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Development of a black pepper harvester

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Abstract

Three models of pepper harvester were fabricated and evaluated on the basis of efficiency in the cutting action and easiness in operation. All the three models basically consisted of a mild steel cutting unit, aluminium conveying pipe and a collecting basket. The main concepts adopted for the fabrication were impact, shear and pulling action for the proper insertion and cutting of the spikes and collection. The test was conducted for Panniyur variety out of which, the most efficient and user friendly was the second model due to its light weight, easiness in operation and minimum loss. The main advantages accounted for this model were simultaneous cutting and collection of spikes without heavy loss.

Keywords: black pepper, harvesting, Panniyur, pepper spike

Introduction

Black pepper (*Piper nigrum* L.) has been one of the most ancient commodities of the spice trade (Binoo *et al.* 2003; Pritty *et al.* 2008). Harvesting is usually done manually. But the labourers experience intense pain especially in the nails after prolonged working hours. So harvesting of black pepper panicles has to be carried out with a simple farmer friendly tool. Several tools were studied for harvest of the fruits (Muhammad 2005). The protocols were developed for the harvest of fruits in Farm Power Machinery & Energy Department of Kelappaji College of Agricultural Engineering and Technology of Kerala Agriculture University. With this background a simple, efficient and cost effective method for harvest of pepper was developed.

Materials and methods

The conceptual development of the tool was done by studying various garden tools available in the farm machinery lab (Muhammad 2005). The study was undertaken in the workshop of Kelappaji College of Agricultural Engineering & Technology, Tavanur from 2008–09.

Model no: 1

The materials selected for the tool were mild steel plate, aluminium conveying pipe, stainless steel blade, PVC pipe and other accessories to

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support harvesting (Fig 1). A V- groove was formed on the mild steel sheet. The PVC pipe was cut elliptically with an inclination of 45º to horizontal. The mild steel sheet was shaped elliptical to fit into the cut section of the PVC pipe. Another mild steel sheet was provided as support to the elliptical plate and both were welded. Two stainless steel blades were attached to the plate in such a way that the clearance between them was equal to the mean diameter of the spike.

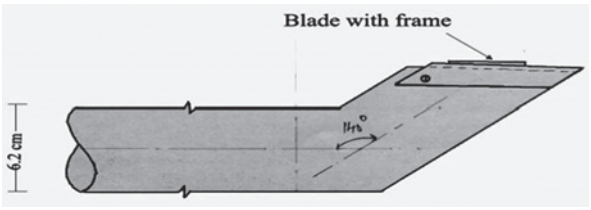

Fig. 1. Line diagram of Model no. 1

Model no: 2

In the second model (Fig 2), for the construction of the blade, 2 mm thick mild steel sheet was selected and the blade of required dimension was cut. The two blades were properly aligned to get the correct cutting action. A hinge was provided to give the tool the required pivoting action. A hollow rectangular aluminium pipe of suitable length was selected and the tool was

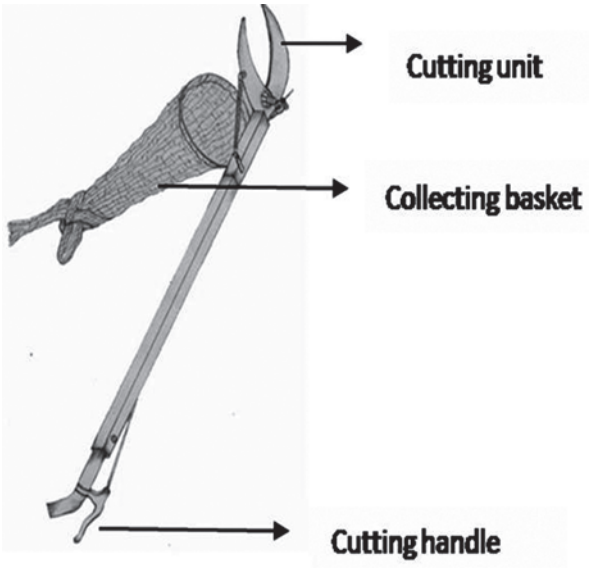

Fig. 2. Line diagram of Model no. 2

mounted on its frame. A handle brake was provided at the bottom of the pipe in order to regulate the cutting action.

For collecting the spikes a basket was provided just below the blade with required angle for proper conveyance.

Model no: 3

The materials used for this model were bent mild steel plate (2mm thick), springs and blade from leaf plate, nylon pulleys, belt rope, mild steel plate clamps, hand lever and accessories (Fig 3). The tool basically worked with a cutting action provided by the guiding plates which is operated by the handle lever, through

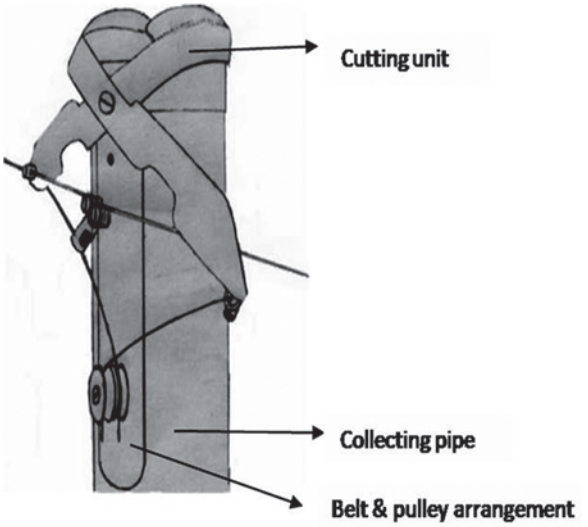

Fig. 3. Line diagram of Model no. 3

rope and pulley arrangement. The two blades were placed in such a way that there was no gap between the two blades for the correct shearing of the panicle. For the proper movement of the blades two springs were attached so that their combined actions provided the required force for the movement of the two blades. For utilizing the maximum spring tension, a nylon pulley was provided. The wrapping of the rope with the pulley provided the required angle of pull. It also helped for the easy movement of the rope.

Two clamps were provided at the bottom of the pipe, for guiding the rope to the lever as well as for getting maximum drive and other for attaching the hand lever. Clamp 1 was used

in order to provide the required tension and to prevent the sagging effect of the rope. Clamp 2, is a lever clamp and is provided for controlling the motion of the hand lever by the user. The hand lever controls the entire working of the tool. The movement of the lever stretches the spring which moves the blades closer and cuts the panicle held between them. Once the lever is free the spring moves the blades apart to its original position, the lever attains its original position with the help of a lever spring. The panicles which were cut are also simultaneously collected. This function was performed by the circular aluminium. For easy collection of the harvested panicles a collecting bag was hung around the waist of the operator.

Results and discussion

The developed models were tested and the results are discussed in terms of easiness in operation, damage to harvested panicles and berries, amount of harvesting loss etc. These models were tested with three pepper vines available in the campus.

Model no: 1

The model 1 (Plate 1) described above was tested for Panniyur variety. The panicles was positioned due to the v- groove provided on the cutting unit. The inclination in the pipe enabled the blade to firmly hold to the panicle. The sharp edges of the stainless steel blade provided the necessary shearing action and the clearance between the blades was just enough to insert the panicle in between the blades. The panicles harvested by shearing action were conveyed through the pipe to the ground. The diameter of the pipe was enough to convey the panicles without any damage and bridging action. The advantage of this tool was that once the spike was correctly inserted between the plates it could be easily harvested and conveyed simultaneously. One of the main limitations of the tool was that the insertion of the panicle into the cutting portion of the blade was difficult.

Plate 1. Cutting unit of Model no.1

Model no: 2

In the second model, the panicle was easily harvested and collected simultaneously. This was due to the efficient cutting and collecting part of the proposed tool. The percentage loss was very less compared to the previous model (Table 1). It was operator friendly with its simple working and efficient cutting action. The two plates of the blade with proper alignment and correct positioning of holes helped it for correct cutting action.

Table 1. Harvesting details of the developed models

Replication	No. of spikes collected per hour (manually)		
	Model no. 1	Model no. 2	Model no. 3
R1	720	780	725
R2	744	768	749
R3	768	804	780

The cutting mechanism (Plate 2) of the tool occurred due to the shearing action by the stainless blades by pulling the pipe vertically downwards. The harvested panicles were collected through the aluminium pipe to the collecting basket without much bridging in the pipe.

Model no: 3

This model overcame the limitations associated with the previous models. The two mild steel plates could move freely over the pin and the tension in the wire rope was enough to guide the cutting blades to the panicle. The spring

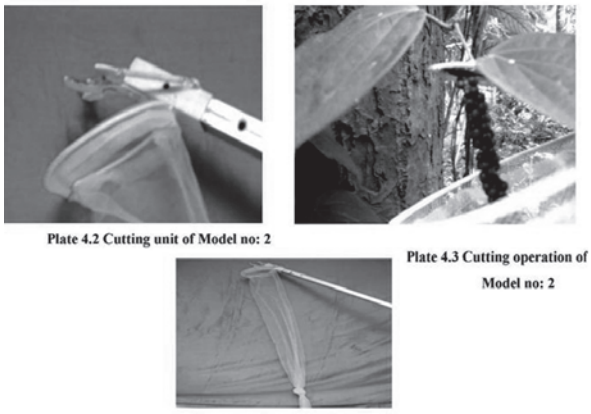

Plate 2. Model no. 2 under operation

provided along with the cutting unit could move the plates apart once the load was removed.

The cutting action (Plate 3) provided by the guiding plates which was operated by the handle lever, through rope and pulley arrangement worked efficiently with the required efficiency. The two blades of equal length and width gave the required cutting

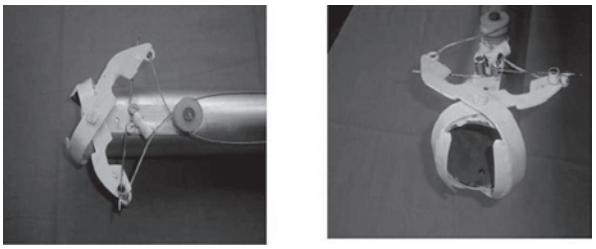

Plate 3. Cutting unit of Model no. 3

action. The two springs attached to the blade and their combined action provided the required force for the movement of the blades. The nylon pulley provided on the pin utilized the maximum spring tension, *i.e.*, pivotally joined. The wrapping of the rope with the pulley provided the required angle of pull.

Clamp 1 provided the required tension and prevented the sagging action and Clamp 2, as a lever clamp helped for controlling the motion of the hand lever by the user. The hand lever controlled the entire working of the tool. The cut panicles were simultaneously collected in the basket. This function was performed by aluminium pipe and collected at the lower end of the pipe. When the bag was sufficiently filled, the operator emptied the panicles to the required destination.

From the field tests done for each model, it was evident that the proposed models were good for Panniyur variety. Out of these models, Model no 2 was the best. Its light weight and easy handling helped in better performance and collection of the panicles with less loss. The model consisted of a simple square frame with cutting part at the top and a corresponding basket for collecting the harvested panicles.

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