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5. SUMMARY AND CONCLUSION:

The main aims of the present study is to solve the problems which face the mechanical threshing of sunflower crop by designing a prototype working with an electric motor, suitable for small farmers to produce sunflower for various usage such as eating or oil extraction and to select the suitable conditions for sunflower threshing. That was by:-

1- Study some physical and engineering properties of the sunflower plant and seed.

2- Study the different prevailing methods used in threshing sunflower in Egypt.

3- Development and testing a threshing machine to suit the head threshing of sunflower variety with a little consumption of electric energy.

4- Determining the seed quality, threshing efficiency and threshing capacity.

5- Economical evaluation of the proposed sunflower thresher.

The experiments were carried out at El-serw Agriculture Research Station, Damietta Governorate.

The design bases for the local thresher are as follow:

1- Cylinder speeds:

Three cylinder speeds were chosen (8.3, 10.9, and 14.7 m/s) which were named S_1, S_2 and S_3 respectively.

2- Using three concave clearances:

They were 2, 3 and 4 cm. They were named C_2, C_3, and C_4 respectively.

3- Using three drum positions:

A- Using 2 rows of spike teeth each of them contain 4 teeth (8 teeth).

B- Using 3 rows of spike teeth each of them contain 4 teeth (12 teeth).

C- Using 6 rows of spike teeth each row contained 4 teeth (24 teeth).

They were named Position (A, B, and C) respectively.

4- Crop moisture content:

Three levels of moisture content were (19, 14 and 10 %). they were named M_1, M_2 and M_3 respectively.

The machine performance was evaluated according to following criterions:

1- Threshing efficiency.

2- Seed quality.

3- Threshing capacity.

5-1. The effect of the tested parameters on machine performance:

5-1-1. Effect of spikes number:

A- The minimum percentage of un-threshed seeds and high percentage of threshing efficiency, recorded at position (C) at all levels of moisture (M_1, M_2 and M_3) and drum speeds (S_1, S_2, and S_3).

B- The minimum percentage of seeds damage and high seeds quality recorded at position (A), that inverse wholly at position (C) at all levels of moisture (M_1, M_2 and M_3) and drum speeds (S_1, S_2, and S_3).

C- Position (C) achieved the maximum threshing capacity, position (B) is the following one and position (A) is the last one at all moisture and speeds levels.

So the best position for the spike teeth was position (C).

5-1-2. Effect of cylinder concave clearance:

A- Decreasing the clearance from C_4 to C_2 decreasing the un-threshed seeds at all levels of moisture content and speeds.

B- Increasing the clearance from C_2 to C_4 decreasing the seeds damage and so increasing the seeds quality at all levels of moisture content and speeds.

C- It was noticed that threshing capacity increased with increasing the clearance from C_2 to C_4 at all levels of moisture content and speeds.

The best clearance may be considered at (C_4).

5-1-3 Effect of cylinder speed:

Increasing cylinder speed from S_1 to S_3 under moisture content (M_3) and concave clearance (C_4), it was noticed that:

A- The percentage of un-threshed seeds decreased at increase of speed from S_1 to S_3 and so threshing efficiency increased from 91 to 95.1 %.

B- The percentage of seeds damage increased when increasing drum speed from S_1 to S_3 and so Seed quality-decreased from 98.86 to 97.51 %.

C- Threshing capacity increased from 10.75 to 12.25 kg/min.

The pest speed can be considered S_3 as the best speed because of minimum un-threshed seeds and not reaches for non-allowed percentage of seed damage .

5-1-4 Effect of moisture content:

Increasing the crop moisture content from M_3 (10 %) to M_1 (19 %) under cylinder speed S_3 and concave clearance C_4, it was noticed that:

1- The percentage of un-threshed seeds increased from 4.9 to 7.5 %.

2- The percentage of seeds damage decreased from 2.49 to 1.98 %, that increasing seeds quality from 97.51 to 98.02 %.

3- The decreasing of threshing capacity from 12.25 to 7 kg/min.

The best moisture content must be M_3 when comparing among M_1, M_2 and M_3 in seed damage and un-threshed seeds.

Notes:

1- Seeds damage percentage decreased by increasing moisture content and is increased when the moisture content decreased due to the elasticity of grains.

2- The seed damage percentage increased by increasing cylinder speed due to increasing of reject seeds.

3- The un-threshed seeds that remain in the heads are in the middle of heads and they are approximately empty and have no economic benefit.

In general, the relative importance of independent variables with respect to their effect on threshing efficiency, capacity and seeds damage could be put in the following order;

1- Drum speed.

2-Cylinder concave Clearance.

3- Spikes numbers and position.

4- Moisture content.

From previous discussion, it can be concluded that:-

The optimum combination of drum speed, concave clearance, spikes numbers and position, and moisture content of the sunflower thresher in order to obtain the minimum damage, best threshing efficiency and best threshing capacity. At (S_3= 14.7 m/s) drum speed, moisture content (M_3=10 %), spikes number and position (C) = (24 hammers X 6 rows) and concave clearance (C_4 = 4 cm). achieved the highest threshing efficiency (95.1 %) , threshing capacity (12.25 kg/min) and the lowest brooking ratio (2.49 %).The developed sunflower thresher if operated at these combinations of parameters will give optimum performance.

6. APPLIED RECOMMENDATIONS

It is known that threshing process must be proceeded with minimum un-threshed seeds, less seed damage and maximum capacity.

Tips for successful threshing

1- Threshing sunflower when seed-moisture content about 10 percent.

2- Using cylinder concave clearance 4 cm.

3- Using a steady feed rate by mechanical method.

4- Using more teeth.

5- Using higher speeds.

6- Using the developed machine for threshing sunflower because of benefits like simple operation, low maintenance and easy interior inspection.

Hofman *et al.* (1982) reported that Combine harvesters suitable for threshing small grains can be adapted to harvest sunflower. But, according to the local researchers, most of the Egyptian farms are divided into small areas, where 52 % of total arable area is divided into plots less than 5 feddans **(Helmy, 1988)**. This scattering leads to some difficulties of having a combine harvester, because of its higher costs and more power consumption especially in small areas. So using this developed machine will be very economical.