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Evaluate The Field Performance Of Wheel Type Combine Harvester For Different Varieties Of Paddy Crop

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Abstract
The present study entitled "Performance evaluation of self propelled combine harvester for paddy crop" was conducted at research farms of JNKVV, Jabalpur (M.P.) during November-December 2019. Clearly depicted that the effective field capacity was 0.64 ha/h, 0.69 ha/h and 0.74 ha/h for variety Kranti with average forward speed was 2.7 km/h, 2.8 km/h and 2.9 km/h respectively. Similarly, the effective field capacity was 0.65 ha/h, 0.69 ha/h and 0.76 ha/h found to be for variety JR-206, 0.64 ha/h, 0.71 ha/h and 0.78 ha/h for variety JR-81, 0.67 ha/h, 0.71 ha/h and 0.78 ha/h for variety IR-64 with their corresponding speeds of 2.7 km/h, 2.8 km/h and 2.9 km/h. The speed of operation of self propelled combine harvester in black cotton soil vary between 2.7 km/h to 2.9 km/h.

INTRODUCTION

India is one of the world's largest producers of rice (Oryza sativa). Rice contributes more than 40 per cent of the country's total food grain production. According to the data released by the government of India, the total rice production in India stands at 104.32 million for the year 2015-2016. India could achieve a record rice production of 100 million tonnes in 2010-11 crop year on the back of better monsoon this year. India's rice production reached to a record high of 104.32 million tonnes in 2011-2012 crop year (July–June).
Harvesting and threshing operations may be done separately or in "one go" depending upon the availability of equipment. Fast and efficient method of harvesting is the immediate need of the farmers. At such stage, when timeliness of harvesting and threshing operations is the main criterion, the use of combine harvester for the harvesting of the crop should be the most appropriate. Nowadays, combine harvesters are becoming popular among farmers as it performs cutting, threshing and winnowing operations simultaneously thus saving the time, drudgery and labour involved in these operations.

MATERIALS AND METHOD-

The present study entitled "Performance evaluation of self propelled combine harvester for paddy crop" was conducted at research farms of JNKVV, Jabalpur (M.P.) during November-December 2019. The model Preet 849 combine harvester was tested for paddy crops with different treatments.

Functional components of combine harvester

Five major operations are accomplished by the self propelled combine harvester during the harvesting. These may be classified as (1) picking up and cutting the standing crop and feeding to the threshing cylinder (2) threshing the grain from ear head (3) Separating the grain from the straw (4) cleaning the grain and (5) handling the grain after threshing. These operations are performed automatically as the material is moved through different system of combine harvester. (Presented **fig.1**)

fig.1 Functional components of combine harvester operations are performed automatically

Technical Specification

Technical specification of self propelled combine harvester presented in Table.no.1

Table 1. Technical specification of self propelled combine harvester.

A. MODEL	Preet-849
B. ENGINE	
Model	ALUW-04D
Power	76 PS @ 2200 RPM
No. of cylinder	Four
Cooling system	Water cooled
C. CUTTER BAR MECHANISM	
Cutter bar width (m)	3.42
Cutting height (mm)	30-1290
Reel drive	Chain and sprocket
Reel height adjustment	Hydraulic
D. THRESHING MECHANISM	
D1.THRESHER DRUM	**Peg tooth**
Width (mm)	890
Diameter of thresher drum (mm)	605
Speed (rpm)	540-1200
Speed adjustment	By means of mechanical variator
D2. CONCAVE	
Length (mm)	790
Clearance	
Front (mm)	17
Rear (mm)	17
D3. CLEANING SIEVES	
Upper sieve area (m^2)	1.4
Lower sieve area (m^2)	1.2
D4. STRAW WALKER	
No. of straw walker	4
No. of steps	4
Length (mm)	2500
Width (mm)	210
E. CAPACITY	
Grain tank (M^2)	1.7
Fuel tank (Ltr.)	160
F. ELECTICAL SYSTEM	
Capacity and Rating	12V, 100Ah Battery starting lighting equipment, front and rear lights
G. TYRE	**SIZE**
Front	16.9 – 28
Rear	7.50 – 16
H. MAIN DIMENSIONS (APPROX.)	
Length (mm)	7280
Width (mm)	3800
Height (mm)	3330
Ground clearance (mm)	380
Total weight (kg.)	6460 Approx.

RESULT

The data were collected at three different speeds i.e. 2.7km/h, 2.8 km/h,2.9km/h during the field evaluation trails. The data collected were analyzed to determine the field efficiency (%), effective field capacity (ha/h), total harvesting losses (%), crop throughput (t/h), straw output (kg/h and kg/ha).The cost of operation was calculated

for the combine and compared with conventional one for all the four varieties i.e. Kranti, JR-206, JR-81 and IR-64 individually and operation wise and source wise energy requirement were determined.

4.1 Performance evaluation of self propelled combine harvester for different varieties and speed of operation.

Table 4.1 Field performance of self propelled combine harvester forkranti

Parameters	S1	S2	S3	Average Results
Average forward speed, (km/h)	2.7	2.8	2.9	2.8
Width of cutter bar, (m)	3.4	3.4	3.4	3.4
Total harvested time, (sec/ha)	5631.6	5187.0	4890.6	5236.4
Actual harvested time, (sec/ha)	3831.6	4172.0	3590.6	3864.7
Effective field capacity, (ha/h)	0.64	0.69	0.74	0.69
Theoretical field capacity, (ha/h)	0.91	0.95	0.98	0.94
Field efficiency, (%)	70.32	72.63	75.51	72.82

Table 4.2 Field performance of self propelled combine harvester forJR-206

Parameters	S1	S2	S3	Average Results
Average forward speed, (km/h)	2.7	2.8	2.9	2.8
Width of cutter bar, (m)	3.4	3.4	3.4	3.4
Total harvested time, (sec/ha)	5483.4	5187.0	4742.4	5137.6
Actual harvested time, (sec/ha)	3783.4	4187.0	3542.4	3837.6
Effective field capacity, (ha/h)	0.65	0.69	0.76	0.70
Theoretical field capacity, (ha/h)	0.91	0.95	0.98	0.94
Field efficiency, (%)	71.42	72.63	77.55	73.86

Table 4.3 Field performance of self propelled combine harvester forJR-81

Parameters	S1	S2	S3	Average Results
Average forward speed (km/h)	2.7	2.8	2.9	2.8
Width of cutter bar (m)	3.4	3.4	3.4	3.4
Total harvested time (sec/ha)	5631.6	5038.8	4594.2	5088.2
Actual harvested time (sec/ha)	3931.6	4018.8	3394.2	3781.5
Effective field capacity (ha/h)	0.64	0.71	0.78	0.71
Theoretical field capacity (ha/h)	0.91	0.95	0.98	0.94
Field efficiency (%)	70.32	74.73	79.59	74.88

Table 4.4 Field performance of self propelled combine harvester forIR-64

Parameters	S1	S2	S3	Average Results
Average forward speed (km/h)	2.7	2.8	2.9	2.8
Width of cutter bar (m)	3.4	3.4	3.4	3.4
Total harvested time (sec/ha)	5335.2	5038.8	4594.2	4989.4
Actual harvested time (sec/ha)	3735.2	4138.8	3494.2	3789.4
Effective field capacity (ha/h)	0.67	0.71	0.78	0.72
Theoretical field capacity (ha/h)	0.91	0.95	0.98	0.94
Field efficiency (%)	73.62	74.73	79.59	75.98

4.1.1 Effect of speed on effective field capacity:

Table 4.1 to 4.4 showed that the average value of effective field capacity of combine with different treatments. The speed of operation of self propelled combine harvester varied between 2.7 km/h to 2.9 km/h.

Fig 4.1 clearly depicted that the effective field capacity was 0.64 ha/h, 0.69 ha/h and 0.74 ha/h for variety Kranti with average forward speed was 2.7 km/h, 2.8 km/h and 2.9 km/h respectively. Similarly, the effective field capacity was 0.65 ha/h, 0.69 ha/h and 0.76 ha/h found to be for variety JR-206, 0.64 ha/h, 0.71 ha/h and 0.78 ha/h for variety JR-81, 0.67 ha/h, 0.71 ha/h and 0.78 ha/h for variety IR-64 with their corresponding speeds of 2.7 km/h, 2.8 km/h and 2.9 km/h respectively.

Speed may be little less in Jabalpur as compared to other places and it was due to Vertisoil i.e. sub classification of black cotton soil. This type soil is very hard and having cracks on the surface of the field, so its affected the speed of operation, As the width of cutter bar was fixed i.e. 3.4 m for all operations, so effective time of operation was mainly depended on the average forward speed of combine. It is clear from data that as speed of combine

increases effective field capacity increases for all varieties effective field capacity could have further be improved by operating in higher speed or by using larger size of cutter bar width.

Fig. 4.1 Effective field capacity at three different speed with four varieties of paddy

4.1.2 Effect of speed on field efficiency:

The speed of operation of self propelled combine harvester in black cotton soil vary between 2.7 km/h to 2.9 km/h. The average values of field efficiency are given in Table 4.1 to 4.4. Fig 4.2 shows the field efficiency obtained with different forward speed for four different variety of paddy.

The width of cutter bar was 3.4 m for all operations, so field efficiency was mainly depended on the average forward speed of combine harvester. Field efficiency increases from 70.32 to 75.51 per cent with the Kranti variety, 71.42 to 77.55 percent for the JR-206 variety, 70.32 to 79.59 percent for the JR-81 variety and 73.62 to 79.59 percent for IR-64 variety respectively as the speed increases from 2.7 km/h to 2.9 km/h.

For time requirement for cleaning, turning, clog removing and unloading of combine at the end of row and idle time were little different, so the field efficiency at same forward speed also varied.

Field efficiency was improved by removing the bunds in the field and making individual fields of larger size. The presence of bunds had no significance as most of the fields were irrigated by sprinkler.Time lost in turning of combine varied with change in operator. The field efficiency could have improved by providing additional labor for unloading and cleaning and clog removing. Idle travel time could have been reduced if sowing was uniform.By increasing the forward speed the field efficiency increased but probably harvesting losses also increased.

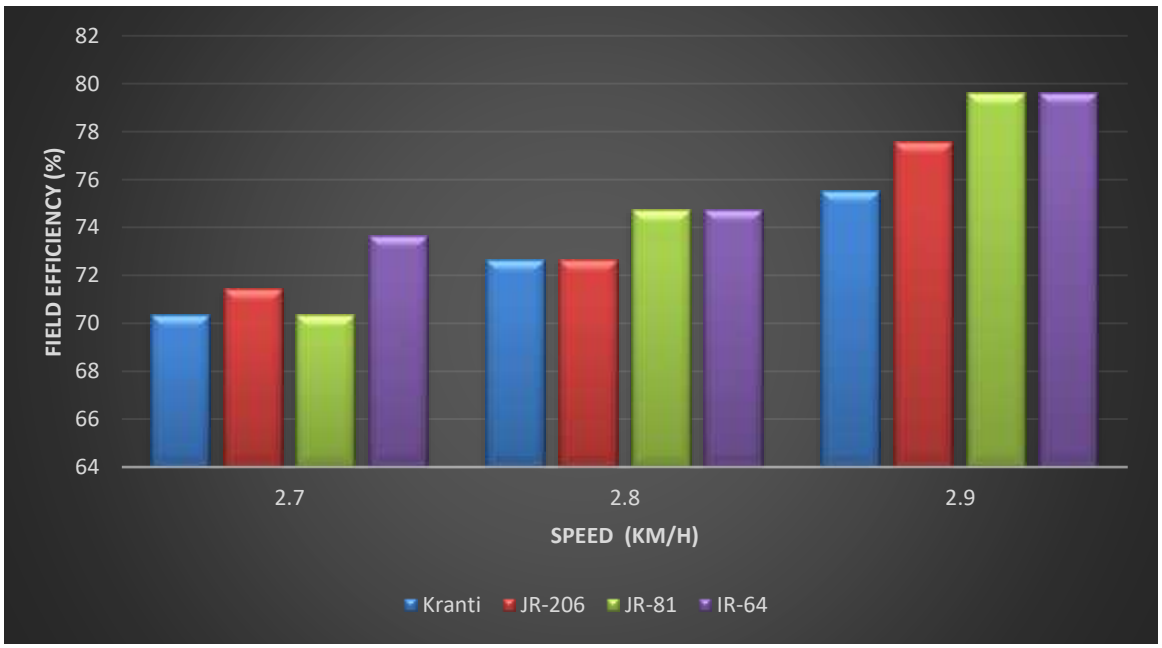

Fig 4.2 Field efficiency at three different speeds with four varieties of paddy

DISCUSSION

The direct and indirect energy was calculated.In the case of direct energy, energy consumption in combine harvesting was 1505.11 MJ/ha and energy consumption in transporting was 292.99 MJ/ha. The value of energy coefficient for human is 1.96 MJ, heavy machinery is 62.70 MJ and diesel is 56.31 MJ. (Ojha and Michael, 2016) The value of Load coefficient factor for heavy machinery is 0.7.

In the case of Indirect energy, energy consumption in combine harvesting was 405.04 MJ/ha and energy consumption in transporting was 12.60 MJ/ha.The value of Total energy (Direct energy + Indirect energy) was 2215.74 MJ/ha.

Summery

The study was conducted at three different speeds and four different varieties which are used in Madhya Pradesh. The results can be summarized as below:

1. Effective field capacity was found to be 0.64 ha/h, 0.69 ha/h and 0.74 ha/h for Kranti, 0.65 ha/h, 0.69 ha/h and 0.76 ha/h for JR-206, 0.64 ha/h, 0.71 ha/h and 0.78 ha/h for JR-81 and 0.67 ha/h, 0.71 ha/h and 0.78 ha/h for IR-64 with the corresponding speed of 2.7 km/h, 2.8 km/h and 2.9 km/h respectively. So we can elucidated that by increasing forward speed of combine effective field capacity increased.
2. The average value of field efficiency for Kranti, JR-206, JR-81 and IR 64 was observed to be 72.82%, 73.86%, 74.88% and 75.98% with the corresponding speed of 2.7 km/h, 2.8 km/h and 2.9 km/h respectively. So it is observed that field efficiency was directly proportional to the forward speed of combine harvester.

CONCLUSION

The effective field capacity of the combine harvester was observed at three different forward speeds for each rice variety:

Kranti: 0.64 ha/h, 0.69 ha/h, and 0.74 ha/h, JR-206: 0.65 ha/h, 0.69 ha/h, and 0.76 ha/h, JR-81: 0.64 ha/h, 0.71 ha/h, and 0.78 ha/h, IR-64: 0.67 ha/h, 0.71 ha/h, and 0.78 ha/h.

From these observations, it can be concluded that increasing the forward speed of the combine harvester leads to an increase in effective field capacity.

The average field efficiency for each variety, corresponding to forward speeds of 2.7 km/h, 2.8 km/h, and 2.9 km/h, was:

Kranti: 72.82%, JR-206: 73.86%, JR-81: 74.88%, IR-64: 75.98%

Thus, it is observed that field efficiency increases with forward speed, indicating a direct proportional relationship between the two.

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