Tomatoes - Grades & standards

THE WEST OF SCOTLAND AGRICULTURAL COLLEGE

HORTICULTURAL LABOUR STUDIES No. 3

TOMATO GRADING

A Study of Equipment and Methods

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Research Bulletin No. 39
1967

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SUMMARY

The bulletin describes the results of an investigation into the grading of tomatoes on five nurseries, each using a different system. The output of each is shown, together with the time taken for the various operations and the percentage of grades at each nursery. From the figures, a true comparison of the systems has been built up, on the assumption that the conditions are the same for each, and it is shown that the output of labour, using a machine, efficiently operated, is about twice that of hand grading. Some of the factors which affect the speed and effectiveness of grading are discussed and a comparison is made between baskets and boxes for despatching fruit. Suggestions are put forward for the most effective organisation of the work and possible outputs by the different systems are quoted.

INTRODUCTION

The most important horticultural crop in the West of Scotland is the tomato and since it is entirely a glasshouse crop, it is subject to high costs and has high labour requirements. Growers to-day are faced with the need to modernise their methods to meet an ever increasing competition, so that capital expenditure for labour-saving equipment has to be seriously considered. This is particularly true of tomato grading, for new statutory regulations are shortly to be introduced, which set out grades likely to be stricter than those that they will supersede. Growers may therefore find it necessary to re-appraise their grading methods to ensure the quality of produce that is needed to obtain the maximum income.

A study was made of tomato grading during the summer of 1966, to investigate some of the methods and equipment in use in the West of Scotland, with a view to assisting growers to decide the most suitable system for their own requirements. Five nurseries in Lanarkshire were visited, and the work of grading was observed at each. In each nursery, a different system was used for grading and these were as follows:-

1. Hand Grading,
2. Hand Grading on moveable trays,
3. Machine Grading with home-made helical type grader,
4. Machine Grading with diverging belt grader,
5. Machine Grading with rotary grader.

DESCRIPTION OF SYSTEMS

Grading tomatoes consists essentially of two different parts, quality grading, in which substandards - i.e. roughs, greens, and bad tomatoes - are removed, and grading for size. In the hand systems all the tomatoes have to be handled by an operator i.e. they are separated into the grades individually. In the machine systems, only the sub-standard tomatoes are handled individually, as they are picked off the grading belt or tray; and the different machines provide different facilities for doing this. In the machines, size grading is done mechanically and provision is made for the different sizes to pass into individual baskets or boxes. In the descriptions which follow, it is convenient to distinguish between grading proper and weighing and packing, which form an essential part of the job.

1. Hand Grading

The nursery on which this system was observed was typical of a small scale enterprise and all the work was done by the grower himself. Grading, weighing and packing were carried out on a table in a reasonably well lit packing shed, which was of ample size for the requirements. Tomatoes for market were packed in 12 lb. cardboard boxes which were lined with two sheets of blue paper. The boxes were made up in the evening previous to the grading day. The work was carried out at a steady pace and little or no time was wasted.

2. Hand Grading on Moveable Trays

The equipment used in this system consists of three trays each with round holes in it set one above the other in a wooden framework. The size of the holes is such that Grade A tomatoes only are retained in the top tray, Grade B in the second and Grade C in the lowest tray. The A's are quality graded and removed from the top tray which is slid aside revealing the second tray. The B's are then graded and the procedure repeated for the C's.

The work was carried out by three persons - the grower with one male and one female worker. The two workers operated the grading trays while the grower removed graded baskets from the shelf of the grader, weighed and packed them, and carried them to a corner of the shed to await lidding. He also lined baskets with two sheets of blue paper. Grading was done in the morning and, on the day of our observation, it was finished by noon, and in the afternoon the grower and the female worker lidded the baskets. To do this, the baskets were taken from the corner of the shed back to the packing bench and returned to the corner of the shed again after lidding. The shed was small and cramped and the double journey was necessary because there was not enough room for storing baskets near the packing bench.

3. Helical type Grader

This home made machine consists of a frame on which is set a tray about 5 ft. long and 2 ft. wide, where quality grading is carried out. The tray slopes and tapers, leading into the end of two rollers about 5 ft. long and 4 inches in diameter. Half-inch diameter rope is fixed in a spiral fashion round the rollers, which rotate in opposite directions so as to pass the tomatoes outwards. A grading bar is fixed at the side of each roller, at an angle, so as to form a gradually increasing gap. Fruit passes through the gap into four sloping compartments - small fruit into that nearest the grading tray and larger fruit into successive trays as the width of the gap increases. Baskets are set at the mouths of the compartments to catch the fruit.

Two persons were engaged in grading, the grower, who filled the machine and carried out the quality grading, and a woman, who lined empty baskets with 2 sheets of paper, removed full baskets from the grader, and weighed and packed them ready for lidding. Lidding was carried out as a separate operation later in the day. The grading shed was rather small and the space was barely adequate for convenient working. The two rollers in the machine allowed two grading lines to be operated; one was used for firm or under-ripe tomatoes and the other for ripe ones.

4. Diverging Belt Grader

This consists of a wooden framework with a series of pulleys at both ends round each of which passes an endless rubber belt. The pulleys are placed fairly close together at one end and are spaced wider at the other. As tomatoes fall on to the belts, they are carried along until the gap between the belts is such that the tomatoes fall through. They pass into one of the compartments, according to their size, and the outlets of these open to allow the fruit to pass into a box or basket.

Above the belts is fixed a tray-hopper into which the ungraded tomatoes are emptied. This is set at a fairly steep angle so that the tomatoes run down on to the belts, small fruit falling into a box below. Quality grading is carried out on the tray hopper.

At the nursery where this system was observed, the packing shed was large and roomy so that there was plenty of space available. Three persons were engaged in grading. The grower himself carried out the quality grading at the end of the tray and assisted in filling the grader. A woman worker prepared baskets, with three sheets of paper, on a bench in the far corner of the grading shed. She carried the baskets a distance of about 25 ft. to a heap beside the grader. This worker also emptied baskets of tomatoes into the grader, filled baskets with graded tomatoes at the sizing compartments and took them to a floor stack beside the weighing machine. There, a second woman worker weighed the baskets, packed and lidded them and set them aside to the appropriate stack.

Some time was spent filling baskets at the grader, because the flaps at the sizing compartments were normally kept closed and had to be held open by hand while a basket was being filled.

5. Rotary Grader

This is composed primarily of a fairly flat cone supported on a stand and rotating in a horizontal plane. It is fed by a 5 ft. long belt on which quality grading is carried out, and this in turn is fed from a tray-hopper into which the baskets of ungraded tomatoes are poured. On the framework near the circumference of the cone are fitted six adjustable sizing bars arranged so that the gaps between them and the cone increase in size in the direction of rotation. When the cone rotates, tomatoes move to the circumference and pass into one of the grade compartments. From there, they go through the outlet flap into a box or basket.

At the nursery where this system was in operation, the grader had been installed only a few weeks previously and since adequate working instructions had not accompanied it, the staff were not operating the machine in the most effective manner. The packing shed was too small and there was not sufficient room to move round the grader. Thus, under more favourable conditions the output could have been greatly increased.

Three persons were engaged in grading - all women members of the grower's family. The manpower requirements of the machine were such that all three workers were required to operate it. A batch of baskets was graded and then the machine was stopped while the workers weighed and packed baskets and boxes. 12 lb. cardboard boxes were used for tomatoes being sent to market, but fruit for local sale was packed in 12 lb. baskets.

When operating the machine, one worker was fully engaged on grading at the belt. She was assisted by another worker who also filled the hopper with tomatoes and occasionally helped in taking off graded boxes. The third worker was employed filling boxes or baskets with graded tomatoes. Again the flaps of the sizing compartments were kept closed and the baskets and boxes were filled by hand. While the machine was idle, in addition to weighing and packing, workers made up boxes, which were not papered, and lined baskets with three sheets of paper.

BASIC INFORMATION

Some of the data obtained from the observations is given in Table I. This shows the grades, output, and details of times taken at each nursery on the day of the observations.

TABLE I

Basic Information

1. System	Hand	Hand & Tray	Machine Helical	Machine Diverging belt	Machine Rotary
2. No. of workers	1	3	2	3	3
3. Output per hour of team 12 lb. baskets or boxes	31	68	48	95	35
4. Time taken - man minutes per basket - all work	1.9	2.6	2.2	1.9	5.1
5. Ditto - grading only	0.9	)	)	)	2.82
6. Ditto - Preparing baskets and boxes	0.5	) 1.6	) 1.0	) 1.3	1.27
7. Ditto - Weighing & Packing	) 0.5	0.7	0.9	) 0.6	) 0.7
8. Ditto - Lidding	)	0.3	0.3	)	)
9. Ditto - Other Work	-	-	-	-	0.4
10. Estimated potential output of machine - baskets per hour	-	-	68	118	360
11. Percentage of each grade					
A	88.5	51.5	81	74	58
B	9.5	32.5	10	10.5	11.5
C	-	8	-	5	10.5
Large A	-	-	-	3	2.5
Substandards	2	8	9	7.5	17.5
12. Area of Glass - ft.	500	3000	2430	6380	2250
13. Approx. No. of baskets produced per day (or boxes) at peak period	100	300	300	750	450

Line 3 shows the number of boxes or baskets produced per hour during the period of the observations. This amount was produced by the number of workers shown in line 2. In order to obtain a more realistic idea of the actual output, the time in man-minutes taken to produce one box or basket is shown in line 4. A breakdown of these figures into the various operations is given in lines 5 to 9. Where two operations are carried out concurrently, they are bracketed and a single time is quoted for both. Line 10 shows the estimated potential output of the machine if it were to operate continuously.

The percentage of each grade, shown in line 11, is the average for the period during which the work was observed. On some nurseries a number of different varieties were graded on the same day and it was therefore not possible to relate the percentage of each grade to the variety. Lines 12 and 13 give an indication of the size of the enterprise and the extent to which production is level or comes to a peak. The production per day at the peak period is important because it forms the basis on which the type of grading equipment used and the size of the packing shed must be decided.

COMPARISON OF SYSTEMS

The figures in lines 3 and 4 of Table 1 relate to the production as was observed but they are not strictly comparable, because of the different circumstances under which each system was operating. Workers on the different nurseries were working at different paces, the size and layout of the packing sheds differed, and the percentage of each grade of tomato varied from one nursery to another. Again, on some nurseries it seemed that improvements in the method of working were possible. In order, therefore, to make valid comparisons between the different systems, as distinct from the different nurseries, it is necessary to calculate the times which would be taken for the work under a set of circumstances which would be common to all systems. Fortunately a method for doing this is available.

When the observations were made on the grading process at each holding, the times taken for the various parts of the job were recorded and an assessment was made of the rate of working of the operators so that it has been possible to reconstruct the times that would be taken in given circumstances, under the different systems. In estimating these times, it has been assumed that all the work has been carried out as effectively as possible and that unnecessary work has been eliminated. It has also been assumed that each packing shed was adequate in size for the system. The percentage of each grade of tomato for all systems is taken as the average found on the nurseries and is as follows:-

Grade A	70%
" B	15"
" C	5"
Substandards	10"
	100%

The number of baskets of fruit picked to make up 100 12 lb. baskets of all grades and substandards varied, on the different nurseries, from 80 to 132, but for these calculations the average figure of 107 has been taken.

In comparing the different systems it is clear that only the grading operations themselves are relevant. The preparation of baskets and boxes, weighing and packing are common to all systems, and can be carried out quite independently of grading proper. The strict comparison of systems therefore has been confined to the grading operation only, whether by hand or machine, and does not take into account the time taken for packing, weighing, or preparing baskets or boxes. This aspect will be considered later.

Table II shows the estimated time that would be taken to produce 100 baskets of graded tomatoes or carry out the equivalent operation of hand grading, under these conditions. This figure is known as the work content of the job and as it is shown in man minutes, the number of workers required is not taken into consideration

TABLE II

Work Content - Grading only

System	Work Content minutes per 100 baskets
Hand Grading	103
Hand Grading on Trays	156
Machine - Helical Type	107
" Diverging Belt	63
" Rotary	59

While the figures above speak for themselves some comments on the systems may be useful.

Hand Grading

Hand grading by one individual on a bench gave more effective use of labour than hand grading on trays. In the latter system, the actual grading and picking tomatoes off the tray took longer than picking off a bench. The advantage of trays is that the tomatoes are sized automatically, while a worker grading at a bench has to size by eye. Consequently the trays may have some advantage where unskilled labour is being used.

Helical Grader

This machine would take about the same number of man-minutes as hand grading, but two workers would be required to operate it. Quality grading was easy because the grading tray was fairly large and the slope

was gentle so that the fruit did not pass down it too rapidly. One advantage of this machine over the others is that it can divide the fruit into two separate streams for sizing so that two different qualities can be sized at a time. There are other graders of this type on the market which differ in several respects from the one observed.

Diverging Belt Grader

For a moderate quantity of good quality tomatoes this machine worked effectively, but for larger quantities or poorer qualities it seems that its output might be limited by the rate at which substandards could be picked out. There was not room for an additional person grading at the end and access to the tray-hopper from the side was not easy. In addition, the slope of the tray was rather steep so that tomatoes passed down it rather fast.

Since the tray sits on top of the grader, this machine has the advantage of compactness. There are, however, other makes on the market which are better suited for quality grading. In some, the tray is in line at the end of the machine and grading takes place at the side, while in others, the tray is replaced by a grading belt.

The flaps at the outlet of the grade compartments are designed to remain open, so that tomatoes fall into the box or basket without assistance from a worker. The flaps need only be closed when baskets are being changed.

Rotary Grader

The rotary grader is available without a grading belt, but a belt is really essential for effective grading of more than a small quantity. With a grading belt, the machine is capable of high output - possibly up to 350 baskets an hour - provided the necessary workers are available to operate it. In this, as in the last mentioned grader, the flaps of the grade compartments should be left open, so that the tomatoes run directly into the baskets. Excessive labour is used when the baskets are filled by hand. It is important, too, that the machine should be level so that tomatoes do not slide off the course they are intended to follow, and the adjustment of the sizing bars must be accurate for the grades required.

Weighing and Packing

Where sufficient staff were available these operations were carried on at the same time as grading and, when well organised, this could provide a smooth flow of work with a minimum of double handling and wasted time. If the number of workers was insufficient to do all this work at one time, it was easy to separate the weighing and packing from the grading. On two of the holdings grading and weighing were carried out simultaneously up to packing the baskets, but lidding was done separately, later in the day.

The times taken for weighing and packing on the different holdings varied according to the way the operations were carried out and the convenience of the packing shed. In a small shed, where space was cramped, a certain amount of double handling became necessary, but sometimes the small shed was an advantage, because travel distances were short. From the figures obtained from the nurseries, the average work content for preparation, weighing and packing of baskets and boxes was estimated, based on the assumption that a good method was used.

TABLE III

Preparation and Packing

	Man min. per 100	
	Baskets	Boxes
Lining	20	-
Making up	-	55
Weighing	21	17
Packing and Lidding	39	36
	80	108

It will be noted that more time is required for boxes than for baskets. A full comparison is given later.

FACTORS AFFECTING GRADING

From the information obtained, certain principles emerge which may help to ensure effective grading and a high throughput. There are also a number of factors which affect the efficiency of grading and these are now discussed.

Grading Machine

Where a grading machine is used, it is important that it should be suitable for the output required, and it should be capable of being operated by the number of workers likely to be available. Machines should be set up, operated and maintained in the manner recommended by the manufacturers, but it must be admitted that too few manufacturers provide their customers with adequate operating and maintenance instructions.

Packing Shed

For ease of working, the packing shed should be large enough to give ample room round the machine. It should enable weighing and packing to be done without interference, and have sufficient storage

space for packed baskets or boxes. Where space in the packing shed is limited, it may be convenient to store empties in another shed and bring in the day's supply before starting to grade. If the packing shed is large, care should be taken to keep the tomato grading and packing in a compact area round the grader so that energies are not dissipated in long journeys round the shed.

Quality Grading

This is the key operation of the whole job. It should be completed before the tomatoes move on to the sizing mechanism, so that it is unnecessary for workers to remove substandard tomatoes from the grade compartments. The number of persons required for quality grading depends on the speed at which tomatoes are coming through the machine, and the proportion of substandards which have to be picked out. Most machines have only one operating speed, so that the rate at which tomatoes come through the machine is governed by the rate of filling. In order to obtain the maximum throughput, the rate of filling should therefore be as fast as the machine can take without blockage. For a given speed of the machine, more workers will be needed for grading, when the proportion of substandards increases. Grading can be done most effectively when tomatoes are in a single layer on a belt. There should be sufficient room round the belt for as many operators as are likely to be needed to grade the poorest quality crop.

Taking off Baskets

Provided the baskets are filled by the correct method, as outlined earlier, taking off is a simple matter. The supply of lined baskets should be close to the take off point on the grader. This is especially important if the worker has other work to do such as lining baskets. If the graded fruit has to be carried from the grader to the weighing machine, the transport distance should be as short as possible. In a large packing shed, however, with a high output per day, it may be an advantage to have the weighing point some distance from the grader to be near to the storage points. In such a case, a roller conveyor between the taking off point on the grader and the weighing machine may be worth while.

Weighing Baskets

Baskets of make-weight tomatoes of all grades should be kept close to the scale. The more accurately the weight of baskets (or boxes) is judged by the person taking them off the grader, the shorter will be the time needed to make them up to the correct weight on the scale.

Packing Baskets

This may be done by the person who weighs but, where the output is high enough, it may be carried out as a separate operation. There is some advantage if packing directly follows weighing and lidding follows packing, because, if these operations are done separately and baskets have to be set aside between each, double (or treble) handling may be involved in bringing them back to the packing table for the next operation.

At some nurseries, tickets bearing the name and address of the grower are inserted in the basket before lidding. Since the lids also bear the name and address of the grower it seems superfluous to have tickets as well.

Lining Baskets

There are two methods of organising the lining of baskets. A supply may be made up before grading starts, or the work may be done during grading. There is some advantage in the latter method because after the grader is filled, the empty baskets can be passed direct to the lining table, singly if the distance is close, or a dozen or so nested if the distance is more than a few yards. The lining table should be located near the supply of empty baskets and should be placed so that the lined baskets can be set down near the grader. On some nurseries three pieces of lining paper are used on others only two. If two are sufficient is it necessary or advantageous to use a third piece?

Making up boxes

Boxes are made up from the prepared flat cardboard usually before grading starts. Of the two growers who used cardboard boxes one lined them with blue paper and the other used them unlined.

Baskets v. Boxes

It has been shown that more work is required when tomatoes are packed in boxes than when they are put in baskets. Nevertheless to make a valid comparison between the two, the cost of containers and other materials must be taken into account. The following figures show, for each method, the total costs of using 100 12 lb. containers.

TABLE IV

Costs for 12 lb. Baskets and Boxes

Baskets	Costs per 100	
100 baskets @ 150/- per 144		£5: 4: 2
200 sheets blue lining paper @ 11/10d per ream		1: 8
100 lids @ 16/9d per 144		11: 8
200 rubber bands @ 10/6d per lb.		2: 3
Labour. 1 hr. 20 min. @ 5/- per hour		6: 8
		£6: 6: 5

Boxes	Costs per 100	
100 boxes @ 108/- per 144		£3:15: -
100 lids @ 17/- per 144		11:10
Labour. 1 hr. 48 min. @ 5/- per hour		9: -
		£4:15:10

It is assumed that two papers are used for baskets and that boxes do not require papering.

A further advantage of boxes may be that the empties in the form of flat cardboard take up less storage space than empty baskets. On a medium sized nursery producing, say, 8000 12 lb. boxes or baskets a year, assuming that all the years supply of empties are stored, that baskets are stored up to 6 ft. high and the flat cardboard of boxes to only 4 ft. high, the floor space required for 8000 containers of each would be as follows:-

Baskets	165 sq. ft.
Boxes	120 " "

There are other considerations which have to be taken into account. There may be differing opinions as to the suitability of boxes for carrying tomatoes. Then again full boxes are not so convenient to handle, as they have to be carried in front of the body using two hands, while baskets can be more easily carried one or two in either hand.

ORGANISATION OF GRADING

Now that the details of the various operations have been discussed it is possible to consider the organisation of the job - how many workers are required under different systems and different circumstances, and the output that might be expected. Whatever system of grading may be adopted it must be suited to the quality of tomatoes normally produced and it must be capable of dealing with the output at the peak period of production.

The following paragraphs suggest ways in which the grader could be manned and the approximate outputs which might be expected under good conditions, using good methods, where work proceeds smoothly. In practice, it may not be possible to achieve these outputs because conditions are not always good, e.g. the packing shed may be small and cramped which may result in a poor layout. By careful planning beforehand and proper maintenance of machinery and equipment much may be done to ensure that good methods are used and that unforeseen difficulties are cut to a minimum. In the examples which follow, it is assumed that the proportion of substandards is 10 per cent, and that baskets are used for the despatch of fruit.

Hand Grading

The estimated output for a worker for this system under these conditions is about 30 baskets per hour. The number might be reduced if the proportion of C's and small fruit were high, but, in hand grading, where all fruit is handled, variation in the proportion of substandards should not affect the output to any great extent.

Where two persons are grading, each may carry out all the operations by himself, or one may grade while the other weighs and packs Where there is plenty of room, so that workers do not get in each others way, the first is probably the most effective method, as each can work at his or her own pace and is not kept waiting by the other.

Hand grading is a suitable system where not more than about 100 baskets have to be graded in a day. Above that output it would probably be worth while considering the use of a machine. Successful hand grading depends on the ability of the worker to estimate correctly the size of fruit, so that where unskilled labour is used there is a further reason to favour a machine.

Hand Grading on Trays

The estimated output for this method is low and is about 24 baskets per worker per hour.

Machine Grading

Four factors govern the output of machine grading.

(1) The speed at which the machine operates and passes fruit through it.

(2) The provision at the machine for placing additional workers at essential work points to enable a large quantity of fruit to be processed.

(3) The availability of additional workers to deal with high throughput.

(4) The economic desirability of employing such additional workers.

Some of the machines used for grading tomatoes are primarily sizing machines and they do not have adequate provision for quality grading. The tray hopper into which the ungraded tomatoes are poured may not hold the fruit long enough for all the substandards to be removed and access to it may be difficult for additional workers. Probably the best equipment for quality grading is the moving belt which is long enough to have room for extra workers to pick out substandards when quality is low.

It is possible that additional workers may enable the manning of a machine to be reorganised to give a higher throughput, but care must be taken to ensure that this is economically justified. Output per hour may increase but output per man may decrease because the team is not well balanced, so that some of the workers have some idle time. This implies making a decision as to whether it is better to concentrate on speed of operation or economy of labour - or perhaps a compromise between the two.

Diverging Belt Grader

Assuming that it is operated in the most effective manner, the possible output of the machine observed would be round about 107 baskets of graded fruit per hour. To achieve this, a suitable organisation for manning would be as follows:-

1 worker quality grading,
1 " filling, taking off and lining baskets,
1 " weighing and packing.

The packer probably would not quite be able to keep up with the output and would have to be assisted by the other two at the end of the day. It must be pointed out, however, that the output of the larger machines with a grading belt would approximate more to that of the rotary grader described below.

Rotary Grader

When adequately manned it is estimated that a high output could be obtained from this grader. The manufacturers claim a throughput of two tons per hour. To achieve a figure of this sort some 9 or 10 workers would be needed, but it would be possible to operate the machine with as few as two workers. When a small number of workers only is available, the work can be divided into two parts - grading proper and weighing and packing, the workers completing the grading of a batch and then proceeding to weigh and pack it.

The organisation and estimated output for teams of different sizes are shown below.

Team: Two workers — Same team weighs and packs after batch has been graded.

Grading only: - 1 worker filling grader and taking off baskets,
1 worker grading,

Packing: - 1 worker weighing and assisting packing,
1 worker packing.

Packing takes nearly twice as long as weighing, so, after all the weighing has been completed, the worker would change over to packing. Both workers would line baskets, enough for a days grading, either before grading is started or after packing is finished ready for the next day. The estimated possible output by this method would be about 80 12 lb. baskets per hour.

Team: Three workers — As in (1) Same team weighs and packs after grading.

Grading only: - 1 worker filling grader and assisting grading on the belt,
1 worker grading,
1 worker taking off baskets and part time lining baskets.

Packing: - 1 worker weighing,
2 workers packing.

The worker taking off baskets would not be able to complete all the lining and would have to be assisted by the other two for 5 minutes or so during the day. The estimated possible output of such a team would be about 125 baskets per hour.

Team: Four workers — Weighing and packing would be done by the same team after grading each batch.

Grading only: - 1 worker filling and some grading,
2 workers grading,
1 worker taking off baskets.

Packing: - 1 worker weighing,
2 workers packing,
1 worker lining baskets.

The possible output of such a team would be about 166 baskets per hour.

Team: Nine workers. This number of workers enables weighing and packing to be carried on at the same time as grading. Manning of the work would be as follows.

1 worker	filling,
2 workers	grading,
1 worker	taking off baskets,
1 worker	weighing,
2 workers	packing,
1 worker	lining baskets,
+ 1 worker	assisting weighing packing and lining as required.
9	

If the proportion of substandards was high an additional worker might be needed at the grading belt. With an organisation of this sort it is estimated that the output could reach 350 12 lb. baskets per hour.

Grading for the New Statutory Grades

The figures shown above are based on the grades in use in 1966, and on an average proportion of substandards of 10%. With the introduction of the new grades in 1967, grading will be stricter and it may be that, in some nurseries, the average proportion of substandards will rise to nearly 20%. Where tomatoes are hand graded this should not make much appreciable difference to the rate of output quoted above but with machine grading more workers may be needed at the quality grading point to maintain the same output. Alternatively the output may be slightly reduced if a fixed number of workers, only, is available. It is assumed that most growers will be producing Class I tomatoes, sizes D, E and F. Class 2 and Class 3 would be removed along with unsaleable fruit at the point of grading.

This study has been confined to the grading of tomatoes on individual nurseries and the question of centralised grading by a number of producers has not been investigated. The possible advantages of this, however, should not be overlooked, as it might well lead to lower costs and greater uniformity of product. Now that a compulsory grading system is being introduced, strict compliance with the standards is required. This could more easily be achieved, and a more evenly graded product obtained, by a central organisation, than by a number of individual growers. Full use could be made of one, or more, of the larger graders and, if a reasonably regular output were arranged, a permanent staff of workers could be employed over the season. With an efficient organisation and good operating methods, the cost of grading might well be less than that on individual nurseries. An organisation of this sort could be of particular benefit to growers with a small or medium sized output.

ACKNOWLEDGEMENTS

The authors wish to express their gratitude to the growers who co-operated in this investigation. They are also indebted to the horticultural advisers in Lanarkshire, and in particular to Mr. R.D. Pollock, for assistance and technical advice.