

ASSESSMENT OF PERFORMANCE OF MANUALLY OPERATED COTTON PICKER

*Sarvesh Kumar, Prashant M. Dikker

*Department of Farm Machinery and Power Engineering, Faculty of Agriculture Science and Allied Industries, Rama University, Mandhana, Kanpur, Uttar Pradesh-209217

*Corresponding author Email: drsarvesh.fas@ramauniversity.ac.in**Abstract**

India is first in area for cotton cultivation and second in raw cotton production. The share of the India in cotton cultivation was 33.23% to the total area under cotton cultivation in the world. In India, debut GM variety of cotton increasing average yield from 326 kg/ha to 546 kg/ha in 2000 to 2014, respectively. Recent trend indicate, today need to develop the low initial cost mechanical harvesting system for cotton. The manual harvesting of cotton is time consuming and labor intensive. The manually operated pneumatic cotton picker had developed but it had low output capacity. To overcome the issues, develop a manual operated cotton picker. Evaluate performance of cotton picker, with varying the aspirator speed with varying the diameter pickup pipe. The three different pickup pipe of diameter 18 mm, 25 mm and 32 mm and three different speed of aspirator as 4500 rpm, 5500 rpm and 6500 rpm used.

The output capacity was the found maximum to be 8.60, 8.46 and 6.72 kg/h for 32, 25 and 18 mm diameter of the pickup pipe at the 6500 rpm of speed of aspirator. The picking efficiency was the found maximum to be 92.35, 94.58 and 95.26 per cent at the 18, 25 and 32 mm diameter of pickup pipe at 6500 rpm of speed of aspirator. Trash content was found maximum 10.28, 11.48 and 14.12 per cent for 18, 25 and 32 mm diameter of the pickup pipe at 6500 rpm of speed of aspirator. The fuel consumption was found to be 0.72 l/h, 1.06 l/h and 1.38 l/h at the speed of aspirator 4500, 5500 and 6500 rpm. In evaluation of performance of the cyclonic cotton picker observed that the aspirator speed increasing with increase the output capacity with increases the trash content in the cotton.

Keywords: Pickup pipe, aspirator speed, output capacity and trash content.

1. INTRODUCTION

Cotton is the white soft, fluffy fibrous substance that grows in to boll around the seeds of cotton plant. Cotton often referred as "King of fiber" or "white gold" has been in cultivation in India for more than seven thousand years ago. Manual picking of cotton is labour intensive, tedious and slow process, requiring 1565 man-hours per hectare. Mechanical harvesting of cotton in India was very less as compare to other cotton grower such as Russia, Israel in 2014 (Anon.2014). The most of the farmer is marginal land holders and the initial investment and maintenance of cotton picker is high. Because of this reason Indian farmer lag behind to adopt the cotton picker and stripper (Konduru et al., 2013). The single man operated cotton picker was developed and assessment of performance of cyclonic cotton picker with different suction pipe diameter and speed of aspirator. The manually operated pneumatic cotton picker is creating

suction with the help of impeller. It is applied on the boll due to that it was drag from its burs and collect into the tank. On these principles few researches had carried out, these researches concluded that output capacity is increase with impeller speed also increase the trash content. (Selvan et al., 2006., Verma et al., 2016. and Gupta et al., 2017).

Objectives

1. To study the field performance of the developed cyclonic cotton picker.
2. Cost estimation of the cotton piker

2. MATERIALS AND METHODS

Manual Cotton picking is hectic, laborious and time consuming operation. While, designing of machine the feasibility and efficiency machine play crucial role in adaptation. The developed pneumatic cotton picker was backpack type. It comprises IC engine, cyclonic chamber, different diameter of pickup pipe, transport pipe and collection tank.

Specification of Machine Component

Sl. No.	Technical descriptions	Cotton picker
1.	Overall dimensions (L × B × H), mm	570 × 460 × 520
2.	Engine model	3 WF- 3A
3.	Engine power	1.8 kW
4.	Engine C.C.	42
5.	Minimum and maximum speed of impeller, rpm	2000, 7500
6.	Dimension of fuel tank (L x B × H), mm	260 × 60 × 95
7.	Mounting pattern of collection drum	Vertical
8.	Mounting pattern of cyclonic device	Vertical
9.	Diameter of pick-up pipe, mm	18, 25 and 32 mm
10	Collection tank, liter	14 (polypropylene)
11	Operator, person	1 No's

Working of cotton picker

The first phase in the pneumatic cotton picking process is selecting the cotton bolls from the plant burs. The second step is to gather the selected cotton bolls in a collection tank after removing them from the airstream. Picking the cotton bolls was accomplished by using suction on cotton bolls of varying pickup pipe diameters. The impeller created the suction pressure, as the impeller housing' inlet, which serves as an aspirator to pick cotton bolls and cotton bolls collected into collection tank.

2.1 Performance and Evaluation of Cyclonic Cotton Picker

The performance of the developed cotton picker was evaluated in terms of output capacity, picking efficiency, trash content, collection efficiency and fuel consumption.



Fig. 3.1 Assessment of Cotton picker at field

The plot size for each parameter 1.20×1.0 m was randomly selected for the testing of the machine. The actual time of operation, time lost for unloading cotton bolls, time lost in adjustment, fuel consumption of the cotton pickers, number of bolls left unpicked was observed during the field trial.

Independent variables	Dependent variables
Speed of aspirator 4500rpm 5500rpm 6500rpm Dia. of pickup pipe 18 mm	Picking efficiency, (%)
	Trash content, (%)
	Fuel consumption, (l/h)

25 mm 32 mm	Output capacity, (kg/h)
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❖ Independent variables

The different speed of aspirator and the different diameter of pickup pipe were used during performance of cotton picker.

❖ Speed of aspirator

The optimum speed of aspirator for cotton picker ranges from 2200 to 5500 rpm (Rangasamy et al., 2006). The best speed for the operation of knapsack type cotton picker in terms of output capacity ranges from 2500 to 5500 (Verma and Mathur, 2016).

Therefore three speeds of aspirator 4500, 5500 and 6500 rpm were selected for the laboratory and field evaluation of the cotton picker. The best speed out of these four speeds was selected for field evaluation of cotton picker.

2.1.2 Diameter of pickup pipe

The different diameter of the pickup pipe 18, 25 and 32 mm had selected. To analysis the effect pipe diameter on the dependant parameters.

2.2.1 Fuel Consumption

Fuel consumption of the cyclonic cotton picker was measured at different speeds of aspirator. Fuel consumption was measured by filling the fuel by measuring cylinder operating the cotton for a known time and it was recorded in l/h.

2.2.2 Picking efficiency

In the evaluation, the number of bolls on the plant was counted before and after picking and picking efficiency was determined from the following formula (Rangasamy et al., 2006).

$$\eta_p = \frac{n_1 - n_2}{n_1} \times 100$$

where,

η_p = picking efficiency, per cent

n_1 = number of bolls present before picking, and

n_2 = number of bolls present after picking

2.2.3 Trash content

The trash content was determined by manually separating the trash from the cotton. The weight of cotton and trash collected was recorded in grams. The trash content was determined by the following formula (Rangasamy et al., 2006).

$$T = \frac{W_1}{W_2} \times 100$$

where,

T = trash content, per cent

W₁ = weight of trash separated, g

W₂ = weight of cotton received in drum, g

2.2.4 Output capacity

The output capacity was obtained by taking ratio of the weight of cotton picked by the picker to the time taken to pick the cotton bolls. The weight of cotton was measure in kilogram. The output capacity was calculated in kg/h. The output capacity was determined by the following formula (Sharma et al., 2011).

$$OC = \frac{W_{mc}}{t_{mc}}$$

Where,

OC = output capacity, kg/h

W_{mc} = weight of seed cotton, kg

t_{mc} = time, h

Evaluation of Economics of Cotton Picker

Based on the materials used and labour requirement for the fabrication cotton picker, the material cost and fabrication cost of the unit were calculated. The cost of operation per kg of cotton collected by cotton picker was worked out using the procedure recommended by RNAM test codes (Anon., 1995). This cost was compared with the cost of picking of one kg of cotton by conventional method. The performance of the cotton picker is depends on the speed of the aspirator and the diameter of pickup pipe.

3. RESULTS AND DISCUSSION

The assessment of performance of the developed cotton picker was evaluated in the farmer's field. The output capacity, picking efficiency, trash content, collection efficiency and fuel consumption were studied.

3.1 Output capacity:

The output capacity varied from 4.9 to 8.78 kg/h for 18 and 32 mm diameter of pickup pipe in second picking at 4500 and 6500 rpm, respectively. In aspirator speed 6500 rpm, the maximum and minimum output capacity was found to be 8.78 and 7.82 kg/h for 32 and 18 mm diameter of the pickup pipe.

It was also observed that, the output capacity was strongly correlated with aspirator speed and pickup pipe diameter. The output capacity increased with increase in aspirator speed. The output capacity was maximum in the first picking, and it increased with increase in picking

interval. It was also observed that the output capacity was higher if the cotton bolls were matured and disease free.

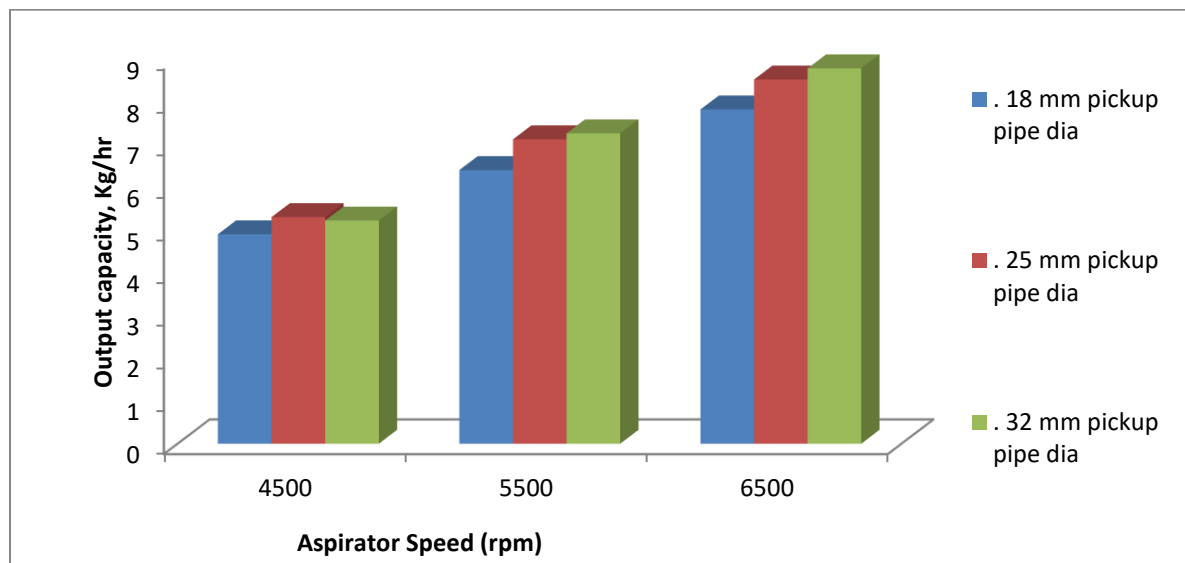


Fig. Effect of the aspirator speed on output capacity for different diameter of pickup pipe

3.2 Picking efficiency

The picking efficiency of the cotton picker was evaluated for 18, 25 and 32 mm diameter of pickup pipe and different aspirator speeds. It was observed that, the picking efficiency varied from the 89.20 per cent to 95.26 per cent at different diameter of the pickup pipe for different aspirator speed. At the aspirator speed 4500 rpm, the maximum and minimum picking efficiency was found to be 91.3 and 89.20 per cent, respectively for 32 and 18 mm diameter of pickup pipe. At the aspirator speed of 5500 rpm, the maximum and minimum picking efficiency was found to be 93.36 and 91.2 per cent, respectively for the 32 and 18 mm diameter of the pickup pipe. At the aspirator speed 6500 rpm, the maximum and minimum picking efficiency was found to be 94.16 and 91.57 per cent, respectively for the 32 and 18 mm diameter of the pickup pipe. It was also observed that, the picking efficiency was significantly affected by the speed of the aspirator and diameter of the pickup pipe. The pickup pipe diameter of 18 mm was found to have lower picking efficiency compared to 25 and 32 mm diameter pickup pipe.

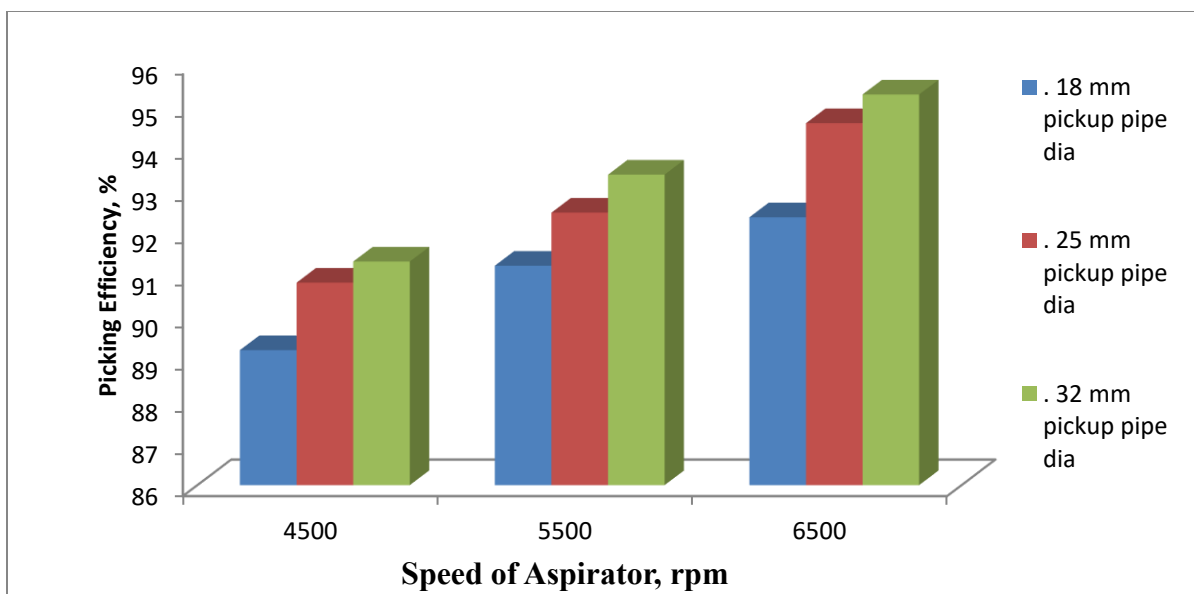


Fig.4.2. Effect of aspirator speed on the picking efficiency

The picking efficiency was higher for the healthy cotton bolls. The picking efficiency was also dependent on the maturity aspect of the cotton bolls.

❖ Trash content

The trash content of the cyclonic cotton picker was evaluated for 18, 25 and 32 mm diameter of pickup pipe and at various speed of the aspirator. The three trails were taken during the performance for each set of parameters.

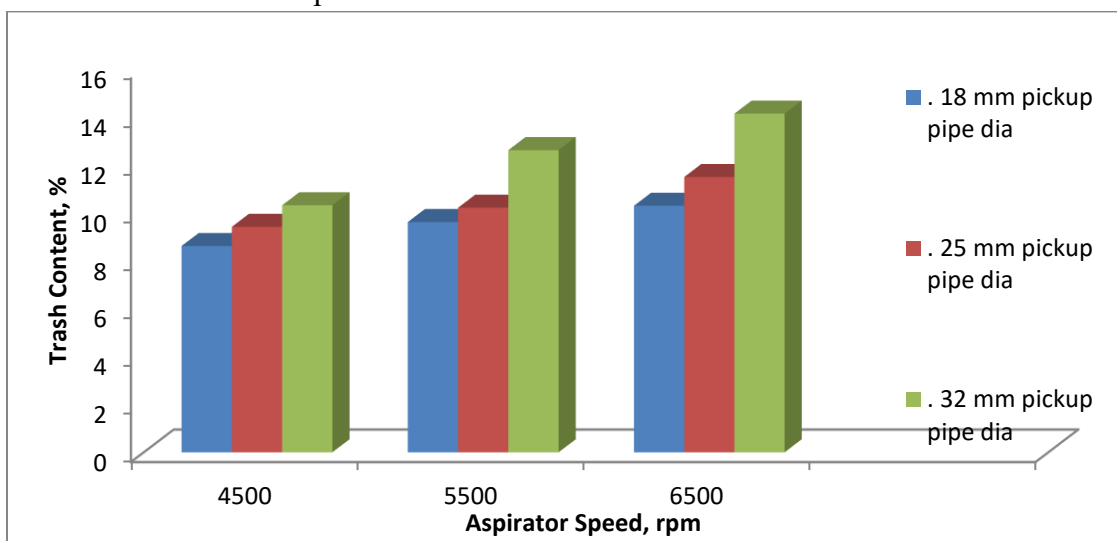


Fig. Effect of aspirator speed on trash content for different diameter of pickup pipe

It was observed figure that the trash content varied from 6.37 to 9.43 per cent for different diameters of pickup pipe. At aspirator speed of 4500 rpm, the maximum and minimum

trash content was found to be 9.43 and 8.7 per cent, respectively at 32 and 18 mm diameter pickup pipe. At aspirator speed of 5500 rpm, the maximum and minimum trash content was found to be 8.43 and 7.08 per cent, respectively at 32 and 18 mm diameter pickup pipe in first picking and third picking. At aspirator speed of 6500 rpm, the maximum and minimum trash content was found to be 7.58 and 6.37 per cent, respectively at 32 and 18 mm diameter pickup pipe in third picking and first picking.

❖ Optimum Independent Variables for the Operation of the Developed Cotton Picker

The identification of the optimum diameter of pickup pipe and speed of aspirator is necessary so that maximum output capacity and picking efficiency could be achieved with minimum trash content. The main criteria for the constrained optimization were maximum possible output capacity and picking efficiency and minimum trash content. The best diameter of pickup pipe of 25 mm and aspirator speed of 6500 rpm was found to result in maximum output capacity and picking efficiency and minimum trash content. The output capacity, picking efficiency and trash content at the

Optimal levels were 8.52 kg/h, 94.58 per cent and 11.48 per cent, respectively.

❖ Fuel Consumption

Fuel consumption of the cotton picker was measured at different speeds of aspirator. Fuel consumption was measured 0.72 l/h, 1.06 l/h and 1.38 l/h at the speed of aspirator 4500, 5500 and 6500 rpm.

❖ Cost Economics of the Developed Cotton Picker

The cost economics of the developed manual operated cotton picker was analyzed as per the RNAM test code and procedure for harvesters (Anon., 1995). The cost of picking of cotton by using manually and cotton picker and was Rs.21.00 and 15.80 per kg. The saving in cost compared to manual picking Rs 2.20 per kg, respectively. It can be inferred that the developed cotton picker was technically as well as economically feasible.

4. CONCLUSIONS

1. The maximum output capacity of the developed cotton picker was 8.78, 8.52 and 7.82 kg/h for 32, 25 and 18 mm diameter of the pickup pipe, respectively and at 6500 rpm speed of aspirator.
2. The maximum picking efficiency was 95.26, 94.58 and 92.35 per cent for the 18, 25 and 32 mm diameter of the pickup pipe, respectively and at 6500 rpm speed of aspirator
3. The minimum trash content was 8.6, 9.4 and 10.3 per cent for the 18, 25 and 32 mm diameter of the pickup pipe, respectively at 6500 rpm of speed of aspirator
4. The maximum fuel consumption was 0.72, 1.06 and 1.38 L/h at 4500, 5500 and 6500 rpm speed of the aspirator, respectively.

5. The best diameter of pickup pipe and speed of aspirator for obtaining the maximum output capacity and picking efficiency and minimum trash content was 25 mm and 6500 rpm, respectively. The output capacity, picking efficiency and trash content at the best combination of diameter of pickup pipe and speed of aspirator was 8.52 kg/h, 94.58 per cent and 11.48 per cent, respectively.

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