Improved Machine for Cleaning Coffee Harvested with Plastic Nets[1]

Evangelina Recio de Hernández[2]

ABSTRACT

This paper describes a new machine for cleaning coffee harvested with plastic nets, as well as the coupling of this machine to the horizontal washer. The machine consists of two blowers in two tunnel chambers. The material fed by a screw conveyor is taken by a rotating shaft and ejected by the action of the blower in the upper chamber. The separated material (coffee beans, berries, dirt and small twigs) which falls through the screen to the bottom chamber is carried by a water stream into the washing reel. Further separation of the above mentioned material is accomplished by the washer, the shaker screen, and the flotation tank. This machine, together with the washing reel, is capable of processing coffee from 4.3 acres in an 8-hour run with the screw conveyor set at a speed of 30 rpm. Reduction of the speed to 20 rpm also reduces the output to that of 1.9 acres in an 8-hour run.

INTRODUCTION

The cleaning operation of coffee harvested with plastic nets is of primary importance because the nets contain large amounts of leaves and twigs and lesser amounts of seeds, stones, dirt, and other extraneous matter.

The behavior of this material depends largely on the weather. In dry weather, the leaves are loose, with no coffee beans attached, but during the rainy periods the leaves become soggy, start to rot and the coffee beans become attached to the leaves.

Cancel et al. (4) designed and patented a blade-type blower that worked almost perfectly when the material collected from the nets was completely dry, but could not operate efficiently during the rainy season. This machine did not separate objects larger than the coffee beans.

After designing this blower, Cancel (3) designed and constructed an improved machine for cleaning coffee gathered in plastic nets.

This report deals with the description of the equipment, changes made in it, its performance, and its integration to the washing machine to implement continuous operation.

MATERIALS AND METHODS

THE CLEANING MACHINE

Figures 1 and 2 show the design and working principles of the machine. It consists of a screw conveyor 1, which transports the coffee material

[1] Manuscript submitted to Editorial Board February 18, 1982.

[2] Assistant Food Technologist, Food Technology Laboratory, Agricultural Experiment Station, Mayagüez Campus, University of Puerto Rico, Río Piedras, P.R.

and feeds it into the upper chamber 2. The velocity of the screw conveyor is regulated by two triple pulleys between the transmission and the motor. Velocities of 30, 20, and 13 rpm can be obtained. The rotating shaft 3, with radially and longitudinally spaced spokes, lifts the material, exposing it constantly to the air current of the ejecting fan 4. The coffee beans and berries pass through the screen 6 into chamber 7. In the case of wet material, its continuous exposure to the air current produces a partial drying of the leaves, enabling the air current to expel them. The air pressure in chamber 7, produced by fan 5, is released through the perforations of screen 6, helping in the lifting of the leaves and twigs.

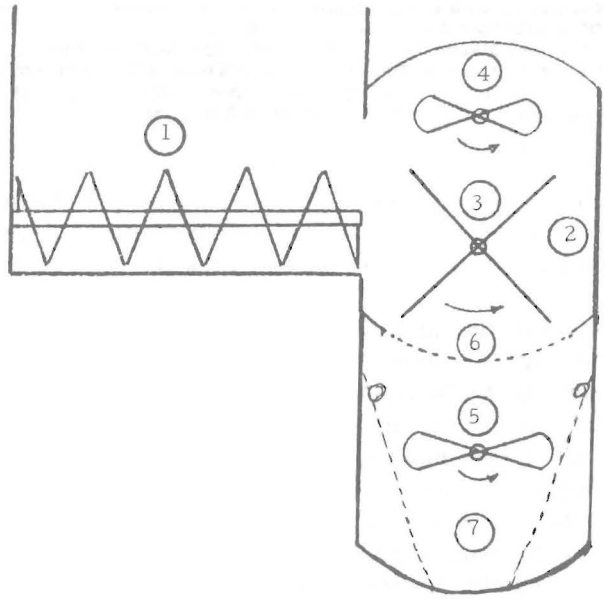

FIG. 1.—Cross sectional sketch of cleaning machine.

The large twigs, stones, and other objects are carried toward the discharging end of chamber 2 by the rotating shaft and the air current.

During the course of our work we made several modifications in the original design. The perforations of the screen 6, were changed in the last two feet of the discharging end, from ½ to ¾ in. A system of water sprinklers was installed at the top of chamber 2. These features are shown in figure 3.

The bottom chamber 7 was fitted with perforated water pipes along its sides, and the inside walls were changed from an oblong shape to a more slanted plane (fig. 4).

INTEGRATION OF THE CLEANING AND WASHING OPERATIONS

Figure 5 shows the blower or cleaning unit coupled (upper left hand) to the washing machine, for a continuous operation. The transfer of the coffee beans from the bottom chamber of the blower is accomplished by the water stream from the perforated pipes, through a rectangular 6½ × 9½ in. opening 8, in the floor of the chamber 7 toward the discharge end. This opening leads to a funnel-type hopper at the entrance of the horizontal washing reel. The washing system is the one described by Cancel et al (6).

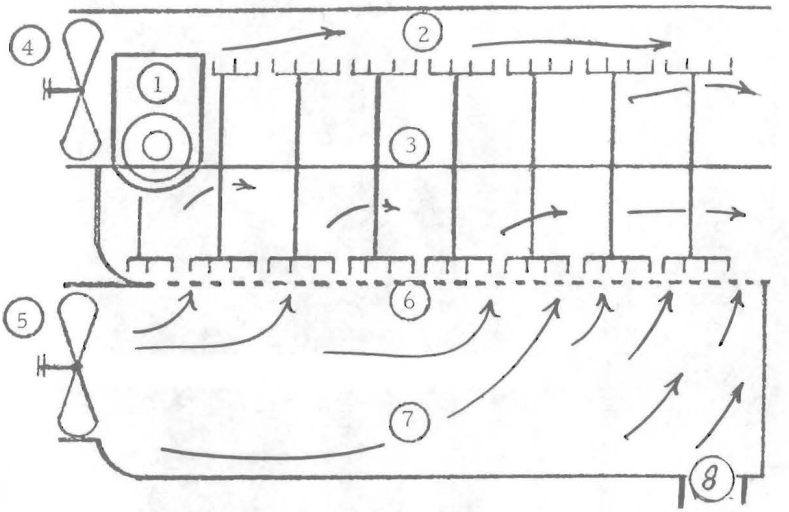

FIG. 2.—Longitudinal sketch of cleaning machine.

MATERIAL COLLECTED ON NETS

The coffee harvested with plastic nets was collected at a selected plot on a private coffee plantation. This plot was divided into two smaller ones, and coffee was collected from each at least twice at different intervals after the nets were laid down.

The material was collected according to the method described by Vicente-Chandler et al. (7) except that for part of these studies the nets were harvested at a 2-week interval (weather permitting) up to a maximum of 10 weeks.

All the material collected from the nets was brought to the Laboratory, where it was processed the following day, in the machine already described.

RESULTS AND DISCUSSION

The work consisted not only in evaluating the performance of the air blower but also of the whole system as it was assembled, and in determining the quality of the processed coffee beans. This work was carried out during two consecutive coffee harvests: 1978–79 and 1979–80, and part of the 1981–82 harvest.

The cup quality of the coffee samples collected every 2 weeks was determined by organoleptic tests and by comparison with commercial brands. These results have already been published *(1, 2)*.

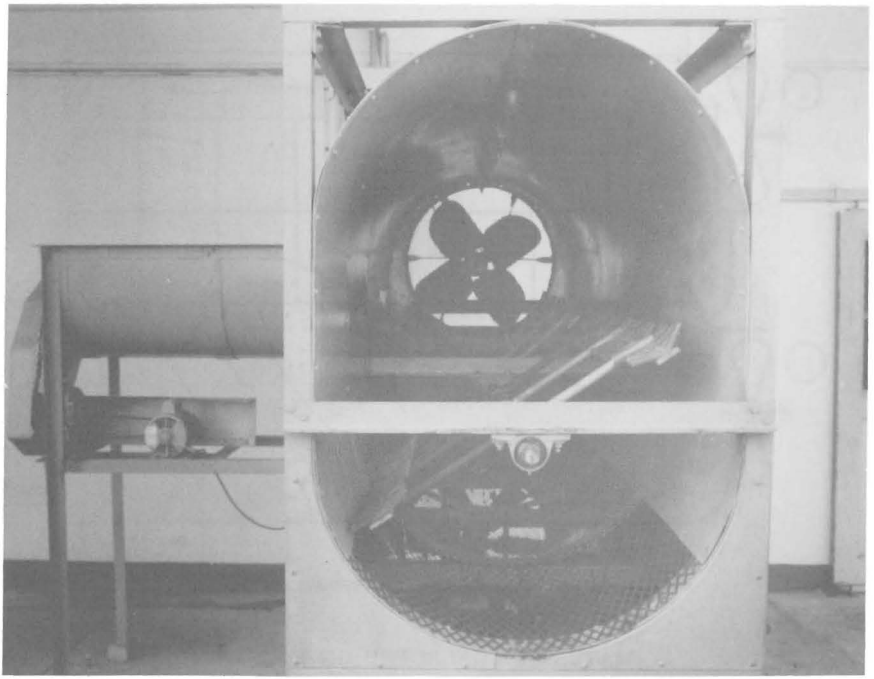

FIG. 3.—Upper chamber of cleaning machine showing changed screen perforations and addition of water sprinklers, as well as other features of the chamber.

Changing the screen's perforations at the discharge end enabled the whole berries to pass through and not to be carried out with the leaves and large twigs. The ripe berries were *pulped* in the washing reel while the ones remaining whole were separated at the shaker screen of the washer.

The water sprinklers at the top of chamber 2 are to be used in the event that extremely soggy material processed causes the clogging of screen 6.

The changes made in the inside walls of the bottom chamber, together

with the perforated water pipes made both coffee beans and the water stream fall near the center of the chamber to better accomplish the transfer of the coffee beans to the washing machine.

Table 1 shows the results from several trials using the whole system as assembled and with different speeds of the screw conveyor.

With a 30 rpm speed of the screw conveyor, coffee from a total of 4.4 *cuerdas* (4.3 acres) can be cleaned in an 8-hour working day. These figures include not only the cleaning of the material collected in the nets

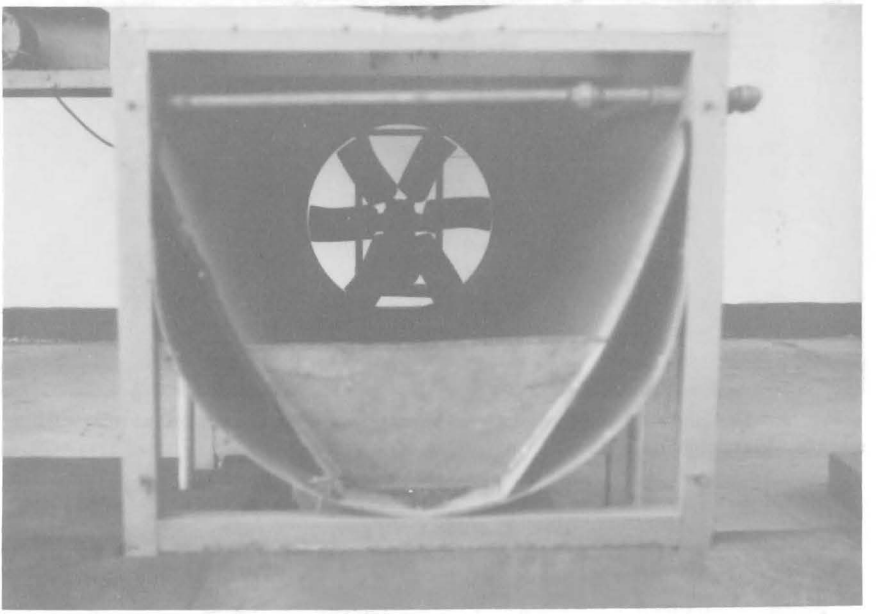

FIG. 4.—Lower chamber of cleaning machine showing perforated water pipes and change of the inside walls.

but also the washing of the separated coffee beans, all in a single operation.

The 57 inch horizontal washing machine has a capacity to handle about 1,000 pounds of coffee beans per hour according to studies made by Cancel et al (5).

Reducing the speed of the screw conveyor to 20 rpm doubles the necessary operating time. With this speed the coffee of only 2 cuerdas (1.9 acres) can be processed in an 8-hour run.

In view of the above results no trial was made with the other velocity of the screw conveyor, 13 rpm. This speed would represent an even lower performance, which is not efficient on a large coffee plantation.

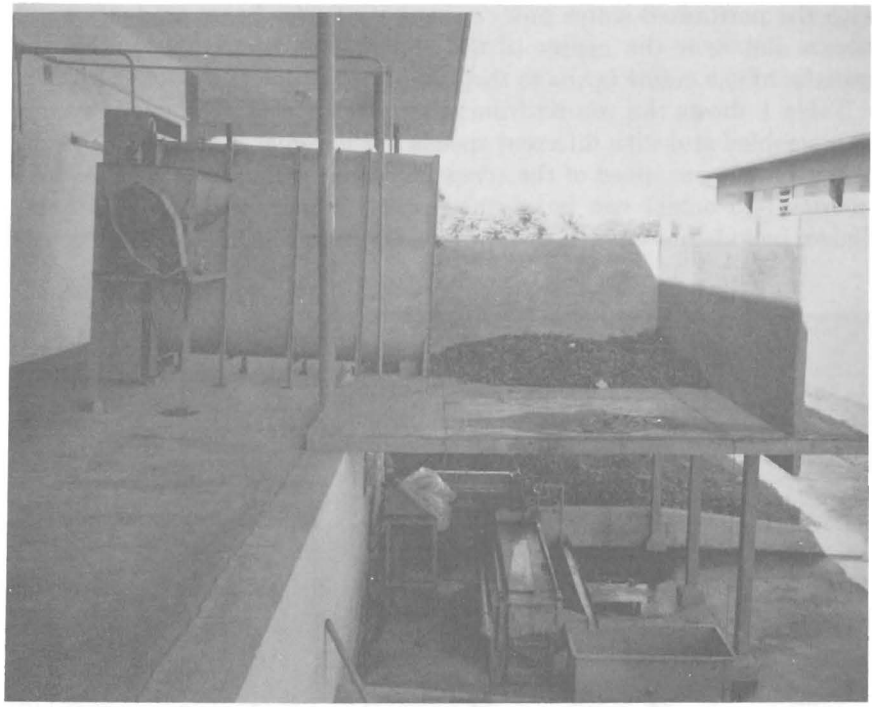

FIG. 5.—Complete operational unit of blower (upper left) coupled to the washing machine (lower right).

TABLE 1.—*Results obtained in cleaning coffee harvested on plastic nets at different velocities of the screw conveyor*

Time nets left on the ground	Velocity of screw conveyor	Visual observation of material collected	Area of material collected	Processing time per "cuerda"[1]	Dried parchment coffee in area collected
Weeks	*rpm*		*ft²*	*h*	*lb*
Over 8[2]	30	Wet	10,960	1.80	119
6	30	Slightly wet	10,960	1.82	222
8	20	Practically dry	7,625	3.50	90 1/4
10	20	Slightly wet	4,650	4.66	93 3/4
2[3]	20	Practically dry	7,625	.58	21
	13	—	—	—	—

[1] "Cuerda" is equivalent to 0.9712 acre; 0.40 ha.

[2] These nets were placed before the peak of the season; no exact date is known.

[3] This sample contained a very small amount of material.

RESUMEN

Se describe una nueva máquina para limpiar el café recogido en redes plásticas así como el acoplamiento de ésta al sistema de lavado. Esta consiste de dos túneles, cada uno con un soplante. El material que es

transportado por un conductor en forma de tornillo, se agita con un eje rotatorio con rayos y se expulsa por la acción del soplante. El material separado conteniendo granos de café, bayas, tierra y palitos cae a través de un cedazo al túnel inferior. De ahí es transportado por medio de una corriente de agua a la lavadora. En ésta, en la zaranda vibradora y en el tanque de flotación se lleva a cabo la separación final del material mencionado.

La máquina soplante, junto con la lavadora es capaz de limpiar el café de 4.4 cuerdas (1.62 ha) en 8 horas laborables a una velocidad de 30 rpm del transportador en forma de tornillo. Al reducir la velocidad de este transportador a 20 rpm también se reduce la capacidad a 2 cuerdas en 8 horas.

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