Evaluation of coffee separating machines[1]

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ABSTRACT

This study describes performance of four separators (Strich's model A, Atienza type I model B, Atienza type II model C and Quin Mattei type model D) to separate coffee beans from coffee harvested by nets on private plantations in Adjuntas, Puerto Rico. Collection unit yielded a bean content (wet basis) of 79.7, 92.8, 79.4 and 73.7 percent for models A, B, C, D, respectively. It gave a trash content (wet basis) of 7.2% for model B, 20.3% for model A, 20.6% for model C and 26.3% for model D compared to a bean loss of 0.9% in model D, 1.8% in model C. Machine output was 73.8 kg/hr for model A compared to 179.8 for model C, 724.9 for model B and 1673.5 for model D. The machine output-input ratio (wet basis) was 0.60, 0.57, 0.68 and 0.61 for models A, B, C and D, respectively.

INTRODUCTION

Coffee harvested with plastic nets[3] contains a large amount of leaves, twigs, seeds, stones, dirt and other extraneous matter depending upon the weather. This adds to handling and separation problems[4]. In dry weather, the leaves are loose, with no coffee beans attached, but during the rainy months the leaves become soggy, start to rot and the coffee beans become attached to the leaves. Cancel (1) developed a coffee cleaning machine, later modified and described by Recio de Hernández[5], who indicated that the modified model can process coffee from 4.3 acres (1.7 ha) in an 8-hour run with a screw conveyor speed at 30 r/min, and 1.9 acre (0.77 ha) with a screw conveyor speed at 20 r/min.

This study evaluated the performance of four existing coffee separating models which are being used by farmers in Adjuntas, P. R.

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[3]Cancel, L. E., I. Hernández-Torres, E. R. de Hernández and J. A. Rosario-Hernández, 1974. Improvements in the washing operation of coffee harvested with plastic nets. J. Agric. Univ. P. R. 58 (1): 1–10.

[4]Sharma, A. D., E. J. Ravalo, C. R. Almodóvar and C. J. Torres, 1984. Experimental facility development for processing coffee harvested by plastic nets. ASAE Paper No. 84-3062 presented at the 1984 summer meeting of the American Society of Agricultural Engineers, St. Joseph, MI.

[5]Recio de Hernández, E., 1983. Improved machine for cleaning coffee harvested with plastic nets. J. Agric. Univ. P. R. 67 (3): 197–203.

MATERIALS AND METHODS

The experimental machines are identified and described in figures 1 to 4. Strich Atienza type I and Atienza type II models are different from Cancel's model, whereas Quin Mattei's machine is a third version of Cancel's model. We did not include the original Cancel model in this study because the machine was not available in the area. Coffee berries are separated on the basis of the dry method in the first three machines (figures 1, 2, 3). In Strich's model berries are fed into the machine (fig. 1) and are carried up hill with the help of a conveyor. After trash is separated with a fan, clean coffee is carried down hill on an inclined frame. The collection unit gathers all berries at the end of an inclined frame. In Atienza type I, the material from a feeding hopper falls on an inclined screened plate form. The blower helps to remove trash as the berries follow a downhill path. Clean coffee is collected at the end of an inclined cylindrical plate. Atienza type II is similar to type I except that the material from the feeding unit is carried on an uphill conveyor to the blower unit. The Quin Mattei unit involves three stages to separate coffee berries and uses a flotation tank to separate the berries (wet method). After the test material is fed into the hopper, leaves are separated with a fan. Harvested material then passes through a second stage where a second fan further removes the trash. Coffee along-with twigs and dirt passes through a meshed screen and falls into a flotation tank (stage 3) by gravity. Water transports clean berries to a collection unit.

During November-December 1983, the coffee harvested with nets was collected at selected plots on a private plantation, Adjuntas, P. R. Preweighed material from the nets was fed into the hopper of each separator under evaluation (fig. 1 to 4). Time to process this material was recorded with a stopwatch. After all the material had been processed by the machine, coffee berries were gathered from the collection unit and weighed. Machine output was defined as a ratio of contents on the collection unit to material fed into the separator and the machine output (kg/hr and %) was calculated for each test run. Four samples were taken from each net, the coffee collection unit and the trash unit. These samples were stored in plastic bags and transferred to the Food Technology Laboratory, Río Piedras, P. R. Each sample was manually sorted into coffee beans and trash. Moisture content of each sample was also determined. Each test run was replicated four times. Performance parameters were calculated on wet and dry basis (table 1).

RESULTS AND DISCUSSION

Table 1 reveals the performance of four separators (figures 1 to 4) of coffee berries from coffee harvested by nets on private plantations, Adjuntas, P. R. The table indicates percentage distribution of berries and

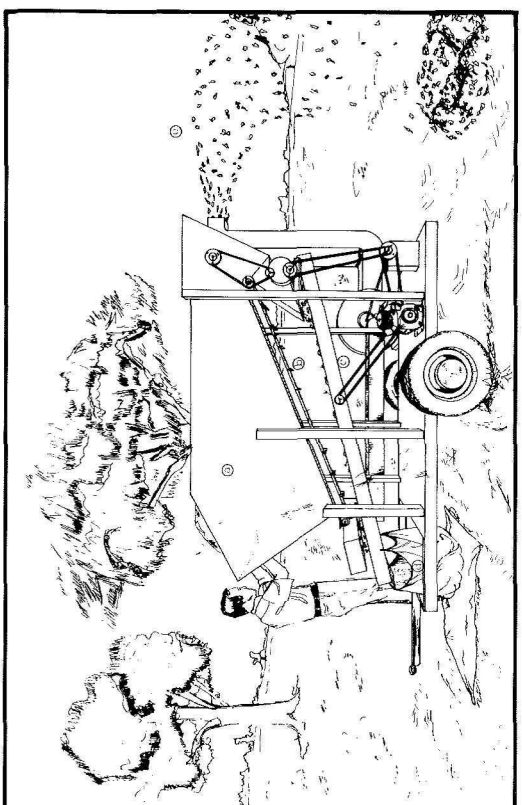

FIG. 1.—Coffee separating machine, Strich model A. (a) Feeding hopper, (b) Conveyor, (c) Inclined frame to separate coffee, (d) Coffee collection unit and (e) Trash.

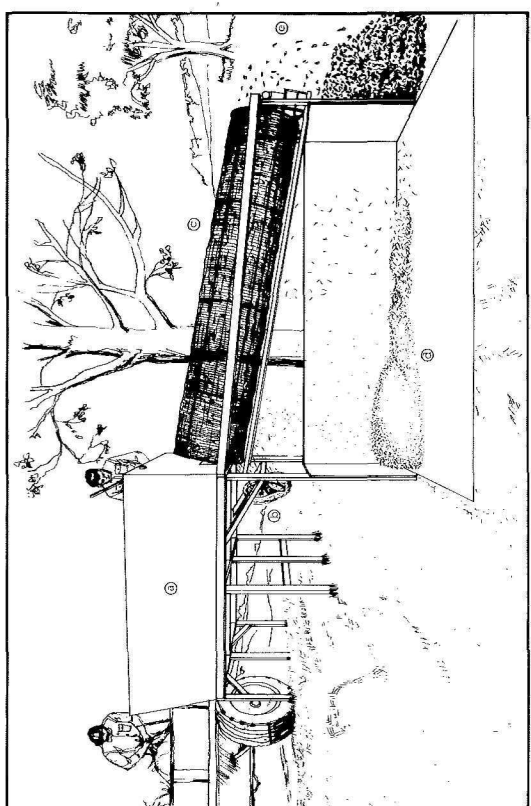

FIG. 2.—Coffee separating machine, Atienza model I B. (a) Feeding hopper, (b) Blowing fan, (c) Inclined frame to separate coffee, (d) Coffee collection unit and (e) Trash.

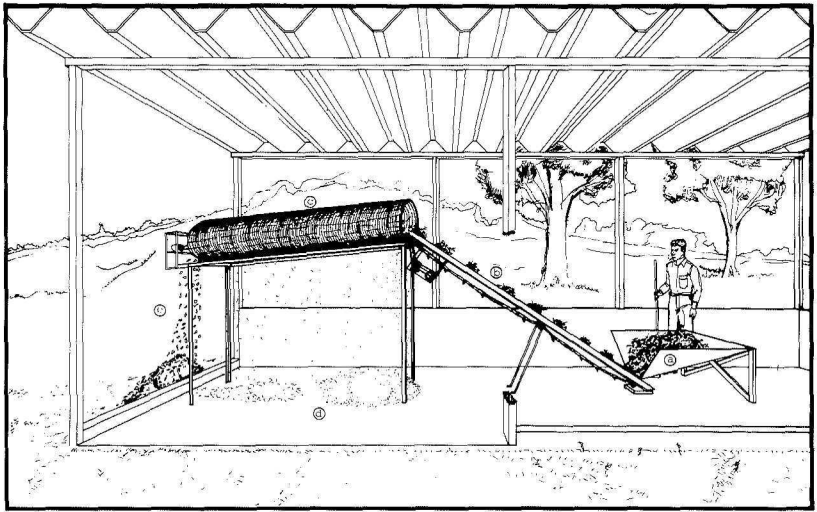

FIG. 3.—Coffee separating machine, Atienza model II C. (a) Feeding hopper, (b) Conveyor, (c) Inclined frame to separate coffee, (d) Coffee collection unit and (e) Trash.

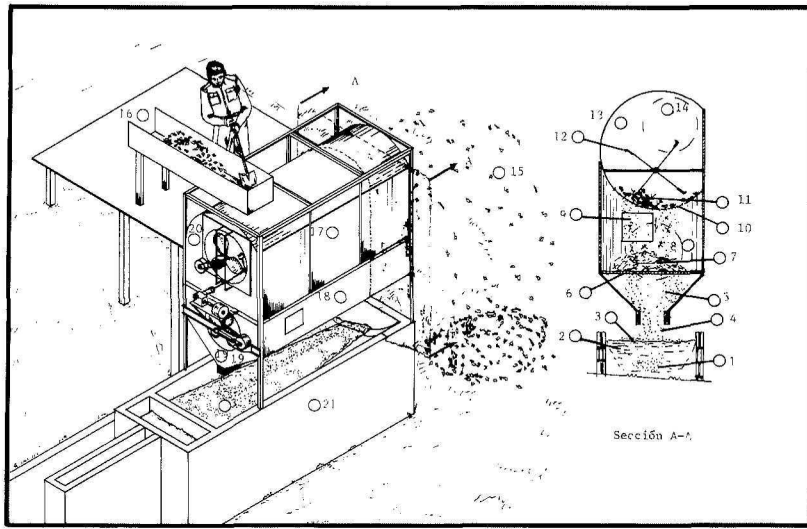

FIG. 4.—Coffee separating machine, Quin Mattei D.
First stage: Trash (15); (16) Feeding hopper; (10, 11, 12, 14)
Separation of leaves; (13, 20) Fan;
Second stage: (7) Fan; (8, 17) Cleaning area.
Third stage: (4, 5, 19) Coffee falling into cleaning trough; (6) Diamond-meshed screen with holes of 2.5 x 3.5 cm (approximate); (3) Coffee with twigs and dirt; (1, 21)
Flotation tank; (2) Water transporting clean coffee.

TABLE 1.—*Performance of four separators of coffee beans from net-harvested coffee on private plantations, Adjuntas, Puerto Rico*

Machine type[1]	Basis	No. of runs	Contents from nets, %					Machine performance[2]										
								Collection unit							Trash unit			
					Moisture content			Output		Beans	Trash	Moisture content, %			Beans	Trash	Moisture content, %		
			Coffee beans	Trash	Beans	Trash	Mean	Kg/hr	%	%	%	Beans	Trash	Mean	%	%	Beans	Trash	Mean
Dry method:																			
Strich. (A)	Wet	1	70.9	29.1	46.2	38.6	42.4	73.8	60.4	79.7	20.3	40.9	24.9	32.9	0.0	100.0	—	30.8	30.8
	Dry		18.7	7.7	—	—	73.6	—	14.6	40.6	10.4	—	—	49.0	—	55.5	—	44.5	44.5
Atienza I (B)	Wet	8	59.4	40.6	42.2	37.2	39.7	724.9	57.1	92.8	7.2	42.3	27.8	35.1	0.0	100.0	—	34.7	34.7
	Dry		20.3	13.9	—	—	65.8	—	26.2	42.7	3.3	—	—	54.1	0.0	56.9	—	53.1	53.1
Atienza II	Wet	4	57.7	42.3	42.6	34.4	38.5	179.9	68.1	79.4	20.6	41.2	27.3	34.3	1.8	98.2	26.4	33.9	30.2
(C)	Dry		21.6	15.8	—	—	62.6	—	32.6	38.0	9.8	—	—	52.2	1.0	55.7	—	—	43.3
Wet method:																			
Quin Mattei	Wet	8	51.6	48.4	48.1	48.8	48.5	1673.5	60.9	73.7	26.3	45.9	42.9	44.4	0.9	99.1	51.7	47.7	49.7
(D)	Dry		3.0	2.8	—	—	94.2	—	12.2	14.8	5.3	—	—	79.9	0.1	1.1	—	—	98.8

[1] Trade names are only for identification purposes and do not imply preference for these machines by the Agricultural Experiment Station.

[2] The machine performance would depend upon the experience of the operator, condition of the contents from nets, and how the samples are taken.

trash (wet and dry basis) in the nets, collection unit and trash unit. It should be noted that machine output depends upon the amount of material collected in the nets, condition of field and nets and time the berries have been in the nets. Strich model A[6] gave a machine output (wet basis) of 73.8 kg per hour, compared to 179.9 for Atienza type II model C, 724.9 for Atienza type I model B, and 1673.5 for Quin Mattei's model D. Ratio of contents in the collection unit to contents fed into the separator (wet basis) was 0.60, 0.68, 0.57 and 0.60 for models A, B, C and D, respectively. The collection unit yielded a trash content (wet basis) of 7.2% for model B, 20.3% for model A, 20.6% for model C and 26.3% for model D compared to a bean content (wet basis) of 92.8% for model B, 79.7% for model A, 79.4% for model C and 73.7% for model D, respectively. The trash unit had no bean loss in models A and B, 0.9% in model D, and 1.8% in model C. It is suggested that these separators be brought to the Adjuntas Experiment Substation to be compared in performance with the model (3) developed by the Agricultural Experiment Station. Testing at one location will give comparable results as it would eliminate variations due to test sites.

RESUMEN

Evaluación de Máquinas para Separar Café Recolectado en Redes Plásticas

Este estudio describe el comportamiento de cuatro separadoras (Strich modelo A, Atienza I modelo B, Atienza II modelo C y Quin Mattei modelo D) de las bayas de café del resto del material recolectado. El café se cosechó en redes en plantaciones de café en Adjuntas, Puerto Rico.

La cantidad de broza fue de 7.2 por ciento con el modelo B, 20.3 por ciento con el modelo A, 20.6 por ciento con el modelo C y 26.3 por ciento con el modelo D, y una pérdida de bayas mezcladas con la broza de 0.9 por ciento en el modelo D y 1.8 por ciento en el modelo C. La producción por máquina fue de 73.8 kg./h. con el modelo A, 179.8 con el modelo C, 724.9 con el modelo B y 1673.5 con el modelo D.

[6]Trade names are for identification purpose only and do not imply preference for this machine by the Agricultural Experiment Station.