advance, lesser deep percolation losses, better soil moisture storage and distribution compared to continuous flow.

Effect of surge flow on soil moisture storage and distribution

The irrigation efficiencies from the variations in soil moisture before and after irrigation for an effective root zone of 60 cm and keeping 120 cm as the depth for moisture analysis summarised that for a furrow length of 200 m, the continuous flow at 1.0 ls^{-1} has resulted in more deep percolation losses (1.36 cm) out of 5 cm depth of irrigation, with an irrigation distribution efficiency at 55%. In case of surge flow at a cycle ratio of 1/2, the deep percolation losses were reckoned as 0.90, 0.78 and 0.66 cm respectively for 5, 8 and 10 number of surges. The respective distribution efficiencies were worked out as 67, 73 and 80 which are high compared to the continuous flow. At a cycle ratio of 1/3 the deep percolation losses were observed as 1.10, 0.96 and 0.86 cm and the distribution efficiencies as 66, 72 and 75 respectively for 5, 8 and 10 surges.

From the discussion, it was established that surge irrigation has an edge over the continuous flow in respect of quicker water front advance, reduced infiltration rates and higher irrigation efficiencies.

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PERFORMANCE EVALUATION OF ROLLER GRADER FOR LIME

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ABSTRACT

A divergent type roller grader was developed and tested for size grading of lime. The unit is capable of grading 400 kg h^{-1} of fruits at 8% slope. The effectiveness of the grader is found as 85%.

KEY WORDS : Roller sorter, capacity and effectiveness

Lime or Nimbu (*Citrus aurantifolia*) is a native fruit of india. It is cultivated in many tropical countries. The fruits are small, round, smooth with yellow or greenish yellow skin and vary in size.

Grading of lime is done to improve its price during marketing. The most important grade factor for lime is size. Manual grading is a time consuming and labour intensive process. Screen and other types of graders were ineffective, slow and require more power in grading lime. Malcom and Garmo (1953) carried out extensive tests on fruits and potatoes using roller tables with the facility to alter translation speed, roller rotation speed and operating positions. Roller sorters were fast, accurate and cause little damage to fruits (Henderson and Perry, 1976). In the present study a divergent roller grader was developed, its capacity and effectiveness in grading lime was also tested.

MATERIALS AND METHODS

The roller grader comprised of a wooden stand, wooden frames, mild steel slotted iron pieces, rollers, feeding tray, rope and pulley, outlets etc.

The stand and frames were connected at top and bottom to ensure rigidity. The slotted iron

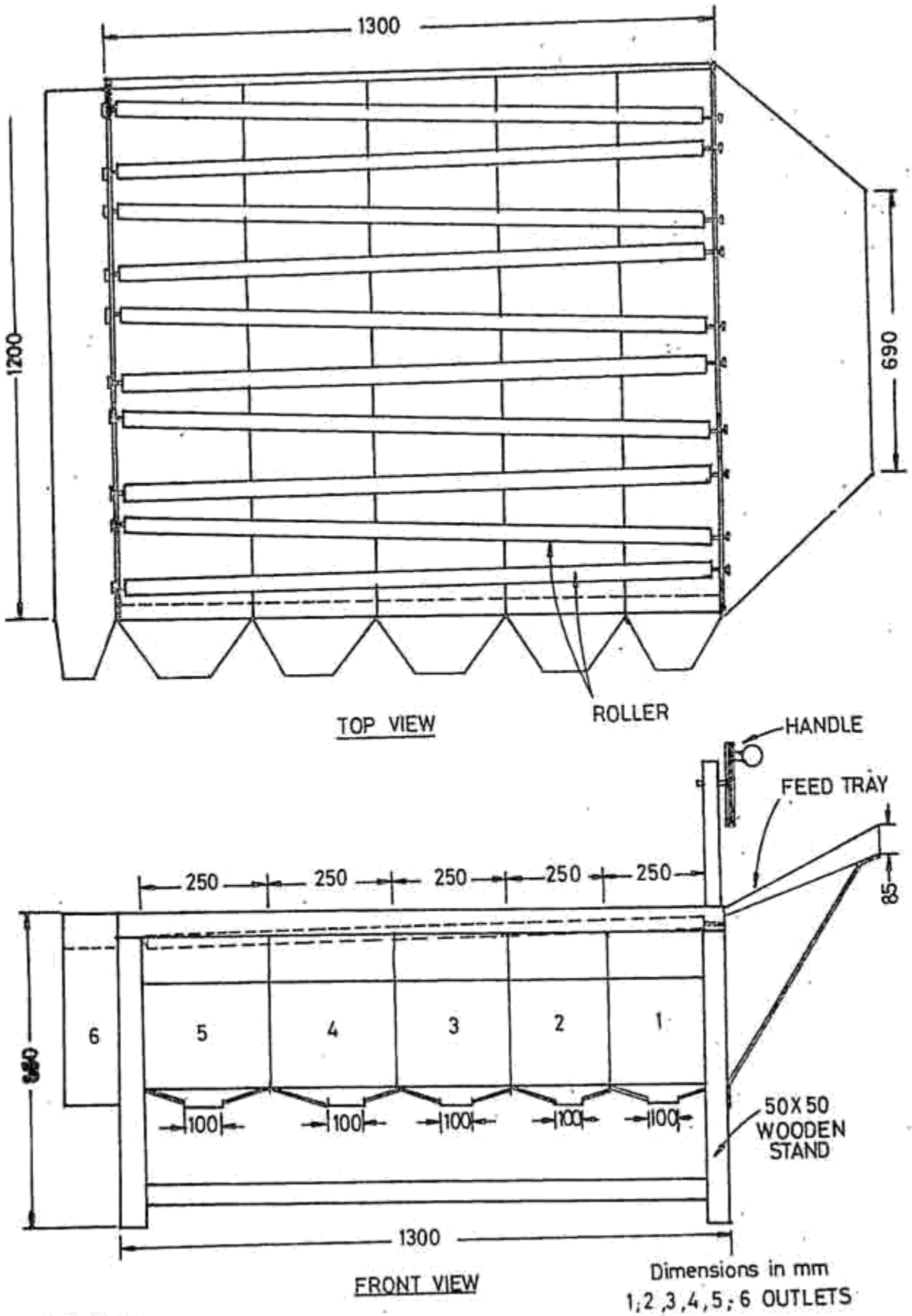

Fig. 1. Roller Grader

pieces were fixed on the stand so as to alter vertical height between iron pieces. Ten numbers of mild steel rollers of 31 mm dia and 1280 mm length were fixed between the two iron pieces by means of bolts. A clearance of 1 mm was provided between the holes on the rollers and were supported by the machined end of the bolt which provided free rotation for the rollers on the axis of the bolts. The

Table 1. Performance of lime graders.

Roller Slope (%)	Capacity of the unit (kg/h)	Effectiveness (%)
4	125	94.3
6	200	88.7
8	400	85.0
10	520	78.4
12	710	75.2

clearance between the rollers was fixed at the free end and can be varied at the delivery end. The divergence of the roller from feed end to the delivery end (30- 60 mm) formed one fruit path. There were five fruit paths. The gap between fruit path was masked by a cover which guided the fruits on its path. Below the rollers there were five compartments made of gunny bags to receive the fruits of similar size from different path ways. Oversize fruits were collected at the outlet end. The rollers were driven by rope and pulley at a speed of 40 rpm manually.

PERFORMANCE EVALUATION

The performance evaluation of the unit was carried out for different slopes of 4,6,8,10 and 12% of the rollers. The slope of the rollers was measured using a dial guage type protractor. Slope less than 4% was not tested due to poor conveyance of the fruit. The dimension of the roller and the variety of the fruit were kept constant. The feed rate was also maximised to an extent of 1500 kg/h for which the holding tray was designed.

CAPACITY

A known quantity of fruit was taken and fed into the machine. The machine was manually operated and time taken for complete sorting of the sample was noted. The capacity of the machine was calculated, as the ratio of quantity of the sample sorted and time taken.

EFFECTIVENESS

Out of six fruit outlets shown in the figure 1, the third outlet was selected in finding the effectivenss. The clearance of the roller above this outlet was measured. Fruits which had the same size as the clearance of the roller above the third outlet were separated manually from the feed mixture and weighed (X_F). Then they were remixed with feed sample and fed into the machine. The machine was operated manually until all the fruits were separated according to the size. The fruits collected in the third outlet was weighed (X_D).

The effectiveness of the unit was calculated using the following formula developed by Macabe and Smith (1976).

$$E = \frac{X_D (X_F - X_B) (X_D - X_F) (1 - X_B)}{X_F (X_D - X_B)^2 (1 - X_F)}$$

where, E - Effectiveness, %

X_F = weight fraction of desired fruit in the feed

X_D = weight fraction of desired fruit in desired outlet

X_B = weight fraction of desired fruit in other outlets

RESULTS AND DISCUSSION

From the table 1, it was observed that when the slope of the rollers increased, the effectiveness of separation decreased. This is obvious that the fruit were conveyed fast when the slope was increased. At a slope of 4%, maximum effectiveness of separation was achieved. This is similar to the results reported by Brantley *et al.*, (1975) for potatoes and cucumbers. When the slope was increased to 12%, the effectiveness of grading reduced to 75.2%. A slope of 8% was found to be optimum to get a capacity of 400 kg/h and 85% effectiveness of separation.

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