string is saved at the expense of extra labour, e.g. where several measurements of the height of wires are made, it is important to consider whether the labour could be used for other work. If no other work is pressing, it may be profitable to take longer to string a house if some string can thereby be saved. Taking the cost of labour at 4/- per hour the cost of 6 yards of 4 ply string - or 12 yards of 2 ply, would be equivalent to the cost of 1 minute's labour.

Organisation of Work

One of the most important considerations in speeding up the work of stringing tomatoes - or any other work - is that it should be properly organized and that each worker should know exactly what he has to do. On some holdings, the workers had no definite scheme of operation and as a result they wasted time in unnecessary walking and waiting, and, where there were 3 or more workers, they often got in each other's way. The method of working should be carefully planned before the job is started, but at the same time, it should be sufficiently flexible to allow of alteration when unforeseen circumstances arise.

A BETTER METHOD OF STRINGING

A new method of stringing is suggested below. It embodies some of the improvements mentioned in the last section and it is estimated that it would require less labour than the methods observed on the holdings visited. In setting out this method the equipment and labour available is assumed to be as follows:-

Glasshouse 100 ft. long x 16 ft. wide.
Central wire, 7 ft. from ground and other wires graded in height.
432 plants in 3 rows in each border - 72 plants per row.
6 balls of 4 ply twine.
1 bag on a shoulder sling for carrying balls of twine.
2 large sharp knives.
2 workers "A" and "B".

Each worker takes 3 balls of twine and a knife into the glasshouse. (The balls of twine could be carried most easily in a bag of some kind which should be slung over the shoulder on a string, and in which the balls would lie in a row). Worker A takes them to one side of the house near the entrance. He then takes the 3 balls of string to the back row, pulls out 3 skeins, measures the height from the wire to the ground and, making allowance for the length required for knots, he cuts the 3 skeins of twine. This gives 36 strings, enough to string half of the back row. He tucks the cut strings into his belt or into a loop made for the purpose fastened at his waist.

Worker A then crosses to the opposite border taking the balls of twine and knife with him, and measures out 36 strings for the back row on that side. He tucks these into his belt at a different place from the first bunch or in a different loop. He puts the knife and balls of string down on the ground.

Worker A then proceeds down the back row of plants taking a string from the last-cut bundle on his belt, tying it to the plant and then to the wire. He moves on to the next plant and so on to plant number 36 in the row. He then crosses over to the opposite border and, taking string from the first-cut bundle he strings the plants in the back row working back to the door.

The worker walks over to where he left the twine and knife and repeats the procedure for the middle rows and then the centre rows, which, because of their reduced height can now be strung without the use of steps or scaffolding. When this has been done he is ready to go to the next house.

Meanwhile, worker B has gone to the far end of the house, and from there, he follows the same procedure as worker A, stringing the plants from the far end to the midway point and back along the opposite border.

It must be pointed out that this is a basic method, which can be modified to suit different conditions on different holdings. For instance, if one worker were slower than the other, the faster one might string, say, 40 plants per row and the slower one only 32, the changeover point being altered accordingly.

In a 200 feet house it might be possible to string the house exactly as described, but if it were too difficult to carry enough strings to do this, then the house could be strung in four sections, instead of two. Where four men are available, for 100 ft houses, it would probably be best to have two men working in each of two houses, whereas in 200 ft.houses each could take a quarter section of one house.

It is not possible to make an accurate estimate of the time that should be taken to string the house by the suggested method because new movements would be used which have not been observed. Nevertheless, by making assumptions as to the time required for the new movements, a very rough estimate of the total time needed for stringing a house may be obtained. With two workers in 100 ft. house the estimated time would be about 50 minutes or/ This presupposes that the organisation is good and that each worker understands exactly what he or she has to do. The approximate saving in twine due to the lowering of the wires would be about 100 yards costing 1/1d per house.

/100man-minutes.

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