Pak. j. sci. ind. res., vol. 32, no. 7, July 1989

EVALUATION OF PERFORMANCE OF SUNFLOWER THRESHER

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(Received February 14, 1989; revised May 29, 1989)

Threshing is a key operation in the mechanised raising of the sunflower, a crop well-suited to bridging the edible oil gap in Pakistan. Three threshers of the peg, rasp bar and rubber bar type were studied, with various combinations of drum type, drum speed and concave clearance. Based on statistical and graphical analysis of the results, the highest yield and realised on a peg-type cylinder unit with a concave clearance of 4.4 cm, with only moderate grain breakage and fair clearing efficiency.

Key words: Mechanisation, Evaluation, Oilseed threshing.

INTRODUCTION

Pakistan is facing a chronic shortage in edible oils and is spending billions in valuable foreign exchange for its import [1]. This situation may worsen significantly in the future, if current trends of increased per capita consumption of edible oils in the country prevail during the next decade [2]. Realizing this, efforts are being made by policy makers and researchers to increase the domestic production of edible oils.

Due to its short duration (90-100 days), high oil content (40%) and ability to withstand stress conditions [3], sunflower has been viewed as the potential oil crop of the future around the world [4]. In Pakistan, its area has increased 10-fold over the last five years [5]. A tremendous potential for further expansion of area under sunflower in the country exists because of its ability to fit in with cotton-rice-based cropping systems [6]. Availability of farm machinery required for production, protection and harvesting of sunflower is also involved. The role of mechanization of farm operation in maximizing per hectare yield and accelerating the raising of sunflower is well documented [7]. At present threshing is mostly manual which is inefficient, expensive and detrimental to seed quality.

This study was conducted to assess and evaluate the performance of threshers for both quantity and quality of the output, taking into consideration important variables like drum type, drum speed and concave clearance, followed by a recommendation for a suitable unit.

METHOD

Variables. Variables in the study were drum type, drum speed and concave clearance and their effect on thresher output, cleaning efficiency and grain breakage was studied. Three types of drums, namely peg type, rasp bar type and rubber strip type were examined at 500 and 600 rpm, maintaining the concave clearance at 2.54, 4.40 and 6.35 cm. Regional Network on Agricultural Machinery (RNAM) Test Codes and Procedures for Farm Machinery were followed [8].

Machine operation. In determining output, the time required to transport thresher to the field and to install it there were not taken into consideration. After putting the thresher into operation by starting the engine, the drum speed was checked using a tachometer. The speed was then brought to the required level by adjusting the engine, while continuing with normal sunflower seed feeding at the inlet end. The thresher was run continuously, and the speed was checked from time to time. At the desired steady drum speed, samples from the output end were collected for 5 mins for each combination of drum speed and concave clearance on each type of thresher. The machine was operated for 6 hr. Samples were collected at one-hour intervals. Immediately before sample collection, the drum speed and concave position were reconfirmed.

Data collection

Output. Five samples, each for 5 mins duration, were collected for each combination of speed and concave clearance on each thresher. Average output of these 5 samples were determined, and converted to kilogram per minutes.

Cleaning efficiency. Grains and other materials (straw etc.) were separated manually from the samples drawn, and each portion was weighed separately. The percentage cleaning efficiency (C.E.) was given by:-

$$\text{C.E.} = \frac{\text{Grain weight}}{\text{(Grain + other materials) wt.}} \times 100$$

Cleaning efficiency for 5 samples for each combination on each machine were calculated separately, and averages were determined for each combination.

Grain breakage. From the clean sample (free from other materials) the whole grains and broken grains were sorted out manually. Then the percent grain breakage (G.B.) was calculated as:

$$\text{G.E.} = \frac{\text{Weight of broken grain}}{\text{Weight of total grain}} \times 100$$

Nature of design. The experimental design had three factors, *viz.* drum type, drum speed and concave clearance, with three, two and three levels respectively. The model can be written as follows:

$$Yijkl = M + Di + Sj + Ck + (DS)ij + (DC)ik + (SC)kj + (DSC)ijk + Eijkl$$

$$i - 1, 2, 3; j = 1, 2; k = 1, 2, 3 \text{ and } l = 1, 2, 3.$$

in which D, S and C represent drum type, drum speed and concave clearance, and E is the component of random error with the usual assumptions. The data were analyzed using MSTAT.

RESULTS AND DISCUSSION

Table 1 shows that the output of the machine was found significantly different among the drum types. The interaction between drum types and drum speed was also significant. However, no significant interaction was found between drum speed and concave clearance. The interactions between concave clearance and drum type and speed were also non-significant. In regard to cleaning efficiency also, the results were similar to those noted in respect of output, with the difference of a highly significant interaction between drum type and concave clearance.

Table 1. Analysis of variance showing of results on output, cleaning efficiency and grain breakage.

SOV	DF	Output (kg/min) MS	Output (kg/min) F-Value	Cleaning efficiency (%) MS	Cleaning efficiency (%) F-Value	Grain (breakage (%) MS	Grain (breakage (%) F-Value
Drum	2	58.446	33.29**	496.746	8.80**	15.093	7.00**
Speed	1	5.185	2.95NS	146.883	2.60NS	0.923	0.43**
Drum* Speed	2	9.394	5.35**	364.746	6.46**	3.875	1.80NS
C.C.	2	3.004	1.75NS	75.510	1.34NS	2.011	0.93
Drum* C.C.	4	0.332	0.19	228.837	4.05**	6.785	3.15*
S* C.C.	2	0.290	0.17	51.630	0.91	1.316	0.61
D*S*C.C	4	0.372	0.21	45.650	0.91	3.327	1.54NS
Error	36	1.756	–	56.453	–	2.157	–

*Significant at 5 percent; **Significant at 1 percent.

In regard to grain breakage, the drum type was found to be highly significant, with a significant clearance.

From the behaviour of different variables, a combination must be sought with high output, high cleaning efficiency and low grain breakage. This seems to be a tall order: while the data in Table 2 show a we have a maximum output of 8 kg per minute for drum type-1 with drum speed 600 rpm and concave clearance 6.35 cm this combination does not give the best results in terms of cleaning efficiency and grain breakage.

Cleaning efficiency and grain breakage play a pivotal role in the disposal of the farmer's crop to the market. Data in Table 1 show that drum speed does not significantly affect the efficiency of the thresher with regard to output, cleaning efficiency and grain breakage. So either 500 or 600 rpm can be employed. To understand the above behaviour visually, the concave clearance was plotted against other variables, as shown in Fig. 1, 2 and 3. these show that best choice would be a peg type cylinder with a concave

Table 2. Interaction means for output, cleaning efficiency and grain breakage.

Drums	Speed (500 rpm) C_1	C_2	C_3	Speed (600 rpm) C_1	C_2	C_3
Output (kg/min)						
I	5.67	6.67	6.92	7.17	7.50	8.00
II	5.42	5.67	5.67	4.08	4.87	4.75
III	1.75	2.63	3.17	4.25	3.75	4.75
Cleaning efficiency (%)						
I	69.95	70.83	62.22	58.80	64.53	60.92
II	72.72	65.30	70.93	78.02	73.42	90.63
III	73.93	69.15	62.00	83.02	71.15	66.23
Grain breakage (%)						
I	1.94	3.74	3.78	4.17	2.91	4.80
II	4.59	4.87	4.18	4.26	3.20	3.92
III	6.60	6.82	3.92	4.01	6.87	3.94

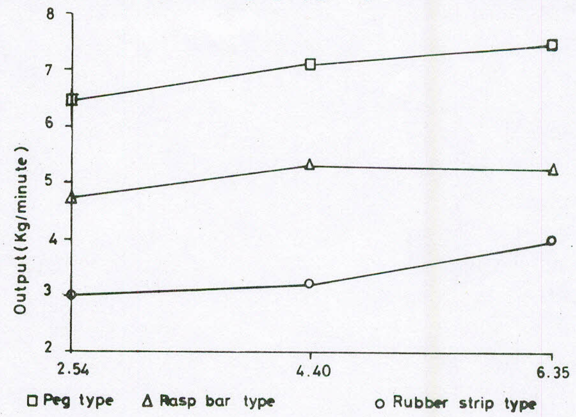

Fig. 1. Relationship between output and concave clearance for different drum types.

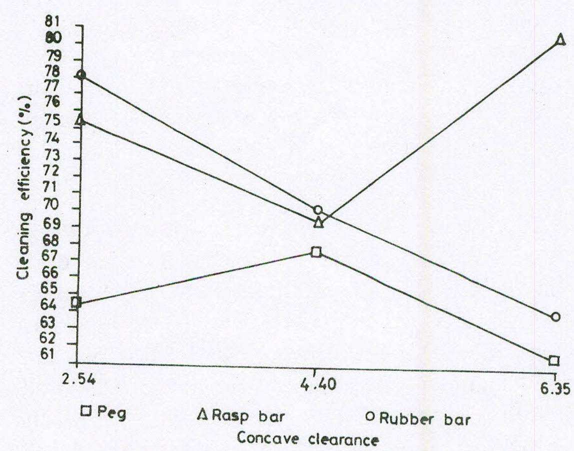

Fig. 2. Relationship between cleaning efficiency and concave clearance for different drum types.

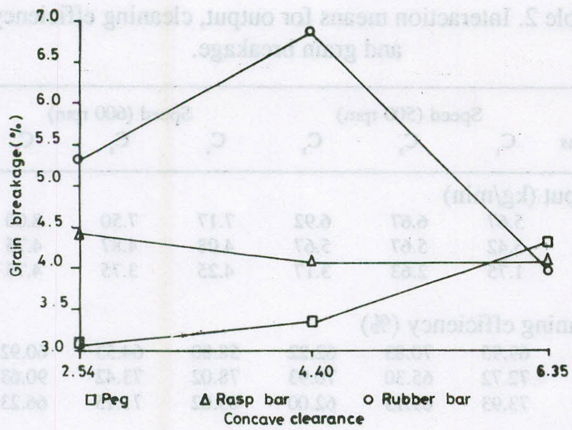

Fig. 3. Relationship between grain breakage (%) and concave clearance for different drum types.

clearance of 4.4 cm and this design can be recommended for manufacture of the thresher. Varietal aspects of the sunflower seed crop would also be need to be examined in future studies.

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