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# EVALUATION AND COMPARATIVE STUDY OF ROW CLEANER MODIFICATION THROUGH IMPROVING PERFORMANCE OF THE NO-TILL PLANTER AND WHEAT PRODUCTION

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## Abstract

The main objective of the present study was to evaluate and compared No till hoe seeder seed (wheat) and fertilizer in one pass with modified row cleaner and without modification the origin part, in Garda-Rash research station / College of agriculture/ University of Salahaddin in Erbil- Iraq, in 2016-2017. Soil texture was sily clay loam. The row cleaner of (Bokan) seeder has add and modified at two levels as a first factor: narrow and wide 'modification adding the modified up to furrow opener. To clean the row seeder from residue or push the residue to the side away from the seeder row after the seeder passes over the field, a split-split plot arrangement in RCBD design. The second factor was two depths of planters 4 and 6 cm, and the third factor was three level of the tractor speed 8, 9, 11 km/h, with three replications. The results showed the best lowest value of loss power in slippage, traction power, and fuel consumption occurred in first depth and first speed with narrow modification 2.37 hp, 18 hp, and 11.53 L/h respectively. The best value of No. plant/m, the height of plant, and grain yield of the wheat achieved in the previous interaction 44 cm, 45.6 cm, and 1767.07 kg/ha respectively.
***Keywords*:** No till seeder, Row Cleaner, Traction power, Fuel consumption, field capacity.

## Introduction

The no-till planting is a conservation agriculture mode that uses a no-tillage seeder equipped with straw cutting and row-cleaning tools, and adopts coulters to cut residues on the sowing rows. The uniform furrows can increase the quality of seeding (including row distance variation coefficient, sowing depth consistency, seed spacing uniformity) and emergence rate, thereby promoting crop growth (Molatudi and Mariga, 2009).

Őzturk (2015) was found that the seed yield for the conventional tillage, reduced tillage and direct sowing were determined as 2144.4 kg/ha, 1956.5 kg/ha and 1724.4 kg/ha, respectively. When compared to conventional tillage, while the seed yield reduced in 8.76% and 19.58%, the fuel consumption reduced in 40.3% and 63.2% in reduced tillage and direct sowing applications, respectively.

Vivak *et al.* (2013) showed from the results that zero-tillage improved the actual field capacity by 81 %, specific energy by 17 % and efficiency of the energy usage by 13 % as compared to the conventional tillage. In the other hand Leghari *et al.* (2014) were studded three treatments; Conventional, reduced, and No-tillage. The results revealed that the effective field capacity was maximum under Conventional tillage 0.49 ha/ h, followed by No-tillage 0.47 ha/h and lowest under reduced tillage 0.32 ha/h similarly, the fuel consumption was highest under Conventional tillage 27.0 L/ha, followed by the reduced tillage 22.33 l/ha and No-tillage practice 12.33 L/ha. The study concluded that reduced tillage practice is more energy-efficient than conventional tillage practice for sustainable wheat production.

Altikat and Calik, (2012) obtained the no-till seeders with hoe type furrow opener provided better soil physical properties than the other two no-till seeders. When they studded determine the effects of different no-till seeders and tractor forward speeds on some of soil physical properties and seed emergence of summer vetch and winter wheat.

Calik and Altikat, (2012) noted In the no-till method, seeds are placed in rows by furrow openers that can work under residue field conditions, In addition Furlani *et al.* (2013). Observed the hoe type of furrow openers in no-till planters has become widespread. Li *et al.* (2015) obtained the row cleaner which was designed and mounted on row units of planter to yield higher percentage of seed emergence.

Hussain *et al.* (2018) mention the results showed that the superiority of zero-tillage system to achieve the best values for each of seed emergence rate، number of grains per spike, 1000-Grain weight and grain yield with 87.31%, 33.16, 30.78 g and 1764.25 kg/ha respectively. While conventional tillage system achieved high values for each of slippage percentage، practical productivity and draft power were recorded 8.251%, 1.035 ha/ h and 5.898 kW respectively.

The aim from the new design is appropriate for the conservation agriculture because it decreases the side effect of the residues. The economic benefits achieved from one pass of the implement, which reduces energy, and fuel consumption and implement wear out and maintenance.

## Materials and Methods

A field experiment was conducted in Gardarash Research Station, College of Agriculture, Salahaddin University in Erbil in 2017-2018 to examine some modifications of row cleaner made to the BUKAN no-till drill seeder to seeding the wheat. Field soil texture was silty clay loam. The effects of the modifications of row cleaner, travel speeds, and planting depth on some machine and plant indicators were tested. Machine performance indicators included the effective field capacity ha/h, traction power hp, and loss power in slippage hp. wheat indicators were number of plant in one meter, height of plant cm, grain yield kg/ha. Some indicators were calculated using the equations listed below. Other indicators were measured directly.

1- Effective field capacity ha/h.

$$\text{Effective field capacity}\left(\frac{ha}{h}\right) = \frac{\text{actual speed}\left(\frac{km}{h}\right) \times \text{work width (m)} \times \text{efficience}}{\text{unit area (ha)}}$$

2- Traction power hp. $\mathbf{T.P} = \text{traction force(kg)} \times \frac{\text{speed}\left(\frac{km}{h}\right)}{270}$

3- Loss power in slippage hp. $Sp = \frac{Pf(Vt - Vp)}{270}$

Where;

Sp: loss power in slippage percentage.

Vt: theoretical speed km/h.

Vp: practical speed km/h.

Pf: draft forces kg which measured by dynamometer (Dillon, 1000 kg).

For the sake for measuring fuel consumption, a special graduated device having a size of 6000 ml was constructed. The graduation permitted gradual measurement of fuel consumption.

### Row Cleaner Modifications

The modifications were made by adding a plate or shell into the front of the shank of furrow opener. The plate has two types, the first type was narrow shape and the second type was wide. The modifications are designed to move and push most of the surface residue to the sides of the row, allowing no-till planting to be achieved in a band with a clean surface. They were added to the front of the furrow opener and compared with original stem, which has no-modification.


**Fig. 1 :** No till seeder with row cleaner modification front view


**Fig. 2 :** No till seeder rear view

The experiment was arrangement at a split-split plot in a Completely Randomized Block Design (RCBD). Three different seeders: M1= seeder without modification, M2= seeder with narrow modification, and M3= seeder with wide modification represented the main plots. Seeding depths D1=4 and D2=6 cm represented and travel speeds S1=8, S2= 9, and S3= 11 km/h and the sub and sub-sub plots, respectively. The experiment was repeated for three times. The data was analyzed by a Statistical Analysis System (SAS) and the significance between treatment means was tested by Duncan Test.

## Results and Discussion

Table 1 revealed the effects of modifications in some mechanical indicators: affective field capacity, traction forces, traction power, loss power in slippage percentage, and Fuel consumption.

Best significant value of affective field capacity was in narrow modification, while the lower value of that indicator recorded with none and wide modification 0.765 and 758 ha/hr respectively. That's agreement with (Leghari *et al.*, 2014).

The traction power had a significantly affects by the types of modifications, and the best or less value was register in narrow modification 33.94 hp then the highest value of traction power was recorded with non and wide modifications 36.21 and 36.79 hp respectively. So the reduced and no-tillage methods provide enough energy saving per ton of yield (Akbarnia and Farhani, 2014).

Loss power in slippage percentage had a significantly affect in modification treatments. The best or less value 6.91 hp recorded in narrow modification, while the higher values achieved in none and wide modifications 8.07 and 8.64 hp respectively. That's agreement with (Hussam, 2016).

Table 1 also shows the significantly effects of modification treatments in some plant indicator: number of plants in one meter, height of plant, and grain yield.

Table 2 explained the significantly effects of depths level on some mechanical indicators: affective field capacity, traction forces, traction power, loss power in slippage percentage, and Fuel consumption.

A significantly effects of depths treatments in the indicator of affective field capacity, the best or higher value 0.779 ha/h was record in first depth. While the lower value for the same indicator recorded in second depth 0.756 ha/h.

Indicators of loss power in slippage percentage, and fuel consumption had a significant and the same behaviors in depths increases. The best or less value of these indicators 7.19hp, and 11.3 l/h was recorded in first depth treatment; in the other hand the second depth achieved the higher value for these indicators 8.56hp, 15.28 l/h. respectively. That's mean; non-precise seed placement means uneven seeding depth, which may lead to uneven crop emergence (Thomison and Lentz, 2002).

Table 2 had no significantly effects of depths treatments on plant indicators, while in first depth recorded the best value in many indicators number of plants in one meter, height of plant, and grain yield, which indicated the selection of suitable method plays an important role in the placement of seed at proper depth also mentioned by (Tanveer *et al*., 2003).

Table 3 revealed the significantly effect of speeds in some mechanical indicators: effective field capacity, loss power in slippage percentage, traction power, and fuel consumption.

The effective field capacity had a significantly affect with speed level, and the best or higher value 0.942 ha/h recorded with third speed. In the other hand, the lower value 0.579 ha/h achieved with first speed. That reason because of the speed it is the one of the elements of E.F.C equation and when the speed increase the E.F.C. increases too. That's agreement with (Hussain *et al*., 2018).

The two indicators: loss power in slippage percentage, and traction power had a significantly effect and same behavior with speed levels, and the best or less value 3.15 hp, and 20.68 hp respectively for these indicators recorded with first speed. While the higher value 13.49 hp, and 49.84 hp respectively for these indicators was achieved in third speed levels. Due to the traction and power in the draw bar point increases with speed level increments. In addition the rolling resistant of the soil increase followed by the speed level increments. That's agreement with (Altuntas *et al*., 2006).

The final indicator from table 3 had a significantly affect with speed levels was fuel consumption, and the best or less value 11.10 l/h recorded in the third speed levels. Then the highest value for the same indicator 15.35 l/h achieved in first speed level treatment. That caused by if the speed increase the working distance increase, and the time of fuel supply to the engine will be less with speed increases. This results agreement with (Hussam, 2016)

Table 3 show the significantly effect of speed levels treatments in some plant indicators: number of plant in one meter, height of plant cm, and grain yield kg/ha).

A significantly effect of speeds in number of plants per meter of length, and the best or highest value, 40.6 plant/m, of that indicator recorded with first speed level. While the lowest value 34.6 plant/m achieved in third speed level treatments.

Grain yield, this indicator had a significantly effects with speed treatments in the same way, and the best or highest value for these indicators recorded in first and second speeds respectively. While the lowest value for three previous indicator was in third speed treatment.

**Table 1 :** The effect of modification treatments on some mechanical indicators and plant indicators.

| Treatments | A.F.C. (ha/hr)** | Traction power (hp)* | Loss.power. in slippage (hp)* | Fuel consumption (l/ha)* | No. plant/m | Height plant (cm) | Grain yield kg/ha |
|---|---|---|---|---|---|---|---|
| **M1** | 0.765 b | 36.21 a | 8.07 a | 13.42 | 39.4 | 37.7 | 1201.94 |
| **M2** | 0.779 a | 33.94 b | 6.91 b | 12.70 | 39.5 | 39.2 | 1311.82 |
| **M3** | 0.758 b | 36.79 a | 8.64 a | 13.75 | 34.6 | 41.2 | 1222.98 |

*The lowest value is better. **highest value is better.

**Table 2 :** The effect of depths treatments level on some mechanical indicator and plant indicators.

| Treatments | A.F.C. (ha/hr)** | Loss. power. in slippage% (hp)* | Traction power (hp)* | Fuel consumption (l/ha)* | No. plant/m** | Height plant (cm)** | Grain yield kg/ha** |
|---|---|---|---|---|---|---|---|
| **D1** | 0.779 a | 7.19 b | 35.44 | 11.30 b | 38.07 | 41.37 | 1278.39 |
| **D2** | 0.756 b | 8.56 a | 35.86 | 15.28 a | 37.66 | 37.44 | 1212.78 |

*The lowest value is better. **highest value is better.

**Table 3 :** The effect of speed treatments in some mechanical indicators and plant indicators.

| Treatments | E.F.C. (ha/hr)** | Loss. power.in slippage (hp)* | Traction power (hp)* | Fuel consumption (l/ha)* | No. plant/m** | Height plant (cm)** | Grain yield kg/ha** |
|---|---|---|---|---|---|---|---|
| **S1** | 0.579 c | 3.15 c | 20.68 c | 15.35 a | 40.6 a | 41.33 | 1335.08 a |
| **S2** | 0.781 b | 6.98 b | 36.43 b | 13.42 b | 38.3 ab | 38.55 | 1271.28 a |
| **S3** | 0.942 a | 13.49 a | 49.84 a | 11.10 c | 34.6 b | 38.33 | 1130.38 b |

*The lowest value is better. **highest value is better.

**Table 4 :** Effects of interaction treatments between three factors: modifications, depths, and speeds

| Interaction treatments | Effective field capacity (ha/h)** | Loss power in slippage %(hp) * | Traction power (hp)* | Fuel consumption (L/h)* | No plant/m | H.P (cm) | Grain yield (kg/ha) |
|---|---|---|---|---|---|---|---|
| **M1D1S1** | 0.584 f | 2.79 ij | 20.35 i | 13.12 cdef | 43.0 abc | 39.0 abcd | 1295.00 cde |
| **M1D1S2** | 0.792 cd | 6.36 fg | 36.41 f | 10.77 ef | 43.3 abc | 41.3 abcd | 1223.00 cdef |
| **M1D1S3** | 0.948 b | 13.14 bc | 50.19 bc | 10.17 f | 30.0 c | 40.0 abcd | 1151.13 def |
| **M1D2S1** | 0.574 f | 3.79 hij | 23.98 h | 18.32 a | 50.0 a | 39.3 abcd | 1261.80 cdef |
| **M1D2S2** | 0.759 e | 8.35 e | 37.02 ef | 15.80 abcd | 34.6 bc | 35.3 bcd | 1319.10 cd |
| **M1D2S3** | 0.932 b | 13.98 bc | 49.35 c | 12.33 def | 35.6 bc | 31.6 cd | 961.63 gh |
| **M2D1S1** | 0.587 f | 2.37 j | 18.00 j | 11.53 ef | 44.0 ab | 45.6 ab | 1767.07 a |
| **M2D1S2** | 0.808 c | 5.30 gh | 34.88 g | 10.36 ef | 41.0 abc | 36.6 bcd | 1279.77 cdef |
| **M2D1S3** | 0.977 a | 10.99 d | 49.01 c | 9.95 f | 36.3 bc | 41.6 abcd | 1188.43 cdef |
| **M2D2S1** | 0.585 f | 3.10 ij | 20.04 i | 17.13 ab | 38.3 abc | 30.0 d | 1094.93 efg |
| **M2D2S2** | 0.774 de | 6.97 ef | 34.51 g | 15.69 abcd | 41.0 abc | 41.0 abcd | 1188.27 cdef |
| **M2D2S3** | 0.942 b | 12.78 c | 47.22 d | 11.57 ef | 36.3 bc | 40.3 abcd | 1352.47 bcd |
| **M3D1S1** | 0.586 f | 2.75 ij | 20.39 i | 13.96 bcde | 34.0 bc | 49.6 a | 1509.57 b |
| **M3D1S2** | 0.793 cd | 6.50 fg | 37.57 ef | 11.72 ef | 34.3 bc | 42.0 abcd | 1242.60 cdef |
| **M3D1S3** | 0.936 b | 14.49 ab | 52.16 a | 10.18 f | 36.6 bc | 36.3 bcd | 848.90 h |
| **M3D2S1** | 0.556 f | 4.14 hi | 21.32 i | 18.07 a | 34.6 bc | 44.3 abc | 1082.13 fg |
| **M3D2S2** | 0.762 de | 8.44 e | 38.22 e | 16.18 abc | 35.6 bc | 35.0 bcd | 1374.97 bc |
| **M3D2S3** | 0.917 b | 15.55 a | 51.10 ab | 12.41 def | 32.6 bc | 40.0 abcd | 1279.73 cdef |

*The lowest value is better. **highest value is better.

Table 4 the effects of three factors (modifications, depths, and speeds) and their interactions in some mechanical indicators: effective field capacity, loss power in slippage, traction power, and fuel consumption.

Interaction the modification, depth, and speed had a significantly effect in effective field capacity. The best or highest value of E.F.C. was in third speed closely with all modification. While the lowest value for the same indicator recorded in first depth with all modification treatments.

The treatments had a significantly effects in power losses in slippage percentage. The best or lowest value of that indicator was closely in first speed of interaction treatments. While the highest value for the same indicator recorded in third speed with other factors.

Traction power had a significantly affect by interaction treatments, and the traction increase by speed and depth effect mostly than modification factor. The best or less value was in first speed with other factors, and on the other hand, the highest value achieved in third speed with other depth and modification factors. That's agreement with (Furlani *et al.*, 2013).

Fuel consumption like the other indicators had a significantly affect with interactions of three factors. Best or less value was in third speed with all other factors. While the highest value recorded in first speed with all other factors. That's agreement with (AL-rijabo *et al.*, 2014).

Table 4 revealed the interactions between modification, depth, and speed factors and their effects in some plant indicators: number of plant in one meter, height of plant and grain yield.

Number of plant in one meter of length had a significantly affect by interaction treatments. The best or highest value 50 of that indicator plant/m achieved in first speed, second depth, and non-modification. While the lowest value 30 plant/m was in third speed, first depth, with non-modification.

About the height of plant, the significantly effect of interaction of three factors (modification, depth, speed) in height of plant and the best value 49.6 cm was in first speed, and depth with wide modification. On the other hand the lowest value 30 cm recorded in first speed, second depth, and narrow modification. This means that the uniform furrows can increase seeding quality and growth crops that are agreement with (Molatudi and Mariga, 2009).

The last indicator from table 4 grain yield has a significantly affect with interactions treatments. The best or highest value 1767.06 kg/ha respectively recorded in narrow modification, first depth, and speed. This interaction increased production at lower costs, that's was argument with (Turi, 2009). On the other hand the lowest value for this indicator 848.9 kg/ha achieved in wide modification, first depth, with third speed.

## Conclusions

- The modification row cleaner achieved reduces energy, and fuel consumption, and increases wheat production,
- The best less value of loss power in slippage, traction power, and fuel consumption recorded in first depth and first speed with narrow modification.
- Traction force and losses power from slippage were increased by increasing tractor speed, while effective field capacity and fuel consumption were decreased.

- Traction force, losses power from slippage, and fuel consumption were increased by increasing the depth.
- The best highest value of No. plant/m, plant height, and grain recorded in first depth and first speed with narrow modification.

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