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PERFORMANCE TESTING OF TRACTOR OPERATED THRESHER FOR SOYABEAN

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Abstract

The detailed study is carried out on effect of seed threshing mechanism on quality of soybean seed and its physical properties. Poor quality in some soybean seed during storage can be due to their physiological characteristics or mechanical causes. The data on physical properties of soybean seed threshing by different methods is to be generated. The soybean seed are susceptible to mechanical injury mediated damage during post harvest handling. These injuries lead to deterioration during storage. The purpose of this investigation was to evaluate the effects of different threshing methods i.e., hand threshing, beating by stick and mechanical threshing on some soybean seed quality.

Soybean threshing is traditionally done by hand beating with a wood stick on hard surface which is a drudgeries operation which leads to time consuming grain damage and grain loss due to shattering. It is also a post-harvest operation that must be given adequate concentration. It must be carefully carried out in order to ensure that the seeds are no damaged. A bad threshing operation will reduce the quality of the seeds or render them completely useless. The primitive system of threshing, which is usually done by beating soybeans with a flail or trampling on it by animal hooves ,is usually energy-intensive is drudgery increase in loss and wastes time. This has been replaced by modern day thresher, which is able to combine the processes together in a single operation .An effective threshing operation depends on type of crop, condition of crop in terms of available moisture content, maturity, rate at which materials are fed into the cylinder, speed of the threshing drum and the number of rows of concave clearance.

Key Words: thresher, seed, Soybean, quality, damaged, physical properties.

Introduction

Before such machines were developed, threshing was done by hand with flails: such hand threshing was very laborious and time-consuming, taking about one-quarter of agricultural labour by the 18th century Mechanization of this process removed a substantial amount of drudgery from farm labour. The first threshing machine was invented circa 1786 by the Scottish engineer Andrew Meikle, and the subsequent adoption of such machines was one of the earlier examples of the mechanization of agriculture. During the 19th century, threshers and mechanical reapers and reaper-binders gradually became widespread and made grain production much less laborious.

Separate reaper-binders and threshers have largely been replaced by machines that combine all of their functions, that is combine harvesters or combines. However, the simpler machines

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remain important as appropriate technology in low-capital farming contexts, both in developing countries and in developed countries on small farms that strive for especially high levels of self-sufficiency. For example, pedal-powered threshers are a low-cost option, and some Amish sects use horse-drawn binders and old-style threshers.

Modern day combine harvesters (or simply combines) operate on the same principles and use the same components as the original threshing machines built in the 19th century. Combines also perform the reaping operation at the same time. The name combine is derived from the fact that the two steps are combined in a single machine. Also, most modern combines are self-powered (usually by a diesel engine) and self-propelled, although tractor powered, pull type combines models were offered by John Deere and Case International into the 1990s.

India is set to grow soybeans on more land in the 2019 crop year as higher prices for the oilseed push some farmers to switch from cultivating competing commodities such as cotton and pulses, an industry official and dealers told Reuters. Increased production of India's main summer-sown oilseed could help the world's biggest vegetable oil importer trim costly purchases from Brazil, Argentina, Indonesia and Malaysia.

Most Indian farmers typically begin cultivating soybeans, cotton and pulses, which are rain-fed crops, in June after the arrival of the monsoon. State of Maharashtra and central India's Madhya Pradesh account for more than 80 percent of the country's total soybean output. Both states could receive lower-than-normal rainfall in 2019, according to private weather forecaster Skymet.

In Maharashtra, soybean is cultivated on an area of 3.8 M ha with production of 3.07 m ton with second rank in India. However, low productivity of the crop remains a major problem of soybean cultivation, necessitating the need to ascertain the problems faced by soybean growers. Therefore, a study was conducted in the 20 villages of five Dist.ricts of western Maharashtra. A survey method using personal interview of 100 farmers and focused group discussion with villagers, were used for data collection during the year 2013-14. Study found that labour problems, irrigation facilities, weed management, marketing of produce, pest and disease management were the top five constraints faced by the farmers in soybean cultivation.

Materials and Methods

The present study on tractor operated thresher was carried out to evaluate the performance of the thresher during the threshing operation of soyabean. This chapter deals with the methods adopted for performance evaluation the tractor operated thresher& equipment used for conducting the experiment.

Selection of machine for test

Machine available with the farmer has been selected for the testing and performance evaluation.

Machine component parts and their functions

Each of the machine member parts was measured according to the working diagram specification. They were cut and joined together to form the complete machine. The machine was fabricated in order to serve as a soybean thresher for small- and medium-scale industries. It

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is designed to be powered by electric motor. It consists of the following parts: the hopper, shelling unit, blower, grain outlet, shaft, the spout, frame and base, pulley and bearing.

1. The hopper: This is the receptive part of the machine for onward transportation into the shelling compartment. It is a trapezoid in shape in order to allow easy flow of materials (soybeans) into the machine.

2. Shelling unit: This comprises the sieve spiels and it carries the hopper at the top. This unit is cylindrical in shape and it is divided into two equal parts, with the sieve/screen at the bottom. The sieve aids the transportation of the threshed soybeans to the sieve. It also reduces the amount of chaff that passes through the fan housing.

3. Spout: The sieve is embedded inside the spout. It is hollow and opens to the fan housing, which is the cleaning unit. The spout transfers the thresher compartment into the cleaning unit.

4. Grain outlet: The grain outlet is an opening which collects the clean grain as they drag from the concave into the collecting tray.

5. Blower: This is an enclosure of the cleaning unit, where the cleaning operation is carried out. It also helps to remove dust and high thrash materials from the desired grain.

6. Frame: The frame is a structural member of the thresher into which fittings of the new component is directly attached on. The frame is very strong because of the Distortion and its flexibility will affect the stability of the machine, which can lead to personal hazards.

7. Pulley: This transmits power from the source (electric motor) to other moving parts of the machine through the use of a belt.

Tests: The testing of tractor operated thresher has been done according to Indian Standard (IS) test codes. The list of IS test codes which were used are as follows:

IS: 6284-1985 (Test code for power operated thresher for cereals)

IS: 9020-2002 (Test code for power thresher – safety requirements)

Type of test

Checking of specification:

The specifications of the thresher were checked as mentioned and data was recorded in Specification Sheet:

Visual observations and provision for adjustments:

The observations were recorded in Data Sheet as given in Appendix B.

Test at load

Short run: The thresher is installed on level preferably on a hard surface and set the clearance,screen slope,etc,as per recommendations.

The sufficient quality of crop of the soyabean has been taken. The moisture content of that soyabean was 6 – 14 percent.

During short run test, three sets of samples at an interval of about 20 minutes at the following outlets for duration of 60 seconds has been taken.

1) Main grain outlet

2) Sieve outlet

3) Straw outlet

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i) Losses

1) Percentage of broken grain

A = B + C + D

Where,

A = total grain input pet unit time

B = quantity of grain collected from all grain outlets per unit time

C = quantity of broken grain collected from all grain outlets per unit time

D = quantity of unthreshed grain collected from all grain outlets per unit time

Therefore, percentage of broken grain = $\frac{C}{A}$ x 100

Where,

C = quantity of broken grain collected from all grain outlets per unit time,

A = total grain input per unit time.

2) Percentage of blown grain = $\frac{G}{A}$**x 100**

Where,

G = quantity of clean grain collected at straw outlet per unit time,

A = total grain input per unit time.

3) Percentage of unthreshed grain = $\frac{D}{A}$**x 100**

Where,

D = quantity of unthreshed grain collected from all outlets per unit time,

A = total grain input per unit time.

4) Percentage of spilled grain = $\frac{J}{A}$**x 100**

Where,

J = quantity of clean grain obtained at sieve overflow and underflow per unit time,

A = total grain input per unit time.

ii) Efficiency:

1) Threshing efficiency = 100 – percentage of unthreshed grain

2) Cleaning efficiency = $\frac{M}{F}$ **x 100**

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Where,

M = quantity of clean grain obtained from the sample taken at main grain outlet

F = total quantity of the sample taken at main grain outlet

Fig: Evaluation Time

iii) Capacity:

1) Rated input capacity: The feed rate at which efficiencies are within the specified limits of the relevant Indian standards is known as rated input capacity.

2) Output capacity: The mass of grain mixture received at all grain outlets when collected at rated input capacity is known as output capacity.

iv) Visual observations: The observations and adjustments are recorded in data sheet

Long run test:

Operate the thresher for at least 5 hours at load, which should be covered by continuous run of at least 5 hours.

Pre-Test observations:

Three samples of the crop are each weighing about one kilogram. Separate the grains from the stalks manually for each sample, take the mass of grain and straw separately for each sample

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and express it as the percentage of the mass of the crop sample. The average of the three samples shall be taken as the grain crop ratio.

Material and instruments required

To measure the specification of machine and to test its performance, following material and instruments were required:

a) Meter tape (5m): A tape measure or meter tape is a flexible ruler and used to measure distance. It consists of a ribbon of cloth, plastic, fiber glass, or metal strip with linear-measurement markings. It is a common measuring tool and used for dimensional measure of the chaff cutter.

b) Scale: A ruler is a device or instrument used in geometry and technical drawing as well as the engineering and construction industries to measure or draw straight lines.

c) Sample box: It is used to hold the sample of cut pieces of fodder for moisture content measurement and other experiments.

d) Digital caliper: A popular refinement replaces the analog dial with an electronic digital display that displays the reading as a numeric value. Rather than a rack and pinion, these calipers use a linear encoder. It is used to measure the dimensions of the various components of the chaff cutter as well as the cut pieces of the fodder.

Result and Discussion

This chapter presents the analysis and interpretation of experimental results of all the phases of the study. The results obtained from the general tests, test at load and pre-tests of tractor operated thresher on the basis of the methods adopted were presented in this chapter.

Specifications of machine

The specifications of tractor operated soybean thresher

Visual observations and provision for adjustments:

The thresher is installed on level preferably on a hard surface and set the clearance, screen slope, etc. as per recommendations. During short run test, three sets of samples at an interval of about 20 minutes at the following outlets for duration of 60 seconds has been taken and the obtained data is furnished in Table 4.1

Table 4.1 Observations of short run test

Sr. no.	**1**	**2**	**3**
Threshing drum speed	540	540	540
Feed rate (kg/hr)	1213	1300	1347
Grain output	754	782	793
Grain crop ratio	0.712	0.567	0.608

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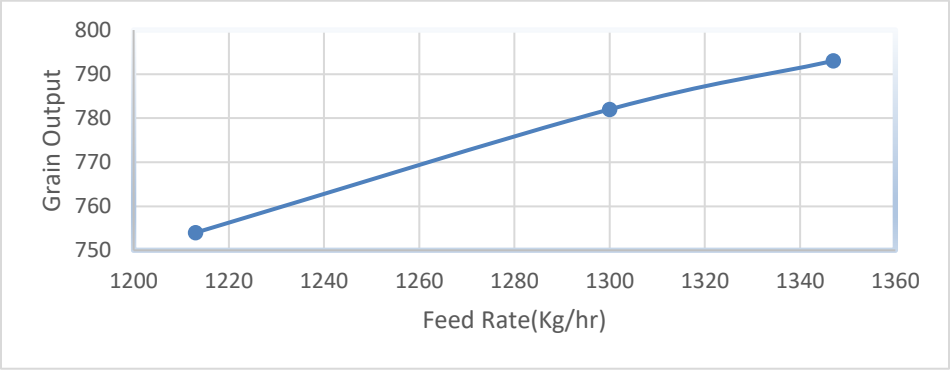
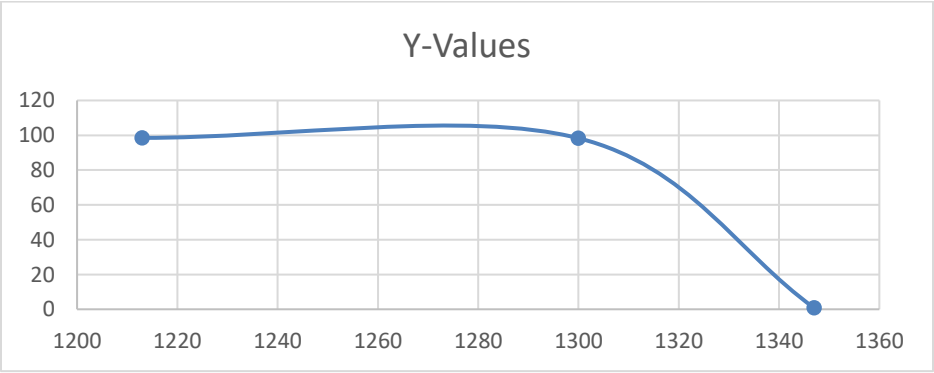
Unthreshed (%)	1.51	1.68	0.82
Broken (%)	0.72	0.82	0.89
Blown (%)	0.79	0.9	1.01
Spilled (%)	1.59	1.71	1.39
Total machine losses (%)	4.61	5.11	5.12
Cleaning efficiency	98.36	98.39	98.12
Threshing efficiency	98.49	98.32	98.18

Effect of feed rate on grain output

The threshing drum speed of 540 rpm, the grain crop ratio, percentage of unthreshed grain, percentage of broken grain, percentage of blown grain, percentage of spilled grain are 0.629%, 1.33%, 0.81%, 0.9%, 1.56%, respectively. The total machine loss is found that 4.94 %. Also the cleaning efficiency and threshing efficiency was found 98.29% and 98.30% respectively.



Graph 1: Feed Rate Vs Grain Output



Graph 2: Feed Rate Vs Threshing Efficiency

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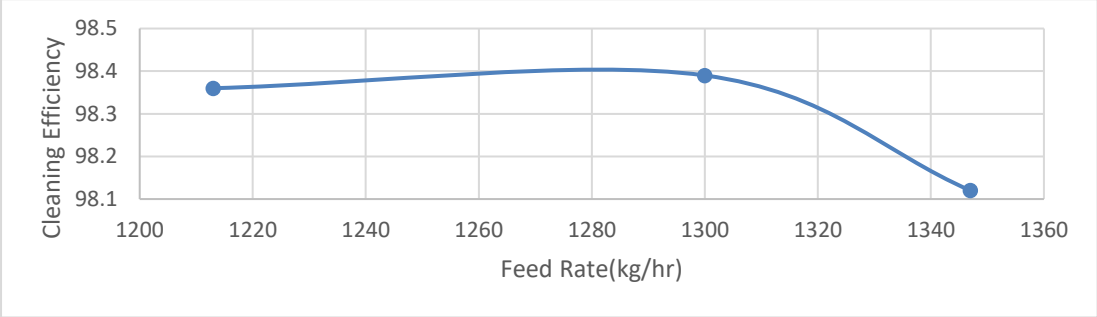
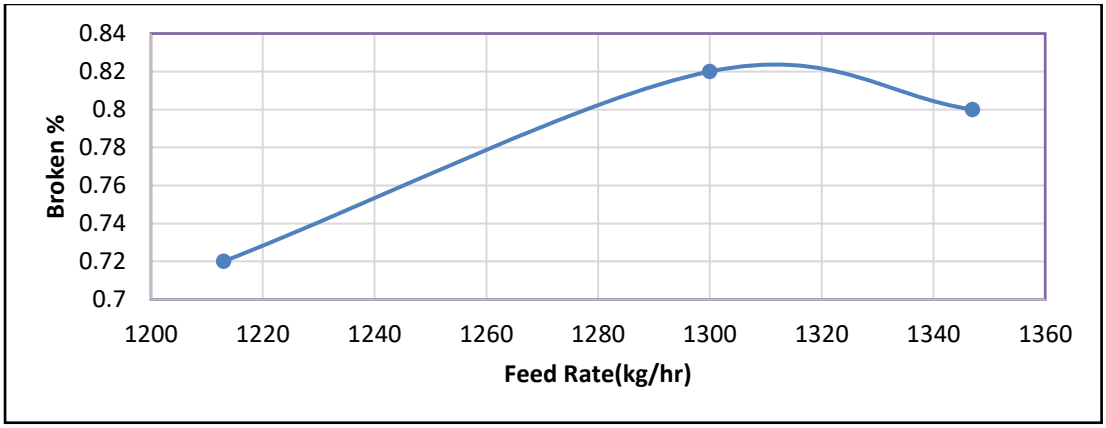


Graph 3 : Feed Rate Vs Cleaning Efficiency



Graph 4: Feed Rate Vs Broken %

Long run test:

Operate the thresher for at least 5 hours at load, which should be covered by continuous run of at least 5 hours. The data collected by observations is furnished in table 4.2

Table 4.2 Long run test

Sr. no.	**1**
Duration of test (hr)	5
Threshing drum speed (rpm)	550
Avg. M.C. of grain (%)	14
Avg. M.C. of Straw (%)	12
Fuel consumption (l/hr)	4.2
Input capacity (kg/hr)	1238
Output capacity (kg/hr)	762

For long run test the thresher was continuously run for 5 hrs at the threshing drum speed of 550 rpm. The average moisture content of grain and straw was found to be 14% and 12% respectively. The fuel consumption was found to be 4.2 l/hr so that for total 5 hrs duration 21 liter of total fuel consumption was occurred.

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Pre-test observations:

Grain-Crop Ratio:

Some samples of the crop each weighing about one kilogram. The grain was separated from the stalks manually for each sample, the mass of grain and straw separately taken for each sample and expressed it as the percentage of the mass of the crop sample. The average of the three samples was taken as the grain crop ratio. The data collected is furnished in table 4.3.1

Determination of Grain-crop ratio

Sr. no.	Grain (gm)	Other (gm)	Grain-crop ratio (%)
1.	416	584	0.712:1
2.	362	638	0.567:1
3.	378	662	0.608:1

Table: Moisture content of Grain and Straw

Sr. no.	Grain			Straw		
	Total mass of grain	Final Mass of grain	Loss of mass (%)	Total mass of straw	Final mass of straw	Loss of mass (%)
1.	100	86	14	50	44	12
2.	100	86	14	50	44	12
3.	100	85	15	50	45	10

The moisture content of grain and straw was found to be 14% and 12% respectively.

Conclusion

The detailed study is carried out on effect of seed threshing mechanism on quality of soybean seed. Poor quality in some soybean seed during storage can be due to their physiological characteristics or mechanical causes. The data on physical properties of soybean seed threshing by different methods is to be generated. The purpose of this investigation was to evaluate the effects of different threshing methods. Traditional threshing methods followed by farmers involved trampling of crop under feet, beating of shelves on hard slant surface, beating crop with a flail, treading a layer of 150to 200mm thick harvested crop by a team of animal. These traditional methods are not only time consuming and involves drudgery but also have poor efficiency and very low out- put. The thresher available with the farmer was selected for testing. The parameters used for performance testing was the percentage of broken grain, percentage of blown grain, percentage of unthreshed grain, percentage of spilled grain, threshing efficiency and cleaning efficiency etc.

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The thresher is attaches to the power source of 35 hp Mahindra tractor.

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