Effect of Machine Clearance and Maize Moisture Contents on Mechanical Parameters For Local Shelling Machine

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Abstract

The impact of local thresher machine on maize Syn12 cultivar was tested at two CL -0.5, and 0.7 mm at three ranges of MOI - 16%, 18%, and 21%. The experiments were conducted in a factorial experiment under a complete randomized design with three replications. The CL- 0.7 mm was significantly more than CL -0.5 mm in all studied parameters. While the corn grain moisture content at a range of 16% was significantly superior compared to the other ranges (18 and 21%) in all parameters. For the CL -0.7mm and MOI 16%, the 
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 were 1.566 t.hr⁻¹and 1.715 t.hr⁻¹, 9.155 Kw and 9.028 Kw, 86.009% and 89.587%; 3.228% and 3.064%; 2.184% and 2.013; 81.14% and 81.69% and 90.743% and 91.587%, respectively.

Keywords: Machine, Maize, CL, MOI, Syn12 cultivar, Sheller.

1. Introduction

The yellow corn crop is one of the important crops. The Ministry of Agriculture seeks to increase the area planted with this crop to reflect positively on increasing productivity. According to the optimal use of the machines involved in the production by scientific and engineering methods. Corn is an important industrial crop that is used in several industries such as vegetable oil, starch, and bread. [1,2]. Shelling is the removal or separation of maize grain from the cobs. The Corn planting in the field or on the farm by hand or machines. The grain is obtained by shelling or friction the operation depends on the varieties grown, the moisture content, and the degree of maturity of the crop. The percentage of germination and the speed of germination depend on the method of removing the grains from the cobs without damage [3].

The study of [4]. Showed that, when grains were endangered damage, with grain moisture increasing which exhibited damage, If the amount of grain wetness content, it makes them enter of the plasticity which makes industry corn very difficult. Therefore, it needs more time to complete industry which leads to a decrease in machine productivity[5]. Concluded the corn crop productivity depends mainly on the type of machine and the methods of its organization. So the grain is affected by the type of machine and the efficiency of the operator. In addition to some foundations important, the machine is used in the processing of corn grains separation grains from ear [6].

The threshing speed was a significant impact on the machine's productivity. This is in turn depends on the corn variety to be processed. Therefore, likes to regulate the clearance of the machine and the threshing speed on the type and size of the corn kernel and the ear length [7]. A shelling unit for maize husker shelling was formerly settled built on a wheat threshing unit which was efficient but the grain smashing was moderately high [8]. The ratio of damage and full grains is linked to the crop type [9]. Maize shelling or simply maize threshing is the most important aspect of the post-harvest operation of maize. [10]. Additionally that this procedure is vastly labor rigorous working and more works in minimum losses of grain in terms of amount and quality [11]. The shelling machine (POD type ) is characterized by high productivity and is easy to organize. This was positively reflected in the decrease in the percentage of breakage and damage to the corn grains that were used in manufacturing [12]. That the threshing time has a negligible effect on the machine efficiency of the machine and ratio loss of power [13].

The main goal of this research was to study the impact of CL, and MOI, on some maize specifications using a Local MTL threshing machine.
2. Materials and Methods

This study was conducted in 2020 to evaluate Local MTL threshing machine performance (figure 1). The experiments were done at two levels of clearances (0.5 and 0.7) and three levels of grain moisture contents (16%, 18% and 21%). The Syn12 cultivar was selected for the experiment. The production process, the power required, breakage ratio, threshing efficiency, cracked ratio, whole maize grains, and grains cleanliness ratio were calculated for each running test. [14], [15].

2.1. Production process

\[ P_p = \frac{W \times 60}{T \times 1000} \]

Where, \( P_p \) is machine production, (t h\(^{-1})\); \( W \) is output mass (g), and \( T \) is time (min). [16-18].

2.2. Power required

\[ P_R = \frac{\sqrt{3}}{1000} \cdot V \cdot I \cos \phi \cdot E_{FE} \]

Where, \( P_R \) is the power consumed (kW); \( V \) is voltage (V) and \( I \) is the electric current (A), and \( \cos(\phi) \) is the angle between the current and voltage while \( (E_{FE}) \) is the efficiency of the motor (assuming as 90%) [19].

2.3. Threshing efficiency

\[ T = \frac{W_{mU}}{W_S} \times 100 \]

Where, \( T_e \) is the threshing efficiency (%); \( W_{mU} \) is the mass of unpeeled maize (g) and \( W_S \) is the mass of maize sample used (g) [20].

2.4. Cracked grain

\[ P_{CG} = \frac{W_{CG}}{W_S} \times 100 \]

Where \( P_{CG} \) is proportion cracked grain (%); \( W_{CG} \) is the mass cracked grain (g); \( W_S \) is the total mass of sample (g) [16, 20].

2.5. Breakage ratio

\[ B_R = \frac{W_{br}}{W_S} \times 100 \]

Where, \( B_R \) is the breakage ratio (%); \( W_{br} \) is the mass grain breakage (g), and \( W_S \) is the mass of the maize sample used (g). [22, 23].

2.6. Whole grains

\[ W_G = \frac{W_{FG}}{W_S} \times 100 \]

Where, \( W_G \) is the whole grain ratio (%); \( W_{FG} \) is a mass whole grain (g), and \( W_S \) is the mass of maize sample used (g). [5, 17].

2.7. Grain cleanliness

\[ G = \frac{W_{s} \times W_{k}}{W_S} \times 100 \]
Where: \( G_C \) : Is the grain cleanliness ratio (%), \( W_s \) : Is the weight of the sample (g) and \( W_I \) : Is the weight of impurities (g).

The results were analyzed statistically using the design complete randomized design (CRD) and the difference among treatments for each factor was tested according to the least significant difference (LSD) test [24].

List of Abbreviations and Symbols

- \( CL \) : Clearance
- \( MOI \) : Moisture grains
- \( P_P \) : Production process
- \( P_R \) : Power required
- \( T_E \) : Threshing efficiency
- \( B_R \) : Breakage ratio
- \( P_{CG} \) : Cracked grain
- \( W_G \) : Whole grains
- \( G_C \) : Grain cleanliness
- \( H \) : Hour
- \( Ha \) : Hectare
- \( Hp \) : Horse power
- \( T \) : ton
- \( LSD \) : Least square difference

### 3. Results and Discussion

The results showed that the CL-0.5 mm had the lowest production process average of 1.395 t.hr\(^{-1}\) compared to CL-0.7 mm gave a high ratio of production process 1.566 t.hr\(^{-1}\), as shown in Figure 1. The increasing MOI leads to a decrease in the production process and which was 1.715, 1.402, and 1.327 t.hr\(^{-1}\) respectively. The reason for this is to engineering the design of the designed machine [4], [5]. Table 1. The interaction among CL-0.7 mm, and MOI-16% was the best (1.823 t.hr\(^{-1}\)).

Figure 2 showed that the CL-0.7 mm had the lowest power required an average of 9.155 Kw compared to CL-0.5 mm gave high power required 10.083 Kw, the increasing MOI leads to the increase in power required and which was 9.028, 9.754 and 10.032 Kw respectively [6] (Table 1). The interaction among CL-0.7 mm, and MOI-16% was the best (8.932 Kw).

Increasing MOI leads to a decrease in threshing efficiency and which was 89.587, 84.688 and 81.932 % respectively. Figure 3 that the CL-0.5 mm had the lowest threshing efficiency average of 84.796 % compared to CL-0.7 mm gave a high ratio of threshing efficiency of 86.009 %. [9]. Table 1. The interaction among CL-0.7 mm, and MOI-16% was the best (90.809 %).

Breakage ratio increased and which was 3.064, 3.515 and 3.786 % respectively with MOI increased. Figure 4 that the CL-0.7 mm had the lowest breakage ratio average of 3.228 % compared to LC-0.5 mm gave a high ratio of Breakage ratio of 3.681 % [10]. [14]. Table 1. The interaction among LC-0.7 mm, and MOI-16% was the best (3.003 %).
The cracked ratio increased and which was 2.013, 2.345, and 2.610 % respectively with MOI increased. From Figure 5 that the CL-0.7 mm had the lowest cracked ratio average of 2.184 % compared to CL-0.5 mm gave a high ratio of Breakage ratio of 2.461 % [15] (Table 1). The interaction among LC-0.7 mm, and MOI-16% was the best (2.001 %).

The results showed that the CL-0.7 mm had a high whole grains ratio average of 81.14% compared to CL-0.7 mm gave lowest whole grains ratio average of 80.11%. From Figure 6 the increasing MOI leads to the decrease in whole grains ratio and which was 81.69, 80.58 and 79.61 % respectively. As a result of the organized mechanical handling and the operator efficiency for obtained the highest ratio of whole grain [13], [16]. Table 1. The interaction among CL-0.7 mm, and MOI-16% was the best (82.23 %).

Figure 7 showed that the CL-0.5 mm had the lowest grains cleanliness average of 90.237 % compared to CL-0.7 mm gave a high ratio of grains cleanliness 90.743%, the increasing MOI leads to the increase in grains cleanliness and which was 91.587, 90.198, and 89.687 % respectively [14], [7]. Table 1. The interaction among LC-0.7 mm, and MOI-16% was the best (92.151 %)
Conclusions

The maize grains moisture content of 16% was superior significantly compared to the other two levels 18% and 21%. Additionally, the clearances between the cylinder of 0.7 mm were superior significantly on clearances between the cylinder of 0.5 mm in all studied properties. The interaction between the Local MTL machine type and MOI 16% was also superior significantly. The interaction between the Local MTL machine type and the CL 0.7 mm in all studied properties.

| CL | MOI % | production process t.ha⁻¹ | power required Kw | breakage ratio % | threshing efficiency % | Cracked ratio % | whole grains % | grains cleanliness % |
|----|-------|---------------------------|-------------------|------------------|------------------------|----------------|----------------|---------------------|
| 16 | 16    | 1.606                     | 9.213             | 3.125            | 88.365                 | 2.026          | 81.15          | 91.022              |
| 0.5| 18    | 1.314                     | 10.456            | 3.901            | 84.255                 | 2.478          | 80.09          | 90.182              |
| 21 | 18    | 1.265                     | 10.581            | 4.018            | 81.768                 | 2.881          | 79.10          | 89.509              |
| 16 | 18    | 1.823                     | 8.932             | 3.003            | 90.809                 | 2.001          | 82.23          | 92.151              |
| 0.7| 18    | 1.489                     | 9.051             | 3.128            | 85.122                 | 2.213          | 81.08          | 90.213              |
| 21 | 18    | 1.388                     | 9.483             | 3.555            | 82.097                 | 2.339          | 80.13          | 89.866              |
| CL | 0.5   | 1.395                     | 10.083            | 3.681            | 84.796                 | 2.461          | 80.11          | 90.237              |
| 0.7| 1.566 | 9.155                     | 3.228             | 86.099           | 2.184                  | 81.14          | 90.743         | 90.473              |
| MOI| 16    | 1.715                     | 9.028             | 3.064            | 89.587                 | 2.013          | 81.69          | 91.587              |
| 18 | 1.402 | 9.754                     | 3.515             | 84.688           | 2.345                  | 80.58          | 90.198         | 90.198              |
| 21 | 1.327 | 10.032                    | 3.786             | 81.932           | 2.610                  | 79.61          |               |                     |
| LSD=0.05 |        |                           |                   |                  |                        |                |                |                     |

Table 1. Effect of CL and MOI on mechanical parameters for shelling machine.
Recommendations

We recommend using different shelter clearance and different moisture content for the maize.

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References

[1] Alsharifi S K., 2018. Affecting on threshing machine types, grain moisture content and cylinder speeds for maize, Cadiz variety Agricultural Engineering International: CIGR Journal, 20(3): 233–244.

[2] Alsharifi S K Alwan, Ghali A A, and Hamzah I J 2021a study some growth characteristics for maize. Bohooth 106 variety under affecting mechanical for machine (moldboard plow type) .IOP Conf. Series: Earth and Environmental Science IOP Publishing doi:10.1088/1755-1315/735/1/012007.

[3] Alsharifi, S. Alwan, Shtewy N., and Alramer S A. 2021b Affecting mechanical on some growth properties for corn, MAHA cultivar, IOP Conf. Series: Earth and Environmental Science IOP Publishing doi: 10.1088/1755-1315/735/1/012009.

[4] Hamzah J I, Al Sharifi, S K, Aleawi A G 2021. Requirements of maize mechanical shelling. CIGR Journal 23(1):252-256

[5] Alsharifi S K, Mousa A A, Manhil A, Taher A 2019b Effect of sheller rotational speed on some maize cultivars quality , Agricultural Engineering International: CIGR journal. 21(2):196-203.

[6] Aljibouri M A, and Alsharifi S K 2019. Evaluation of Local Design Machine for Corn Threshing .Indian Journal of Ecology 46(4): 913-920.

[7] Al Sharifi, S. K., Alwan, S., Mousa A., Aljibouri, Manhil A., and Taher, 2019. Effect of threshing machines, rotational speed and grain moisture on corn shelling .Bulgarian Journal of Agricultural Science, 25 (No 2) Pp: 243–255.

[8] Jun, Fu C Zhi, H Jia, and R Quan. 2018. Review of grain threshing theory and technology. International Journal of Agricultural and Biological Engineering, 11(3): 12-20.

[9] Mohammed, M.A., Salman, S.R., Abdulridha, W.M., (2020), Structural, optical, electrical and gas sensor properties of zr02 thin films prepared by sol-gel technique. NeuroQuantology, 18(3), pp. 22–27.

[10] Alsharifi, S.K, Arabhosseini, A., Kianneher, M.H, and Kermani, A.M (2017b). Effect of moisture content, clearance, and machine type on some qualitative characteristics of rice on (Tarm Hashemi) cultivar. Bulgarian Journal of Agricultural Science, 23(2): 348–355.

[11] Manjeet, P., R. Prem, S. J. Pragi, K. L. Daihi, and A. V. Baria. 2017. Pod shelling machines – A review. International Journal of Agricultural Science and Research, 7(1): 321-326.

[12] Aljibouri M.A and Alsharifi S.K. Alwan 2019, Evaluation of Local Design Machine for Corn Threshing .Indian Journal of Ecology 46(4): 913-920.

[13] Chilur, R V., Sushilendra, P., Veeranouda M Yaranal S R, Hiregoudar S., and Mareppa N B 2012. Effect of operational parameters on dehusking cum-shelling efficiency and broken grain percentage of maize dehusker-cum sheller. International Journal of Scientific Research, 3(8): 10-14.

[14] Alwan, S K A, Arabhosseini, Kianneher M H and A M Kermani. 2016a. Effect of husking and whitening machines on rice Dailman cultivar. CIGR Journal. 18(4): 232–242.

[15] Alwan, S K Alsharifi, Arabhosseini A Kianneher, M H, Kermani A M 2016b. The effect of hulling and whitening on quality of rice cultivar Duro. Thai Journal of Agricultural Science, 49(3): 14–21.

[16] Alwan S.K, Alsharifi., Arabhosseini A, Kianneher M H., Kermani A M 2016c. The effect of two types of machines (hulling and bleaching.) on some qualitative characteristics of rice on (Tarm Hashemi). Euphrates Journal of Agricultural Science, 8(3):32-49.

[17] Alsharifi S K, Arabhosseini A, Kianneher M H, and Kermani A M 2018a. A study Of Some Economic Indicators Of Hulling and Bleaching Machines On The Cultivar Of Rice ,Tarm Hashemi ,journal of the university of Babylon,25 (6):232-252.

[18] Shakir, A.A., Salman, E.F., Shakir, A.J., Mohammed, M.A., Abdulridha, W.M., Almayahi, B.A. , (2019), , Optical properties of polyvinyl alcohol membrane with -HAp for bio-medical applications, Prensa Medica Argentina, 105 (11), pp. 836-841.

[19] Alsharifi, S K A, Arabhosseini A, Kianneher M H, and, Kermani A M 2017a. Effect of clearance on mechanical damage of processed rice. Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis, 65(5): 1469–1476. doi.org/10.11111/actua201765051469.

[20] Alsharifi, S K Arabhosseini, A. Kianneher, M H and Kermani. A M 2018b. The effect of clearance on the performance of machine husting rubber rolls for two rice cultivars, Journal of the University of Babylon:26(3): 207-214.

[21] Aljibouri M A, Alsharifi S K, and Essam L E 2021. Effect of clearance on some rice cultivars quality .IOP Conf. Series: Earth and Environmental Science .IOP Publishing doi:10.1088/1755-1315/735/1/012040.

[22] Al Sharifi, S. K., Mousa A., Manhil A., T 2019. Effect of two types of digger machines and speeds of tractor on the qualitative characteristics of potato 9th International Conference for Sustainable Agricultural Development 4-6 March 2019 Fayoum J. Agric. Res.&Dev., Vol.33 No. 1(B) March,2019 308-322.

[23] Hamzah I and Alsharifi S Alwan 2020. Innovative harvesting methods about the harvest losses for two machines .Bulgarian Journal of Agricultural Science, 26(4) pp: 913–918.

[24] Oehlent, G W 2010. A First Course in Design and Analysis of Experiments. Design-Expert is a registered trademark of Stat-Ease, Inc. Library of Congress Cataloging-in-Publication Data, 2010:134-156.