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Development and testing of belt feeding attachment to power ground nut stripper

R. MURUGESAN AND A. TAJUDDIN
College of Agrl. Engineering, Tamil Nadu Agrl. University, Coimbatore - 641 003, Tamil Nadu

Abstract : A belt type feeding unit was developed as an attachment to power operated groundnut stripper. Performance of the stripper with feeding unit was evaluated at different belt speeds and feed rates. Stripping capacity of the machine increased with increase in feeding belt speed and feed rate. Stripping efficiency decreased with increase in feeding belt speed and feed rate. Pod damage increased with the increase in feed rate. Damage to the stripped vines was negligible when using the stripper with belt feeding attachment. The machine ensured safety of the operators' hands during operation. A maximum stripping capacity of 40 kg h^{-1} was achieved at 8.48 m min^{-1} feeding belt speed with 1.5 kg min^{-1} feed rate. The corresponding pod damage was 8 per cent.

Key words: Groundnut stripper, Feeding unit, Operators' safety, Stripping efficiency, Pod damage.

Introduction

Groundnut occupies 45 per cent of the total area under oilseed crops and contributes 55 per cent of the total oilseed production in India (Babu and Reddy, 1989). The groundnut crop is popular both among the common man and industries for its multiple use such as edible oil, vanaspathy, soaps, cosmetics, cattle feed and fodder. Availability of farm labourers is decreasing day by day and the available farm labourers demand more wages. Therefore, labour saving farm equipment to remove groundnut pods from the plants is the felt need of farmers for a long time.

Groundnut thresher is suitable for both bunch and spreading varieties. But the damage caused to leaves and stems of the threshed plants is a major problem in this type of machine. Since the groundnut plants after removal of pods are mainly used as cattle feed, any machine used to remove pods from groundnut plants is expected to cause minimum damage to the threshed plants. The rotating stripping drum removes the pods from the plants when the stems of the plants are held by hand. One of the reasons for the non-popularity of power operated groundnut stripper is the lack of safety arrangement to operators' hands during operation. Hence an appropriate feeding mechanism to the power groundnut stripper was developed and tested.

Materials and Methods

Description of the power groundnut stripper

In the existing power operated groundnut stripper, a feeding mechanism was attached to safeguard operators' hands from injuries. The designed speed of 400 mm diameter stripping drum was 300 rpm and the blower capacity was 0.42 m^3s^{-1} (Thangavelu and Swaminathan, 1986). The spacing of stripping screws along the periphery of the stripping drum was optimised as 160 to 200 mm and spacing of screws along the axis of the drum was 20 mm for efficient stripping. (Thangavelu *et al.* 1985). Length of stripper drum was 1400 mm. The drum has 6 rows of 4 x 25 mm size round head screws. The machine is powered by a 1.1 kW, 1440 rpm, AC motor.

Development of belt feeding attachment

To minimise thresher accidents, Datta (1993) suggested modifications in the feeding system of threshers. The feeding mechanism consisted of wooden rollers, top and bottom belts, top and bottom metal plate supports to the belts, idler rollers, feeding chute, outlet chute and speed transmission system (Fig. 1). Width of conveyor belt was selected as 250 mm considering the average length of vines less leafy portion of the groundnut plant. The designed lengths of upper and lower feeding belts were 4.51 and 4.50 m respectively. The rotational speed of the feeding unit driving roller of 90 mm diameter was determined as 15 rpm. To grip the groundnut

able 1. Effect of feeding belt speed and feed rate on stripping capacity and efficiency

otational peed of iving roller m	Linear belt speed (m min^{-1})	Stripping capacity (kg h^{-1})			Stripping efficiency (%)		
		F_1	F_2	F_3	F_1	F_2	F_3
0	2.83	3.60	5.55	9.75	94	92	91
5	4.24	8.00	13.50	2.00	93	87	90
0	5.65	10.60	18-75	27.10	92	86	87
5	7.07	11.45	23.70	34.25	92	85	83
0	8.50	13.08	29-10	40-00	85	80	78

= 0. 5 kg min^{-1}; F_2 = 1.0 kg min^{-1} ; F_3 = 1. 5 kg min^{-1}

Table 2. Effect of feeding belt speed and feed rate on pod damage and power requirement

Rotational peed of lriving roller pm	Linear belt speed (m min^{-1})	Pod damage (%)			Power requirement of stripping drum (W)			
						Load		
		F_1	F_2	F_3	No load	F_1	F_2	F_3
0	2.83	3	2	2	190	205	220	235
15	4.24	4	4	6	190	215	230	240
20	5.65	5	6	7	195	220	245	260
25	7.07	6	6	7	200	206	275	285
30	8.50	5	7	8	210	280	300	340

F_1 = 0.5 kg min^{-1} ; F_2 = 1.0 kg min^{-1} ; F_3 = 1.5 kg min^{-1}

crop against the pulling force exerted by the stripping drum to the pods, metal plate supports were provided on both the sides of the inner belts so that the plants move along the length of the belt without sliding (Murugesan, 1995).

Variables studied

The independent variables studied were feeding belt speed and feed rate. Five levels of feeding belt speeds (2.83, 4.24, 5.65, 7.07 and 8.48 m min^{-1}) and three levels of feed rates (0.5, 1.0 and 1.5 kg min^{-1}) were selected. The dependent variables measured were stripping capacity, stripping efficiency, percentage damage to the pods and condition of vines after stripping.

Stripping capacity of the machine was determined by weighing the quantity of stripped

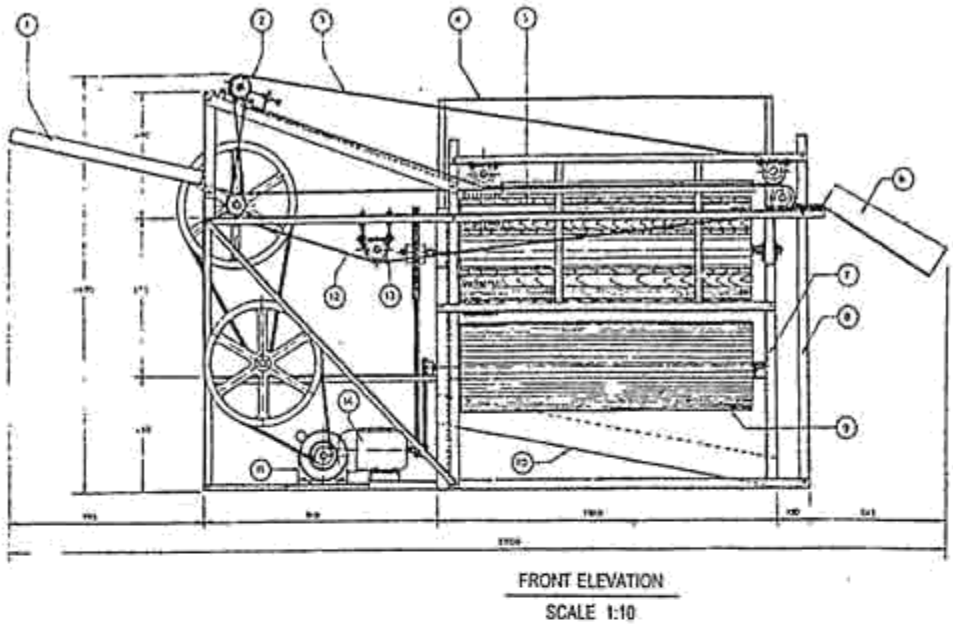

Fig.1. Power operated groundnut stripper with feeding unit attachment

pods collected from collection tray after each test and the time taken for the respective test. Stripping efficiency was found by manually stripping the unstripped groundnut pods from the plants, weighing them and adding to the weight of pods stripped by the machine during each test. Percentage damage to the stripped pods was found by separating the damaged pods and weighing them. Condition of vines after stripping was compared by visual inspection.

Results and Discussion

Stripping capacity

Increasing feeding belt speed had the effect of increasing the stripping capacity of the machine with all the three feed rates *viz.* 0.5, 1.0 and 1.5. kg min^{-1} (Table. 1). With 0.5 kg min^{-1} feed rate, the rate of increase in stripping capacity was found to decrease with the increasing belt speed. With 1.0 and 1.5 kg min^{-1} feed rate, the rate of increase in stripping capacity was found to increase with the increasing belt speed. A maximum stripping capacity of 40 kg h^{-1} was achieved at 8.48 m min^{-1} feeding belt speed with 1.5 kg min^{-1} feed rate. The results revealed that higher out turn of the machine could be achieved at higher feed rates.

Stripping efficiency

When the feeding belt speed increased, stripping efficiency decreased for all the feed rates. There existed a linear relationship between feeding belt speed and stripping efficiency. Beyond 7 m/min^{-1}belt speed, stripping efficiency dropped down for all the three feed rates with respect to feeding belt speed. This revealed that maximum stripping efficiency could be achieved at 7 m min^{-1} feeding belt speed corresponding to 25 rpm rotational speed of the 90 mm driving roller. The lowest feed rate of 0.5 kg min^{-1} was observed to give maximum stripping efficiency of 94 per cent at 2.83 m min^{-1} feeding belt speed.

Damage to the pods

Extent of damage to the pods during stripping in the machine at different feed rates and at varying feeding belt speeds are summarised in Table 2. With 0.5 kg min^{-1} feed rate, damage to the pods increased up to 7 m min^{-1} belt speed, beyond which feed rate the damage to the pods decreased. With 1.0 kg min^{-1} feed rate, damage to the pods varied linearly as the belt speed increased. Among the three feed rates, damage to the stripped pods was minimum with 0,5 kg min^{-1} feed rate. A maximum feed

ıte of 1.5 kg min^{-1} was found to give maximum ercentage damage to the pod (8 per cent) at .48 m min^{-1} belt speed.

ower requirement

Increase in power consumption of the blower ue to load was only 5 W. Change in power equirement of the feeding unit was not appreciable ue to increase in feeding belt speed.(Table 2).

ondition of vines after stripping

Damage to the stripped vines was almost egligible when using the stripper with the belt eeding attachment. The groundnut vines fetch market value of Rs.2500 ha^{-1} and the valuable ines could be saved by using the power groundnut ripper with belt feeding attachment.

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