ISSN 2347 – 3819 EISSN 2347 – 386X

discovery Agriculture

Effect of Wheat Crop Varieties on Plot Combine Harvester

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Received 27 August; accepted 19 October; published online 01 November; printed 16 November 2013

ABSTRACT

The performance of the plot combine harvester manufactured by M/ S Wintersteiger, Austria (Model: Nursery Master Elite) was evaluated different varieties of wheat crop. The minimum and maximum sieve loss were found 0.28 and 0.0.92 % for variety UP 2592 and UP 2565. The shaker loss was observed minimum i.e. 0.21 % in case of variety UP 2592 while maximum i.e. 0.35 % for UP 2590. The performance efficiency was found to vary between 98.50 to 99.14%. Statistical analysis (ANOVA) shows the types of varieties have significant effect on cylinder loss, shaker loss, sieve loss, total loss, grain breakage, performance efficiency and threshing efficiency at 1% level of significance.

Keywords: Plot combine, threshing efficiency, cylinder loss, total loss, grain breakage.

Abbreviation: UP-Uttar Pradesh, ICAR- Indian Council of Agricultural Research, rpm- Revoluation per minute

How to cite this article
Patel SK, Kumar S, Yaduvanshi BK, Singh PK, Chinchorkar SS, Sayed FG, Khardiwar MS. Effect of Wheat Crop Varieties on Plot Combine Harvester. *Discovery Agriculture*, 2013, 1(2), 73- 76

1. INTRODUCTION

In India today, the rate of food production is matching well with the population growth due to the consistent efforts made by the bio-scientists like agronomists, plant breeders, plant physiologists and agricultural engineers. Together, they have considerable impact in increasing the yield per unit area through varietal development using high inputs and assuming the high degree of risk of imported varietal technology. The yield potential of most of crops has more or less stagnated. But, the population in India is growing at an alarming rate of around 1.93 percent per year. This makes it necessary that the food grain production should also increase at least at the same rate or faster to meet out the total food demand of the masses. Thus, the use of the experimental field plot machinery may contribute considerably in pushing the yield towards the genetic maximum potential of the crop. Hence, mechanization of field operations on experimental plots is considered a key input to the agricultural research. Due to many errors in the handling of the experimental harvest, the small annual genetic gain of 1 % increase in yield made through plant breeding efforts gets unnoticed (Segler, 1977). There are many State Agriculture Universities and ICAR institutions with many affiliated research stations. Even on these research centres the experimental plot machines are not in use (Yadav and Yadav, 1991, Patel and Varshney, 2007). The use of experimental field plot machinery plays an important role in increasing the quantity as well as quality of research work and decreasing the experimental errors in gathering important research data (Oyjord, 1980; Segler, 1977). This can also accelerate the availability of research findings of various research institutions to its users. Instead, manual methods and traditional tools are used. The basic reasons may be attributed to the non-availability of field plot machines or limited information on proper use and performance of these machines. Thus, keeping above importance in view, there is a need to evaluate the performance of imported plot combine harvester for different varieties of wheat crops.

2. MATERIAL AND METHODS

2.1. Details of the Machine

The plot combine harvester manufactured by M/S Wintersteiger, Austria was specially designed to meet the harvesting needs of breeding and agronomical experiments for different crops. The reel height and speeds are adjustable. If the reel is set too low or too high, reel winding

Figure 1
Plot combine harvester

or wrapping may occur. The reel height is hydraulically controlled and its speed may be adjusted to suit the crop and forward speed by a two step pulley. The reel, also, has provision for extension. The cutter bar height may also be adjusted by means of the adjusting screws on the skid shoes and its height is also hydraulically controlled. The combine has a 1.50 m long cutter bar. The feeder conveyor belt of the plot combine has one drive roll and one idler roll. Both may be adjusted but normal tension adjustments are made on the idler roll. The threshing concave has provisions for quick change in clearance adjustments and swinging shaker. The cylinder concave clearance and rotational speed of the cylinder are adjusted from the driver's seat matching the requirement for the different crops. The combine is 5.40 m length, 2.10 m width and 2.40 m height (Figure 1).

2.2. Experimental Methodology

The experiments were conducted to evaluate the effect of varieties of wheat at same moisture content on plot combine losses respectively. For varietals effect operational speed and moisture was 1.5 km/h and 8.5 % respectively.
1. Reel index: 1.25
2. Cylinder speed: 610-640 rpm
3. Concave clearance: 6 mm (front) and 4 mm (rear)

The independent and dependent variables were:
I) Independent variables
Wheat Variety -5 levels: UP 2584, UP 2585, UP 2565, UP 2590 and UP 2592

II) Dependent variables
(a) Cutter bar loss, % (b) Cylinder loss, %
(c) Shaker loss, %
(d) Sieve loss, % (e) Total loss, %
(f) Visible seed damage, %
(h) Performance efficiency, % (i) Threshing efficiency, %

2.3. Analysis of Data

The plot combine performance was evaluated by determining different component losses, seed damage, performance efficiency and threshing efficiency. The gross yield was expressed in terms of net yield and combine losses a follows:

Gross yield = Net yield + combine losses (cutter bar + cylinder + shaker + sieve loss), and Equation 1 to 4.

Total combine loss for a given variety was calculated by summing the header loss, cylinder loss, shaker loss and sieve loss. The visible seed damage was determined by collecting the broken grain from the shaker, sieve and grain tank: Equation 5 to 7.

$$\text{Cutter bar loss},\% = \frac{\text{Cutter bar loss, g}}{\text{Gross yield, g}} \times 100 \quad \text{... (1)}$$

$$\text{Cylinder loss},\% = \frac{\text{Unthressed grain collected from shaker and sieve, g}}{\text{Gross yield, g}} \times 100 \quad \text{... (2)}$$

$$\text{Shaker loss},\% = \frac{\text{Threshed grain collected from shaker, g}}{\text{Gross yield, g}} \times 100 \quad \text{... (3)}$$

$$\text{Sieve loss},\% = \frac{\text{Threshed grain collected from sieve, g}}{\text{Gross yield, g}} \times 100 \quad \text{... (4)}$$

$$\text{Visible seed damage},\% = \frac{\text{Total broken seed, g}}{\text{Gross yield, g}} \times 100 \quad \text{... (5)}$$

$$\text{Performance efficiency},\% = \frac{\text{Total grain in tank, g}}{\text{Gross yield, g}} \times 100 \quad \text{... (6)}$$

$$\text{Threshing efficiency},\% = \frac{\text{Total threshed grain, g}}{\text{Gross yield, g}} \times 100 \quad \text{... (7)}$$

Patel et al.
Effect of Wheat Crop Varieties on Plot Combine Harvester,
Discovery Agriculture, 2013, 1(2), 73-76,

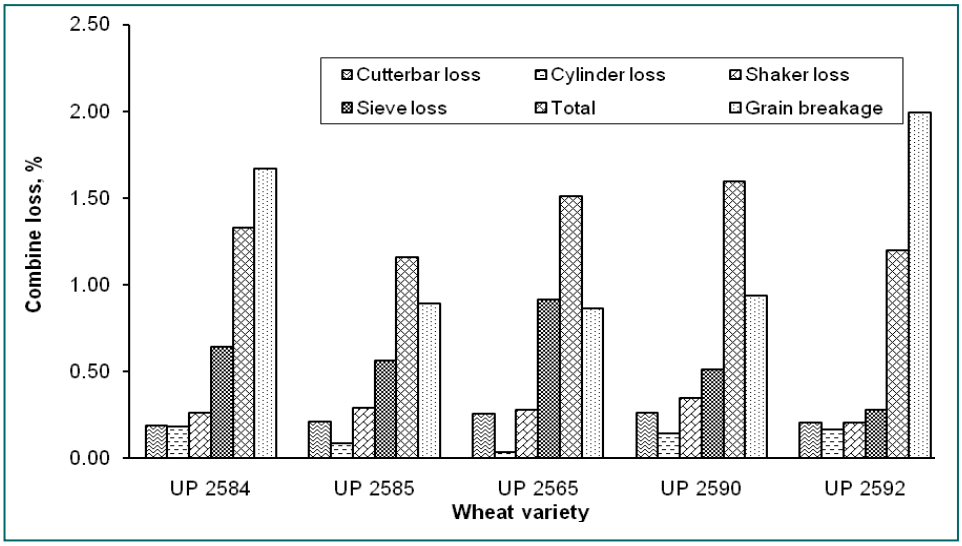

Figure 2

Effect of wheat varieties on different losses of plot combine harvester combine harvester

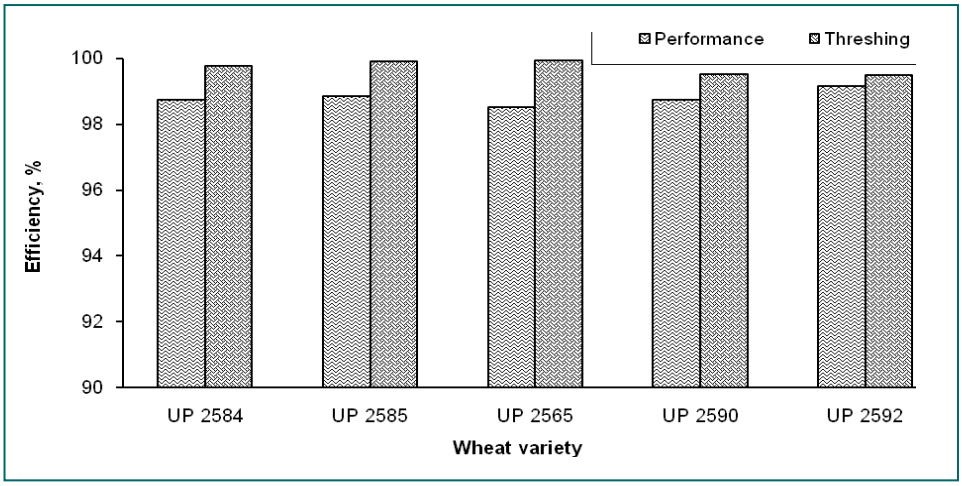

Figure 3

Effect of wheat varieties on efficiency of plot combine harvester

3. RESULTS AND DISCUSSIONS

In order to evaluate the performance of plot combine harvester, two field experiments were carried out at Crop Research Centre of this University during wheat harvesting season, 2003. In the first experiment, the effect of different wheat varieties on various combine losses were evaluated whereas in the second experiment, different combine losses were determined in respect of varying speed of operation as well as moisture content.

3.1. Effects of wheat varieties on various losses of plot combine harvester

The plot combine was tested in the field against five wheat varieties viz. UP 2584, UP 2585, UP 2565, UP 2590 and UP 2592. The cutter bar, cylinder, shaker, sieve, total losses, seed breakage, performance efficiency and threshing efficiency were determined in respect of wheat varieties at 8.46 % (d.b.) moisture content of crop and 1.5 km/h speed of operation of the machine. The data were statistically analyzed and results are presented below.

The cutter bar loss against different wheat varieties are shown in Figure 2. From the figure it is evident that the cutter bar loss was maximum 0.26 % in case of UP 2565 and UP 2590 wheat varieties followed by UP 2585 and UP 2592 (0.21 %) and UP 2584 (0.19 %). The above data indicates that the minimum cutter bar loss of 0.19 % was observed in case of UP 2584 wheat variety. The data of cylinder loss are given in Figure 2. The table indicates that the cylinder loss was found to vary from 0.03 to 0.18 % which was maximum in case of UP 2584 and minimum for UP 2565 wheat variety. Similarly, for other wheat varieties viz. UP 2584, UP 2590 and UP 2592, the cylinder loss was found 0.09, 0.14 and 0.17 % respectively.

Figure 2 shows the data on combine losses in respect of different wheat varieties. The shaker loss was observed minimum i.e. 0.21 % in case of variety UP 2592 while maximum i.e. 0.35 % for UP 2590. Similarly, it was 0.26, 0.28 and 0.29 % for varieties UP 2584, UP 2565 and UP 2585 respectively. Data on sieve loss are presented in Figure 2. The minimum and maximum sieve loss were found 0.28 and 0.0.92 % for variety UP 2592 and UP 2565 respectively followed by UP 2590 (0.51 %), UP 2585 (0.56 %) and UP 2584 (0.64 %). Figure 2 reveals that the total losses were observed to vary from 0.86 to 1.50 % which was maximum in case of UP 2565 variety followed by UP 2590 and UP 2584 (1.27 %), UP 2585 (1.16 %) and UP 2592 (0.86 %).

Figure 2 depicts the relationship between grain breakage in respect of various wheat varieties. The grain breakage was found to vary from 0.87 to 1.99 % for wheat variety UP 2565 and UP 2592, respectively. For remaining wheat varieties, the grain breakage was found 1.67 % (UP 2584), 0.94 % (UP 2590) and 0.90 % (UP 2585). Figure 3 gives the performance efficiency in case of different wheat varieties. The performance efficiency was found to vary between 98.50 to 99.14%. It was maximum for UP 2592 and minimum in case of UP 2565. However, it was 98.73 % for wheat variety UP 2584, UP 2590 and 98.84 % in case of UP 2585. It is clear from the Figure 3 that the threshing efficiency was found maximum 99.95% for variety UP 2565 and minimum in case of variety UP 2592 i.e., 99.49 %. However, it was 99.91, 99.76 and 99.53 % for varieties UP 2585, UP 2584 and UP 2590 respectively. The maximum grain yield was observed 5850.90 kg/ha in case of UP2592 variety followed by UP2585 (5787.00 kg/ha), UP2584 (5362.20 kg/ha), UP2565 (4347.00 kg/ha) and minimum for UP2590 i.e. 4158.40 kg/ha.

Statistical analysis (ANOVA) shows that types of varieties have non-significant effect on cutter bar loss. Whereas the types of varieties have significant effect on cylinder loss, shaker loss, sieve loss, total loss, grain breakage, performance efficiency and threshing efficiency at 1% level of significance however interaction between replication and variety was found non significant.

4. CONCLUSIONS

On the basis of total combine losses, the wheat variety UP 2592 gave minimum losses i.e. 0.86% only which resulted in maximum 99.14 % performance efficiency of the machine. Considering combine losses and grain breakage, it is evident that the plot combine harvester worked quite satisfactorily in case of all wheat varieties. Since total combine losses ranged between 0.86 to 1.50 % and grain breakage varied from 0.87 to 1.99 %. The above data clearly indicate that the combine losses and grain breakage was found very less in comparison to commercial combine

Patel et al.
Effect of Wheat Crop Varieties on Plot Combine Harvester,
Discovery Agriculture, 2013, 1(2), 73-76,

harvesters being used for harvesting different crops in the country.

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Patel et al.
Effect of Wheat Crop Varieties on Plot Combine Harvester,
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