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Performance evaluation of self propelled riding type vertical conveyor reaper

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ABSTRACT : Changing socio-economical scenario, Indian agricultural will sustain only through modernization process by means of agricultural engineering knowledge. The use of improved and precision machinery for harvesting operation such as 'self propelled vertical conveyor reaper' is urgent need in present day agriculture in the country. The saving in labour, time and cost of operation are the major advantages in the use of self propelled vertical conveyor reaper. In view of this, the self propelled riding type vertical conveyor reaper was tested to assess its performance. The test result indicated an average effective field capacity of 0.17 ha/hr at an average forward speed of 1.7 km/hr with 60 per cent efficiency. The vertical conveyor reaper was found to be suitable for reaping the crops up to 55 to 60 cm crop height. Operating cost of the machine was worked out to be Rs.115.27/hr.

KEY WORDS : Vertical conveyor reaper, Soybean

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Soybean is an important legume crop belonging to the family Leguminosae. It is supposed to be originated in Machuria, China. In India, Madhya Pradesh, Maharashtra, Rajasthan are major soybean producing states. Efficient harvesting is main factor to reduce grain losses and cost of production. Rapid urbanization and migration of farm labours created a big problem of timely availability of field labour that affects the production and productivity of field operation. Harvest losses increases with time after maturity as seed moisture content decreases. Soybean has been harvested successfully at moisture content as high as 20 per cent but seed is often damaged. Little damage occurs at 15 per cent but general recommendations are to harvest as close to 13 per cent moisture as possible (Swaminathan and Maniam,1983). Presently harvesting is done by power tiller driven cutting machine, reaper with cutter bar mounted on tractor side. So far, small and medium size fields the self propelled riding type vertical conveyor reaper (VCR) can be used for harvesting of soybean. The riding type vertical conveyor reaper (VCR) is a self propelled unit in which the operator rides on the machine. Drive is by means of two large pneumatic wheels and steering is by rear idlers. The prime mover is 6 hp diesel engine. Convenient brake, clutch, steering, hydraulic system and simple power transmission are provided for ease of operation. It consists of row crop divider, star wheel, cutter bar (76.2 mm), conveyor belt and wire spring etc. This reaper has two forward and one reverse speed. Vardan make self propelled vertical conveyor reaper was tested for its performance with travel speed of 2.7 km/hr. The actual field capacity of reaper was observed to be 0.104 ha/h for soybean. The machine gave field efficiency 68.40 per cent for soybean (Devnani and Pandey, 1995). Hence, there was a need to test self propelled riding type vertical conveyor reaper at Mahatma Phule Krishi Vidyapeeth, Rahuri (M.S.).

METHODOLOGY

This particular experiment on performance evaluation of "self propelled riding type vertical conveyor reaper" was conducted on the field of D-Block under Agronomy Department of Mahatma Phule Krishi Vidyapeeth, Rahuri for the soybean crop.

Working of self propelled riding type VCR:

Observations in the experiment "performance evaluation of self propelled riding type VCR" for soybean crop were recorded for constant forward speed. Before harvesting of

main crop in the field by self propelled riding type vertical conveyor reaper, the entire border of field has to be cut manually so as to facilitate the windrowing of first cut stalks at the right hand side of the ground. Height of plant was measured in a given field with the help of scale. It works in the sequence like cutting of the soybean crop at the base, conveying cut stalks to right side and windrowing it neatly on the ground.

The reaper was then operated in and in (from outside towards interior of field). When machine was moving in the field, four rows of the crop cut at a time and the stalks were pushed towards the cutter bar by the star wheels and the stalks were conveyed to the right side by conveyor belt.

Test procedure:

The testing of experimental self propelled riding type vertical conveyor reaper was done.

Laboratory tests:

The main objectives of laboratory tests were to confirm the dimensions and to study the performance of the components designed. Such a study assisted the modifications and improvement in the design of machine.

Specifications:

Self propelled riding type Vertical Conveyor Reaper was kept on firm level and horizontal surface of the workshop floor and various dimensions were measured.

Visual observations and checking provision for adjustment:

The reaper was inspected thoroughly paying attention in particular to the power transmission components, moving parts, correctness and ease of operations along with various adjustments, tightness of bolts and nuts, etc.

Field test:

The observations on header loss and conveyance loss were recorded for constant speed of vertical conveyor reaper. Pre-harvesting loss from header and also conveyance loss were measured using 1 m x 1 m size area. The grains were collected from 1m2 area. Time and diesel required for the operations were calculated with the help of stopwatch and measuring cylinder, respectively (Bukhari and Nawaz, 1991).

Height of the cut:

It was the cutting height of crop stalk from the ground surface. It was about 8 cm from ground surface for soybean.

Theoretical field capacity:

$$\text{T.F.C. (ha/hr)} = \frac{\text{Width (cm) x Speed (m/sec) x 36}}{10000}$$

Effective field capacity:

$$\text{EFC (ha/hr)} = \frac{\text{S x W}}{100} \text{ x } \frac{\text{E}}{100}$$

where,

S = Speed of travel in km/hr

W = theoretical width of cut of machine in m.

E = Field capacity in percentage.

Field efficiency :

$$\text{Field efficiency} = \frac{\text{EFC}}{\text{TFC}} \text{ x 100}$$

Procedure followed during operation:

Fuel consumption:

Before starting of operation; fuel tank was filled to its full capacity and after operation it was again filled to its capacity. Amount of refueling was the required fuel for that particular period of operation. When filling up the tank, careful observation should be taken by keeping the tank horizontal and not to leave empty space in the tank.

Effective field capacity:

The time lost for every event such as turning, repair, adjustment, refueling and machine trouble should be recorded. However, in calculating field capacity, the time consumed for real work and that lost for other activities such as turning, loading and adjustment depending on field and crop condition should be used.

Time for rectifying machine trouble will vary widely to various factors and its inclusion in time factor sometimes unreasonably lowers the effective field capacity.

$$S = \frac{A}{T_P + T_1}$$

where,

S = Effective field capacity ha/hr

A = Area covered, ha

T_p = Productive time, hr

T_1 = Non productive time, hr.

Field efficiency:

This gives an indication of the time lost into the field and the failure to utilize the full working width of the machine (Singh *et al.*,1988). It was calculated as follows:

$$\text{Field efficiency} = \frac{\text{Effective field capacity}}{\text{Theoretical field capacity}}$$

$$Ef = \frac{We \times Ve \times Tp}{Wt \times Vt \times (Tp + T1)} \times 100$$

where,

Ef = Field efficiency, %

We = Effective working width, m

Table A : Specification of equipment

Sr. No.	Particulars	Value
1.	Overall dimension, mm (L x W x H)	3185 x 1900 x 1450
2.	Weight, kg	1530
3.	Cost of equipment, Rs.	2,50,000
4.	Power source	6 hp diesel engine
5.	Fuel used	Diesel
6.	Horse power requirement, HP	6 hp
7.	Rated width, mm	1750
8	Length of cutter bar, mm	1750
9	Cutter bar pitch, mm	250

Wt = Theoretical working width, m
Ve = Effective operation speed, m/s
Vt = Theoretical operation speed, m/s
Tp = Productive time, min
T1 = Non productive time, min.

Moisture content:

Soil moisture content and grain/straw moisture content was calculated on dry weight and wet basis, respectively. For measurement of moisture, care was taken that samples of wet soils were at least from three different locations of test plots which were selected randomly. Weighed the sample with the electronic balance and the weight of each wet soil sample was recorded. Place the sample in hot air oven maintained at 105°C for at least 8 hours. At the end of 8 hours, the sample was cooled in desiccators and weighed with the help of electronic balance. Same procedure was followed for grain moisture content and straw moisture content.

$$\text{\% dry weight basis} = \frac{\text{Weight of moisture in soil sample}}{\text{Weight of oven dry soil sample}} \times 100$$

Specification of equipment are given in Table A.

RESULTS AND DISCUSSION

The newly developed self riding type propelled vertical conveyor reaper was evaluated for its performance in soybean field.

Laboratory test:

Test was conducted by running the machine on no load conditions. The results were:

– It was observed that though machine was stable, but with more vibrations and noise.

– The strength and parts designed and fabricated were satisfactory.

Field test:

Field test was carried out in the matured soybean field to ensure the proper operation of the machine and prevent failures of parts, if any. The field trials were conducted as per the standard procedure. The data of the field test were analyzed to

Table 1 : Test and results of performance evaluation of self-propelled riding type vertical conveyor reaper for soybean

Sr. No.	Particulars	Soybean
1.	Date of testing	28-10-09 to 30-10-09
2.	Size of field, sq.m	1008 sq.m
3.	Total operating time	33 min 53 sec
4.	Effective working width, m	1.75 m
5.	Harvesting efficiency, %	83.84%
6.	Shattering losses, %	10%
7.	Total harvesting loss %	16.16%
8.	Theoretical field capacity, ha/hr	0.297
9.	Effective field capacity, ha/hr	0.1785
10.	Field efficiency, %	60%
11.	Fuel consumption, 1/hr	0.96 lit/hr
12.	Cost of operation, Rs/hr	115.27
13.	Cost of operation, Rs/ha	645.77
14.	Breakdown of equipment	No

determine the average field capacity, overall performance of the machine, damage percentage, labor requirement, field efficiency, fuel consumption, cost of operation etc. in Table 1.

Conclusion :

The project was undertaken for performance evaluation of self propelled riding type vertical conveyor reaper for soybean. Following conclusions were drawn by the analysis of data and results obtained from performance evaluation of self propelled riding type VCR for the soybean crop.

– There was a saving of labor by 50 % and time saving was up to 60 %.

– During operation, it was observed that while using self propelled riding type VCR, height of cut of plant was uniform and also proper windrowing with ease of collecting harvested crop manually for bundle making as plants fall uniformly at one side.

–. Since harvesting and windrowing operations were mechanized completely, there was reduction in drudgery.

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