EFFECTING DIGGER MACHINE (JOHN DEERE TYPE), SOIL MOISTURE CONTENT AND TRACTOR SPEEDS ON SOME QUALITATIVE CHARACTERISTICS OF POTATO.

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ABSTRACT:

The effect of soil moisture and speed of tractor on potato (Accent) cultivar was studied based on some qualitative characteristics of Potato. One type of digger tubers machine (John Deere) were tested under three speeds of tractor (2.74, 4.06 and 5.21 Km.hr). The experiments were conducted in a factorial experiment under complete randomized design with three replications. The results showed that the 12-14% soil moisture was significantly better than 14-16% soil moisture in all studied conditions. , for 12-14% soil moisture ,the machine productivity, fuel consumption, ,digger machine efficiency lifting percentage ,qualitative loss and quantitative loss were recorded 5.185 t h^{-1}, 7.096 $L.ha^{-1}$, 84.491 % ,93.917%, 19.886%, and 3.733%, respectively while there were 4.522 t h^{-1}, 8.343 $L.ha^{-1}$, 82.088 % , 92.121%, 21.181% and 4.079% respectively under the same operating conditions for 14-16% soil moisture . The speed of tractor 2.74$Km.hr^{-1}$ was significantly superr to the other two levels of 4.06 and 5.21 $Km .hr^{-1}$ in all studied conditions .

Keywords: potato, soil moisture ,speed of tractor , Accent cultivar, tubers digger.

تأثير قالعة الدرنات ورطوبة التربة والسعة العملية للجرار في بعض الصفات النوعية للبطاطا

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المستخلص

دراسة تأثير رطوبة التربة والسعة العملية للجرار على صنف البطاطا اكسنت في بعض الصفات النوعية للبطاطا تحت تأثير ثلاثة سرعات للجرار (2.47 ، 4.06 ، 5.21 كم.ساعة$^{-1}$)، اجريت التجربة باستخدام التصميم العشوائي الكامل وبثلاث مكررات. اظهرت النتائج ان رطوبة التربة 12-14%كانت افضل بكثير من رطوبة التربة 14-16% في جميع حالات الدراسة. في نسبة رطوبة التربة 12-14% كانت الانتاجية واستهلاك الوقود وكفاءة الحفر والخسارة النوعية والفقدان الكمي كما يلي 5.185 طن.ساعة$^{-1}$، 7.096لتر.ساعة$^{-1}$ ،84.491%، 93.917%، 19.886% و 3.733% على التوالي، بينما كانت 4.522 طن.ساعة$^{-1}$، 8.343لتر.ساعة$^{-1}$، 82.088% ، 92.121%، 21.181% و 4.079% على التوالي في نفس ظروف الشغل لرطوبة التربة 14-16%، في حين ان السرعة العملية للجرار 2.47كم.ساعة$^{-1}$ تفوقت على السرعتين الاخريين 4.06، 5.21 كم.ساعة$^{-1}$ في جميع ظروف الدراسة.

الكلمات المفتاحية: البطاطا، رطوبة الربة، سرعة الجرار، صنف اكسنت، قالعة الدرنات.

1.INTRODUCTION:-

In Iraq economy, agriculture plays a dominant role in all area. There are number of basic commodities like wheat, rice and cereals, etc. produced in Iraq , But the Iraq import more ,due to the state's lack of interest in the agricultural sector .At present the dietary system is undergoing changes. The agriculturists have number of options available in the Iraq market. The demand for food is diversified and is increased to a great extent. In order to reduce the dependence on imports efforts are being made to diversify Iraq

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agricultural produce. At the same time Iraq is aiming at ensuring sustainable development of agriculture. The prime objective of this is to increase the agricultural income for the agriculturists. Due to increase in the standard of living the demand for fruits and vegetables has also increased over the years. (Alsharifi ,(1). The potato harvesters specialized in supplying the potato industry began a movement for the acquisition and exchange of experiences with imported potato harvesters, and this created, consequently, a demand for information relating to real opportunities for the improvement that the harvest mechanization has facilitated , The selection of an agricultural machine a daunting task, because there are many variables to consider, and choose the most appropriate equipment to a farm is one of the most important stages of the production process (Alsharifi et al .,(2) .Potato they are staple foods in many parts of the tropics, being the source of most of the daily carbohydrate intake for large populations. These carbohydrates are mostly starches found in storage organs, which may be enlarged roots, corms, rhizomes, or tubers (Younus. and.jayan (13). The process of mechanized harvesting of potatoes can represent a great advance for the producing regions, mainly to optimize the production process, with increased production area ,faster removal of tubers from the soil and minimum damage (Farhadi et al .,(7).

Performance of the potato digger machine was found to be not very effective under local conditions. potato digger machine needs to be developed. The major part involved in the design of tuber crop harvester is the digger depth with soil moisture (Md. Akhir et al., (9). using digger for harvesting potatoes addition separating and transporting them over soil surface with minimum losses of the mechanical damage. Potato harvester is developed by adding a successful vibrating separating mechanism that should base on separating potatoes with minimum losses and damage.(Bangar et al .,(5).

The main goal of this research was to study the effect of digger machine (john Deere type)on potato specification under soil moisture at different speeds of tractor

2.Materials and Methods

This study was conducted in 2018 to evaluate digger machine John Deere performance. The experiments were done at two levels of soil moisture (12-14 % and 14-16%) and three levels of speed 2.74 ,4.06 and 5.21 Km.h-1 . The forward speed used during the tests were monitored on the tractor speedometer on the instrument panel, while the level of web speed 1000 rpm, from the tractor PTO gear system , which determination of during device measure the cycles number. The digger depth for tubers was determined by the tractor hydraulic device was digger depth of 23cm used for experiment . The Accent cultivar was selected for the experiments . Tractor MF-240 was used for experiment , were front wheels width and back wheels of (21 and 22 cm) respectively . Engine Power 75 Hp ,Engine speed (2000 rpm) ,Engine type ,(Perkins ,diesel),Cylinders number 4-cylinders , Firing order 1-3-4-2 ,starter volts 12 .One type of digger machines John Deere (Fig 1 ,Fig 2) and bind its on the triple clamp points on the tractor after they maintained .The machine were organized on certain rake angle 20° . Taken movement it from power take off shaft (P.T.O) for tractor , was the chain carrier spins about numbers from leader wheels and driven , the movement was carried by rollers to star wheels which is give the vertical vibration movement for the chain carrier .

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Figure 1. John Deere digger

2.1.Physical properties

Physical properties of the soils determined ,were taken soil samples for six site randomly selected from the field and for digger depth determined in the experiment were 23 cm by the hydraulic device for tractor according to the method used by (Fathollahzadeh et al., 2010). Were taken of the soil samples for digger depth , And drying it in the oven until it reaches the required level 16% . (Alsharifi and sarah 3) . each running test

2.1.1 Soil moisture :

Samples were taken to measure soil moisture in the surface layer, 23 cm. Samples were weighted before and after 105˚C . Moisture content of soil samples agricultural season end ,by was calculated using Eq (1) (Dehroyeh ,6).

$$W_{=\frac{W_w}{W_s}\times 100} \quad \text{----------(1)}$$

Where : W :Is soil moisture percentage , W_w : Is weight wet soil , W_s : Is weight dry soil .

2.1.2.Soil penetration resistance

Soil penetration resistance was measurement by soil penetration resistance device (pocket penetrometer) for sites nine selected randomly ,with digger depth 23cm and soil moisture 12-14%and 14-16% .

Table I. Experiment field properties

	Digger depth cm	Soil moisture%	Soil penetration resistance Kpa
	23	14%	1119
		16%	1272
VA		15%	1195.5

Table II.Soil minutes volumes analysis in the experiment field

Soil moisture%	Digger depth Cm	Silt	Clay	sand	Soil tissue
	22	470	370	160	

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12-14 %	23	460	390	150	
Av		465	380	155	Silt Clay loam
14-16%	22	470	380	150	
	23	460	370	170	
Av		465	375	160	Silt Clay loam

2.2. Mechanical characteristics

2.2.1.Digger machine productivity

Basically, the digger machine productivity depends on the type of the machine as well as the size and moisture content of the soil and machine efficiency. It can be calculated from the Equation 2 that investigated by Al Sharifi et al.,(4) as follows:-

$$P = \frac{W_{UD+SD+SL+QL} \times 60}{T \times 1000} \quad \text{---------- (2)}$$

Where : W_{UD} Undamaged tubers weight (kg) , SD Sever damage tubers (kg), SL Slightly damage tubers (kg) . QL quantitative loss (kg) , T time **(**hr**)**

2.2. 2. Fuel consumption

Fuel consumption is measured by the fuel consumption device in mL for treatment length (40 m) was calculated using Eq 3 (Alsharifi ,and Sarah .3) .

$$Q_F = \frac{Q_D \times 10000}{W_P \times D \times 1000} \quad \text{---------- (3)}$$

Where : Q_F fuel consumed amount L\ ha , Q_D fuel consumed amount for treatment length (40 m) , W_P machine width (m) , D treatment length (40 m) .

The fuel amount consumed was measured using graduated cylinder placed in the fuel duct between the tank and the fuel injection pump , After the cylinder dictated with fuel , will closed duct fuel from the tank by a tap . The fuel is used from the cylinder when the treatment access ,length 40m. When completed the treatment (length 40 m) . Fills the cylinder with fuel and another treatment is started in three replication .

2.2.3.Digger machine efficiency

Digger machine efficiency is the ratio of total tuber weight to weight of tubers buried under soil , and it can be affected by time lost in the field and full width of the machine Eq (4) was used for calculation of digger machine efficiency (Saad et al .,11)

$$E_{DM} = \frac{W_{Tt}}{W_{tus} + W_{Tt}} \times 100 \quad \text{---------- (4)}$$

Where : E_{DM} :Digger machine efficiency (%) , W_{Tt}: Total tubers weight (Kg) ; W_{tus} : weight of tubers under soil (Kg) .

To find damage tubers coefficient , The damage tubers were classified into three varieties are surface scratching tubers (X1) is the percentage between the weight of the surface scratching tubers and the tubers that were lifting by the machine , Scratching tubers and not in them internal damage (X2) is the percentage between the weight of the surface scratching tubers and not in them internal damage and the tubers that were lifting by the machine . Broken tubers of the broken deep (X3) is the percentage between the weight of the broken tubers of the broken deep and the tubers that were lifting by the machine . Damage coefficient percentage is determined by using Equation 5

$$D_C = X1 + 3X2 + 7X3 \quad \text{---------- (5)}$$

2.2.4- Qualitative loss

Qualitative loss is sum slightly tubers and sever damage tubers .

2.2.5. Quantitative loss

Quantitative loss is tubers buried in soil after of the lifting process of potato .

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2.2.6. Lifting percentage

Lifting percentage is sum undamaged tubers and qualitative loss. The results were analyzed statistically using the randomized complete block design RCBD and for each factor the difference among treatments was tested according to the L.S.D test (Oehlent, 10).

3 RESULTS AND DISCUSSION

3.1 Machine Production

Table 1 shows the influence of soil moisture , speed of tractor on the machine productivity (t h^{-1}). The results indicated that increasing the speed of tractor leads to the increase of machine productivity, and the results were, 3.825, 5.072 and 5.659 t.h-1 respectively . The production process of the machine was determined by the efficiency of the machine, which depends on the type of the machine as well as and also the machine capacity. These results are consistent with the results that gained by (Wakchaure et al., 12).The soil moisture 12-14% was significantly better than soil moisture 14-16% and the results were 5.182 and 4.522 t h^{-1} respectively at different soil moisture . The interaction among parameters of soil moisture 12-14% and the speed of tractor 5.21 km hr-1 caused the best result of 6.178 t h^{-1}. The machine production is shown in Figure **3** at different conditions for soil moisture and speed of tractor.

Table 1.Effect of soil moisture, speed of tractor on machine production t h^{-1}

Soil moisture	Speed of tractor Km.hr^{-1}			Means of moisture
	2.74	4.06	5.21	
12-14%	4.207	5.161	6.178	5.182
14-16%	3.442	4.982	5.143	4.522
LSD=0.05				1.321
Means of speed	3.825	5.072	5.659	
LSD=0.05		1.537		

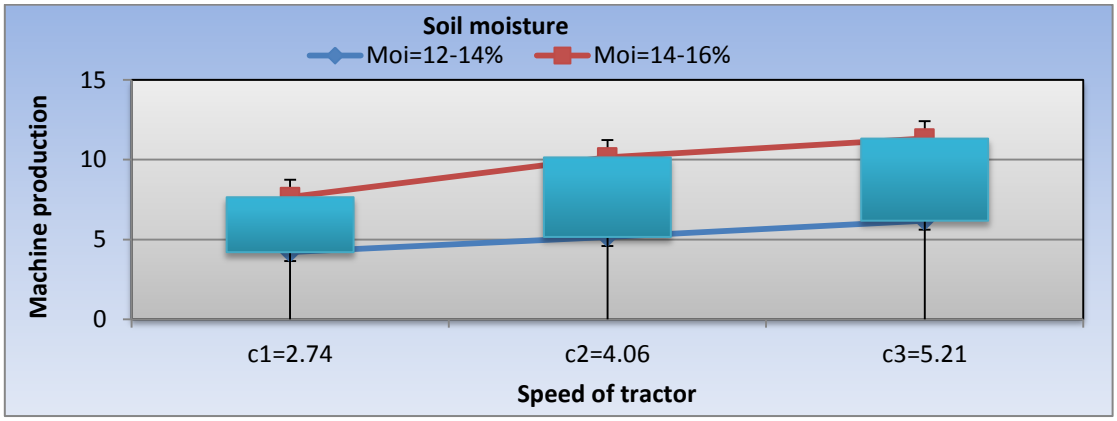

Fig 3. The effect of speed of tractor and soil moisture on the machine production t h^{-1}

3.2.Fuel consumption

The influence of soil moisture on fuel consumption L.ha-1 , was shown in Table. **2** . The soil moisture 12-14% has the lowest fuel consumption which required of 7.096 L.ha-1,and the soil moisture 14-16% has the maximum fuel consumption which required of 8.343 L.ha^{-1}at different soil moisture. The high pressure on digger machine during digger process caused fuel consumption increased. (Alsharifi and sarah .3) .It is indicated that the fuel consumption of the 5.21 km.hr^{-1} speed of tractor was significantly better than 2.74 km.hr^{-1} speed of tractor. The results were 9.345, 7.947 and 5.837 L.ha^{-1} respectively . High soil resistance of the digger movement caused increasing fuel consumption with

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speed of tractor decreased. These results are consistent with the results of (Alsharifi and Sarah, 3) . The best results (5.413 L.ha^{-1}) have come from the overlap among the soil moisture 12-14% and speed of tractor 5.21Km.hr^{-1}. The level of the fuel consumption at different conditions is shown in Fig 4 at different conditions for soil moisture and speed of tractor .

Table 2.Effect of soil moisture, speed of tractor on fuel consumption L.ha^{-1}

Soil moisture	Speed of tractor Km.hr^{-1}			Means of moisture
	2.74	4.06	5.21	
12-14%	8.784	7.091	5.413	7.096
14-16%	9.906	8.803	6.260	8.343
LSD=0.05				2.028
Means of speed	9.345	7.947	5.837	
LSD=0.05		2.321		

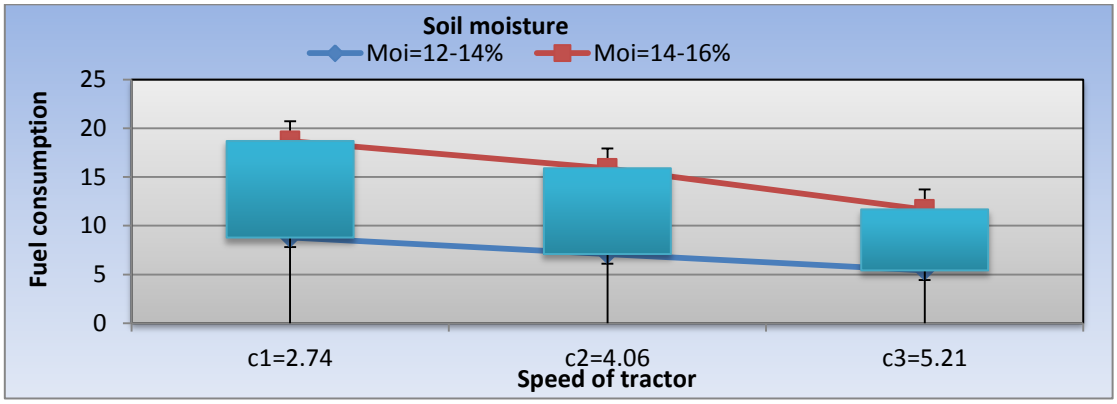

Fig 4. The effect of speed of tractor and soil moisture on the fuel consumption L.ha^{-1}

3.3. Digger machine efficiency

Table **3** shows the influence of soil moisture , speed of tractor on the digger machine efficiency %. The results indicated that increasing the speed of tractor leads to the decrease of digger machine efficiency , and the results were, 84.573, 83.760 and 81.786% respectively at different speed of tractor. This is due to decreasing in the qualitative loss percentage and increase the machine productivity as well as the quantitative loss percentage reduction with decreasing the speed of tractor, which led to a decrease in the percentage of damage .These results are consistent with the results that gained by (Saad et al .,11). The soil moisture 12-14% was significantly better than soil moisture 14-16% and the results were 84.491 and 82.088% respectively .The interaction among parameters of soil moisture 12-14% and the speed of tractor 2.74 km.hr-1 caused the best result of 85.211%. The digger machine efficiency is shown in Figure 5 at different conditions for soil moisture and speed of tractor.

Table 3.Effect of soil moisture, speed of tractor on digger machine efficiency %

Soil moisture	Speed of tractor Km.hr^{-1}			Means of moisture
	2.74	4.06	5.21	
12-14%	85.211	84.703	83.553	84.491
14-16%	83.935	82.816	80.014	82.088
LSD=0.05				1.642
Means of speed	84.573	83.760	81.786	
LSD=0.05		2.109		

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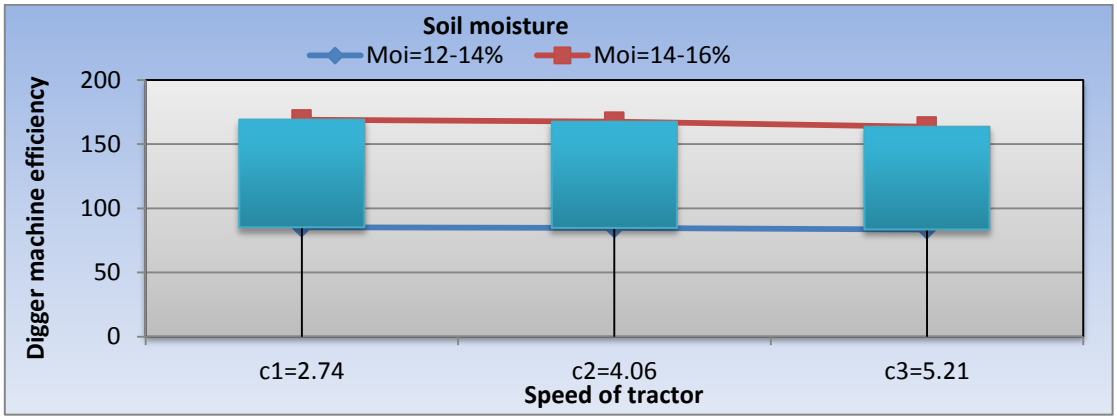

Fig 5. The effect of speed of tractor and soil moisture on the digger machine efficiency %

3.4. Lifting percentage

Table 4 shows the influence of soil moisture, speed of tractor on the lifting percentage % . The results indicated that decreasing the speed of tractor led to the increase of lifting percentage, and the results were 94.478, 93.686 and 90.894% respectively at different speed of tractor. Unbalance the cutting unit of the digger potatoes machine when increased speed tractor in addition to the existence of some obstacles in the experiment field by (Younus. and.jayan 13). The soil moisture 12-14% was significantly better than the 14-16% soil moisture and the results were 93.917 and 92.121 % respectively at different soil moisture. This is due to the efficiency and engineering design of the machine and finishing the works with less time as compared with the local digger machine type These results are consistent with the results gained from (Saad et al. , 11). The interaction among 12-14% soil moisture and the speed of tractor 2.74 km hr-1 caused the best result of 95.405%. The lifting percentage is shown in Figure 10 at different conditions for soil moisture and speed of tractor .

Table 4.Effect of soil moisture, speed of tractor on lifting percentage %

Soil moisture	Speed of tractor Km.hr^{-1}			Means of moisture
	2.74	4.06	5.21	
12-14%	95.405	94.560	91.786	93.917
14-16%	93.551	92.811	90.001	92.121
LSD=0.05				1.203
Means of speed	94.478	93.686	90.894	
LSD=0.05		2.004		

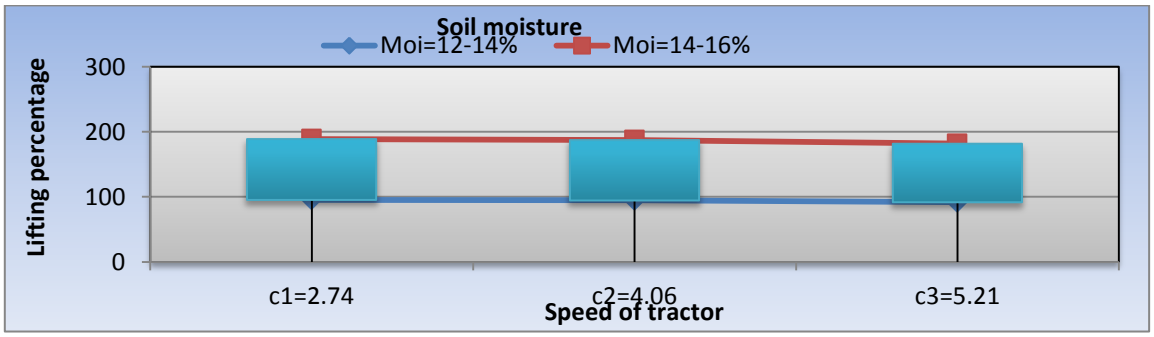

Fig 6. The effect of speed of tractor and soil moisture on the lifting percentage %

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3.5. Qualitative loss

Table **5** shows the influence of soil moisture , speed of tractor on the qualitative loss %. The results indicated that increasing the speed of tractor leads to the increase of qualitative loss , and the results were, 19.067, 20.423 and 22.112% respectively at different speed tractor. The soil moisture 12-14% was significantly better than soil moisture 14-16% and the results were 19.886 and 21.181% respectively at differnt soil moisture . Due to that decreased slightly damaged tubers and damage tubers when used John Deere machine type under soil moisture 12-14% as compared with 14-16% soil moisture .These results are consistent with the results that gained by (Alsharifi et al ., 2) .The interaction among parameters of soil moisture 12-14% and the speed of tractor 2.74 km.hr-1 caused the best result of 18.125%. The qualitative loss is shown in Figure **7** at different conditions for soil moisture and speed of tractor.

Table 5.Effect of soil moisture, speed of tractor on qualitative loss %

Soil moisture	Speed of tractor Km.hr^{-1}			Means of moisture
	2.74	4.06	5.21	
12-14%	18.125	19.720	21.815	19.886
14-16%	20.009	21.125	22.410	21.181
LSD=0.05				1.415
Means of speed	19.067	20.423	22.117	
LSD=0.05		1.534		

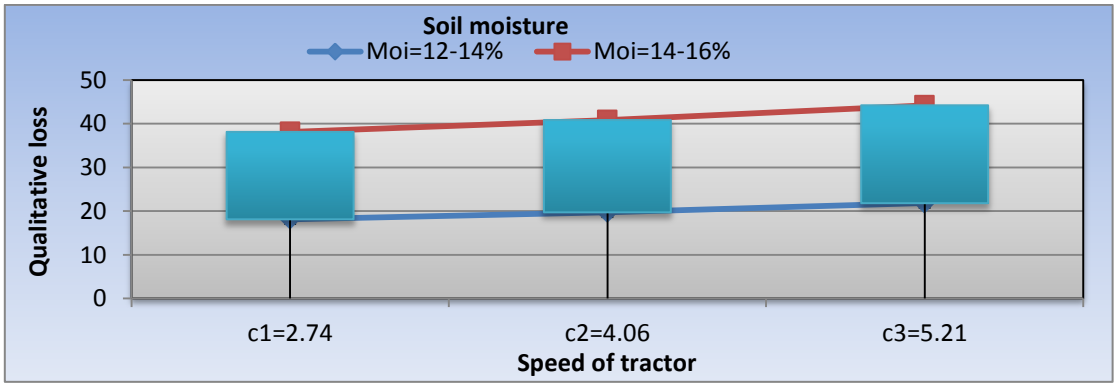

Fig 7. The effect of speed of tractor and soil moisture on the qualitative loss %

3.6. Quantitative loss

Table **6** shows the influence of soil moisture , speed of tractor on the quantitative loss %. The results indicated that increasing the speed of tractor leads to the increase of quantitative loss , and the results were, 2.834, 4.200 and 4.985% respectively .These results are consistent with the results that gained by (Md. Akhir et al., 9). soil moisture 12-14% was significantly better than soil moisture 14-16% and the results were 3.733 and 4.079 % respectively at different soil moisture. The interaction among parameters of soil moisture 12-14% and the speed of tractor 2.74 km.hr-1 caused the best result of 2.505%. The qualitative loss is shown in Figure **8** at different conditions for soil moisture and speed of tractor.

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Table 6.Effect of soil moisture, speed of tractor on quantitative loss %

Soil moisture	Speed of tractor Km.hr^{-1}			Means of moisture
	2.74	4.06	5.21	
12-14%	2.505	3.781	4.915	3.733
14-16%	3.163	4.619	5.055	4.079
LSD=0.05				1.011
Means of speed	2.834	4.200	4.985	
LSD=0.05		1.782		

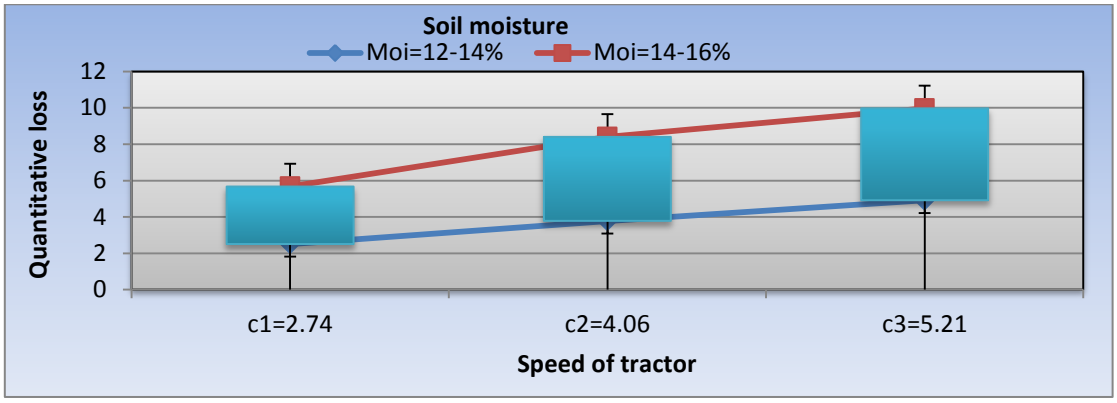

Fig 8. The effect of speed of tractor and soil moisture on the quantitative loss %

4. Conclusions

The soil moisture 12-14% is significantly better than the 14-16% soil moisture. The speed of tractor 2.74 Km .hr was superior significantly to other two speeds of tractor in some studied properties. The best results were obtained from the interaction among 12-14% soil moisture and speed of tractor in some studied

5. Recommendations

The present recommends to carry out future studies using other of machinery types or conduct other organizations on digger machine and other speeds of tractor to know their effect on the qualitative characteristics of potato.

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