Effect of soil moisture and tillage depth on some growth characteristics for wheat crop

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Abstract

The effect of soil moisture and tillage depth was studied on some growth characteristics on wheat .Two types tillage machines(moldboard plow and disk plow) on wheat at three soil moisture levels of 12%, 14% and 16% and three levels tillage depth of 13,15 and 17 cm .The experiments were carried out in a factorial experiment under randomized complete block design were tested with three replications. The results showed that the moldboard plow was significantly better than the disk plow in all studied conditions. The results showed percentage of germination of 84% and 81%, plant height of 76.4 and 74.5 cm ,the plant branches number of 7 and 6 branch, number of spike in one square meter of 178 and 174 spike/m^2 , number of grains in the spike of 76 and 71 grain/ spike and production of wheat crop of 1.25 and 1.17 ton/ Dunum for moldboard plow and disk plow, respectively. The tillage depth of 13 cm was significantly superior to the other two levels of 15 and 17cm , soil moisture of 12% was significantly superior to the other two levels of 14% and 16% in all studied conditions.

Keywords : Tillage , soil moisture , tillage depth , wheat ,machines

تأثير رطوبة التربة وعمق الحراثة على بعض صفات نمو محصول الحنطة

الخلاصة:

تم استخدام الات الحراثة (محراث مطرحي ومحراث قرصي) بثلاث مستويات لرطوبة التربة 12%,14% و16% وثلاث مستويات لعمق الحراثة 13 , 15و 17 سم وقد أجريت التجارب في تجربة عامليه تحت تصميم العشوائي الكامل بثلاث مكررات واظهرت النتائج ان المحراث المطرحي القلاب كان افضل بكثير من المحراث القرصي في جميع ظروف الدراسة .نسبة الانبات 84و 81% , ارتفاع النبات 76,4 و 74,5 سم , عدد فروع النبات 6 و7 فرع \م , عدد السنابل في متر مربع واحد 178 و 174سنبلة ,عدد الحبوب في السنبلة 76 و 71 حبة \سنبلة , إنتاجية محصول الحنطة 1,17 و 1,25 طن / دونم لكلا الات الحراثة المطرحي والقرصي .تفوقت عمق الحراثة 13سم على العمق الاخرين 15 و 17 سم بينما تفوقت رطوبة التربة 12% على المستويين 14 و16% في جميع الصفات المدروسة .

الكلمات الافتتاحية : الحراثة , رطوبة التربة , عمق الحراثة , محصول الحنطة , الآلات.

1.Introduction :

Wheat is considered as the first and the most important crops in the world in so far the economic aspects are concerned and for great proportion of population all over the world because it provides for about %55 from the total carbohydrates and %20 from the total calorie food . Besides rice and corns, wheat occupies about %80 from the total planted areas in Iraq , Wheat is an important source of carbohydrates. Globally, it is the leading source of vegetal protein in human food, having a protein content of about 13%, which is relatively high compared to other major cereals but relatively low in protein quality for supplying essential amino acids. When eaten as the whole grain, wheat is a source of multiple nutrients and dietary fiber In a small part of the general population, gluten – the major part of wheat protein – can trigger coeliac disease, non-coeliac gluten sensitivity, gluten ataxia and dermatitis herpetiformis {16} .

{18}. Change in moisture level due to pre-treatment was found to have significant effect on the physical properties of cashew nuts. {8}. The physical properties of Roselle seeds were found to increase as the moisture content increases with the exception of the bulk density that decreased . {6}. The force needed to rupture a seed decreased as the moisture content increased from 5.85 to 25.85%. The rupture force of 113.99 N was the highest in the horizontal direction at 5.85% moisture content, while the least rupture force was 26.83 N at the moisture content of 28.85%. {4}. That increase in the tillage depth and moisture content leads to a decrease in yield productivity due to increased soil resistance to penetration.{17}. Soil physical conditions detrimental to root proliferation in subsoil are generally related to tillage pans that develop below tilled layer .{1}. Tillage operation with the same implement over several years may lead to compacted layer in field soil. Plowing at the same depth year after year reinforce the plow pan development, so use of different tillage implement may be the only solution to breakup this pan.

{5},That there is a significant effect of soil moisture on the characteristics of the crop depends on the type of machine and depth of tillage .{10},penetration resistance is more sensitive than bulk density to detect effects of tillage management . Measurements of resistance to penetration can provide a composite image of the effect of compaction and moisture status. Several authors have concluded that high penetration resistance in conservative systems reduced root growth ,{13}.Affecting water and nutrient uptake by crops . Low soil-surface temperatures due to accumulation of crop residues can adversely affect emergence and seedling growth under no tillage in mid-latitudes .{19}.Conventional tillage practices modify soil structure by changing its physical properties, such as soil bulk density, soil penetration resistance and soil moisture content. Annual disturbance and pulverizing caused by conventional tillage produce a finer and loose soil structure as compared to conservation and no-tillage method which leaves the soil intact .

The main goal of this research is to study the effect of moldboard plow and disk plow on wheat, at different soil moisture and tillage depth .

2.Materials and methods

This study was conducted in 2016 ,to evaluate the effect of soil moisture and tillage depth on some growth characteristics for wheat the experiments were done at two machine types were used for tillage (mold board plow and Disk plow) at three levels moisture soil of 12% , 14% and 16% ,and three tillage depth at levels of 13, 15 and 17 cm , The moldboard plow was selected for the experiments and set at 17 cm depth and soil moisture 16% .plant height ,germination percentage , number of branches, number of spike ,number of grains in spike and production of wheat crop . The wheat was selected for the experiments .each running test

2.1.Soil moisture :

Soil moisture content usually as a percentage - representing what percentage of total 'volume' of soil is moisture. all the soil particles and compact them to remove all gaps between them (suppose it squashes down to about 40% of the original volume). the organic matter - this would occupy about 5% of the volume. The rest of the volume is made up of pore spaces which can be occupied by either air or water .

$$W_{=\frac{W_w}{W_s}\times 100}$$

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

Al Sharifi .,(2003)

2.2.Tillage depth :

found by the hydraulic device for tractor were 13,15 and 17 cm .

Muhammad *et al*., (2004)

2.3.The crop and its components :

2.3.1.Plant height :

Plant height of wheat is measure from soil surface till the spike in three replications .

Anderson and Ganlinge .,(2000)

2.3.2. Germination percentage :

Percentage of germination is found for number plants growing in one square meter in three replications .

Lech and Kolasinka .,(2004)

2.3.3.Number of branches :

Take 25 of plants growing in one square meter and calculated branches number each plant in three replications .

Jaddoa and Baqir ,(2012)

2.3.4.Number of spike in one square meter :

The samples random were taken for ten and calculated number of the spikes in one square meter in three replications .

Jaddoa and Baqir ,(2012)

2.3.5. Number of grains in spike

The samples random were taken for 25 plants and calculated number of grains in spike in one square meter in three replications. Yagmur and Kaydan .,(2009)

2.3.6. Production of the crop :

The samples random were taken for 25 plants in one square meter and calculate production of the crop in three replications .

Jaddoa and Baqir ,(2012)

The same method was used with the same cultivar (Wheat) to test Moldboard plow at soil moisture in the range of 14%,12% and tillage depth of 15cm and 13cm in three replications. The results were analyzed statistically using the split split unit with randomized complete block design RCBD and for each factor the difference among treatments was tested according to the L.S.D test (Alsahoeke and Cream,1990).

3. Results and Discussion

3.1. Percentage of germination

Table 1 shows the influence of the tillage machines, depth of tillage, and soil moisture on the percentage of germination %. The results indicate that increasing the depth of tillage leads to decrease the germination percentage , and the results were 90 ,83 and 72 % respectively for different tillage depth . The tillage leads to improve soil ventilation which its a significant impact in the absorption of water by the roots .These results are consistent with the results that gained by (Al sharifi 2007). As for the increasing the moisture leads to decreasing of the germination percentage , and the results were 85 , 82 and 81% respectively for different soil moisture . soil moisture increase leads to soil hardness hence decrease germination with increasing soil moisture ,This is consistent with (Lech and Kolasinka .,2004). However the moldboard plow is significantly better than the disk plow . and The results were 84 and 81% respectively . This is due to the efficiency and engineering design of the machine and finishing the works with less time as compared the disk plow .The levels of the percentage of germination at different conditions is shown in fig **1** for two machines (moldboard and disk plow), moisture and tillage depth.

Table 1 The effect of tillage machines types , tillage depth and soil moisture on percentage of germination %.

	The overlap between Machines , Moisture and tillage depth				
Tillage machines	Moisture	Depth tillage cm			The overlap between tillage machines and soil moisture
		13	15	17	
Moldboard plow	12%	93	89	77	86
	14%	92	86	75	84
	16%	90	84	71	82
Disk plow	12%	90	85	74	83
	14%	88	82	71	80
	16%	87	81	70	79
L.S.D=0.05	2.23				N.S
Average of tillage depth		90	83	72	
L.S.D=0.05		4.45			
Machines	The overlap between tillage machines and tillage depth				Average of tillage machines
Mold board plow	92	86	74		84
Disk plow	88	83	72		81
L.S.D=0.05	4.08				2.16
Soil moisture	The overlap between moisture and tillage depth				Average of soil moisture
12%	92	87	76		85
14%	90	84	73		82
16%	89	83	71		81
L.S.D=0.05	N.S				1.13

Note: LSD means least significant difference

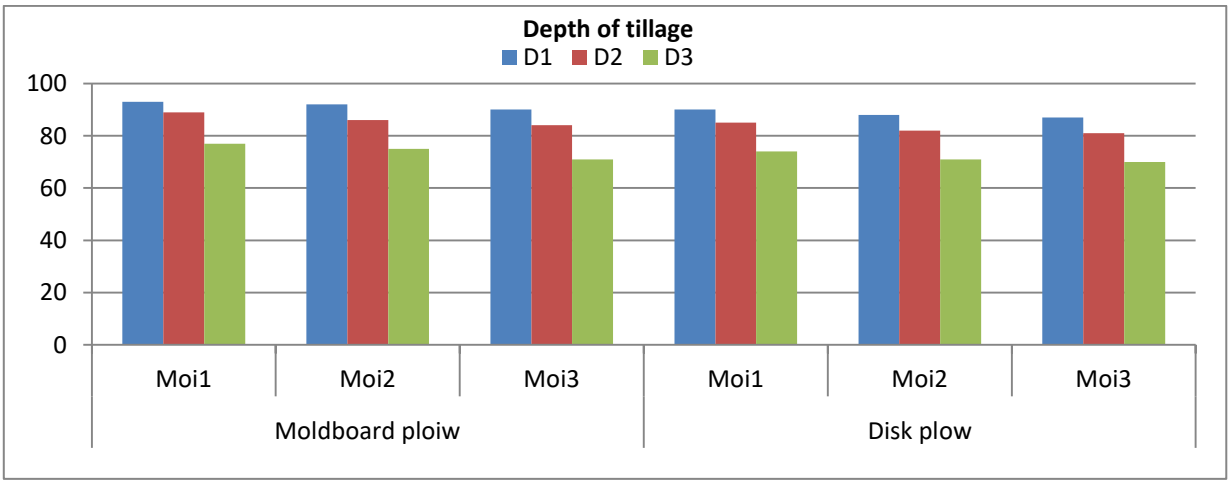

Fig. 1 The effect of soil moisture and tillage depth on the percentage of germination for two tillage machines.

3.2. Plant height

The influence of the tillage machines, depth of tillage, and soil moisture on the plant height %.is shown in Table 2. The results indicate that increasing the depth of tillage leads to decrease the plant height , and the results were 82.1 ,73.6 and 70.5 cm respectively at different tillage depth .Tillage depth increase leads to increasing soil

resistance to penetration hence decrease plant height .These results are consistent with the results that gained by (Akhar *te al*.,2005). As for the increasing the moisture leads to decreasing of the plant height , and the results were of 78.1 , 75.0 and 73.1cm respectively at different soil moisture . soil moisture increase leads to hinder root growth and decreasing plant height .This is consistent with (Gus *et al*., 2008). However the moldboard plow is significantly better than the disk plow . and The results were 76.4 and 74.5 cm respectively for moldboard plow and disk plow . This is due to the increase Damocles effort on soil during the tillage process when used disk plow as compared moldboard plow .The levels of the plant height at different conditions is shown in fig **2** for two tillage machines (moldboard and disk plow) , moisture and tillage depth .

Table 2 The effect of tillage machines types, tillage depth and soil moisture on plant height cm.

	The overlap between Machines , Moisture and tillage depth				
Tillage machines	Soil moisture	Depth tillage cm			The overlap between tillage machines and soil moisture
		13	15	17	
Moldboard plow	12%	87.6	76.9	72.8	79.1
	14%	83.5	74.4	70.4	76.1
	16%	80.6	71.9	69.9	74.1
Disk plow	12%	84.8	75.4	70.9	77
	14%	79.9	72.1	69.8	73.9
	16%	76.4	70.9	68.9	72
L.S.D=0.05	2.44				1.86
Average of tillage depth		82.1	73.6	70.5	
L.S.D=0.05		2.18			
Machines	The overlap between tillage machines and tillage depth				Average of tillage machines
Mold board plow	83.9	74.4	71		76.4
Disk plow	80.4	72.8	70.4		74.5
L.S.D=0.05	N.S				1.89
Soil moisture	The overlap between moisture and tillage depth				Average of soil moisture
12%	86.2	76.2	71.9		78.1
14%	81.7	73.3	70.1		75
16%	78.5	71.4	69.4		73.1
L.S.D=0.05	1.92				1.06

Note: LSD means least significant difference

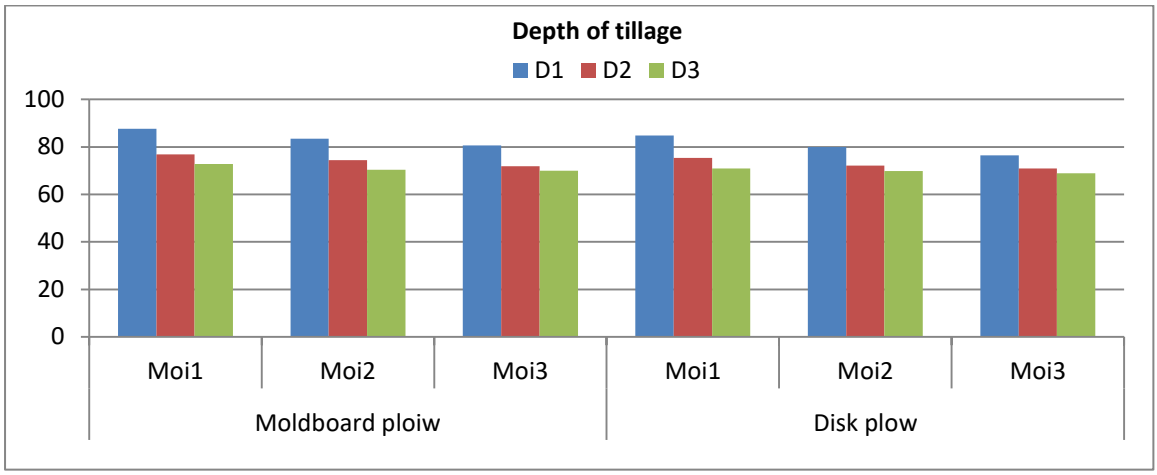

Fig. 2 The effect of soil moisture and tillage depth on the plant height for two tillage machines

3.3 .The plant branches number

The influence of the tillage machines, depth of tillage, and soil moisture on the plant branches number , is shown in Table 3. The increasing the soil moisture leads to decreasing of the plant branches number , the results were 8 , 7 and 6 branch, respectively for different levels of soil moisture , This is due to hinder root growth with increasing soil moisture and decreasing plant branches number .This is consistent with (Mahdi et al., 1998), increasing the depth of tillage leads to decrease the plant branches number , and the results were 7,6 and 5 branch, respectively for different levels of tillage depth .Loss some nutrients with increasing tillage depth These results are consistent with the results that gained by (Jaddoa and Baqir , 2012).However the moldboard plow is significantly better than the disk plow . and The results were 7 and 6 branch, respectively . Because of high quality in tillage process, less capacity was consumed when moldboard plow was used to compare with disk plow .The levels of the plant branches number at different conditions is shown in fig **3** for two tillage machines (moldboard and disk plow) , moisture and tillage depth .

3.4. Number of grains in spike

The influence of the tillage machines, depth of tillage, and soil moisture on number of grains in spike , is shown in Table 3. The number of grains in spike levels of 76 and 71 grain / spike for moldboard plow and disk plow respectively .Because of the lack of withstanding of soil to pressure which facing inside tillage line when the moldboard plow as compared disk plow hence decrease in number grain in spike, This is consistent with (Marin et al.,2011), increasing the moisture leads to decreasing of number of grains in spike, the results were 80, 75 and 67 grain/spike respectively for different levels of soil moisture The moisture increase leads to weak plant and negatively reflected on number grains in spike ,increasing the depth of tillage leads to decrease number of grains in spike , and the results were 77, 74 and 70 grain/spike respectively for different levels of tillage depth .when the moldboard plow as compared disk plow hence decrease in number grains in spike .These results are consistent with the results that gained by (Al sharifi 2007).The levels of number of grains in spike at different conditions is shown in fig **4** for two tillage machines (moldboard and disk plow) , soil moisture and tillage depth .

Table 3 The effect of tillage machines types , tillage depth and soil moisture on plant branches number .

	The overlap between Machines , Moisture and tillage depth				
Machines	Moisture	Depth tillage cm			The overlap between tillage achines and soil moisture
		13	15	17	
Moldboard plow	12%	9	8	7	8
	14%	8	7	6	7
	16%	6	5	5	5
Disk plow	12%	8	7	6	7
	14%	7	6	5	6
	16%	6	5	4	5
L.S.D=0.05	0.21				N.S
Average of tillage depth		7	6	5	
L.S.D=0.05		0.12			
Machines	The overlap between tillage machines and tillage depth				Average of tillage machines
Mold board plow	7	7		6	7
Disk plow	7	6		5	6
L.S.D=0.05	N.S				0.10
Soil moisture	The overlap between soil moisture and tillage depth				Average of soil moisture
12%	9	8		7	8
14%	8	7		6	7
16%	6	5		5	5
L.S.D=0.05	0.13				N.S

Note: LSD means least significant difference

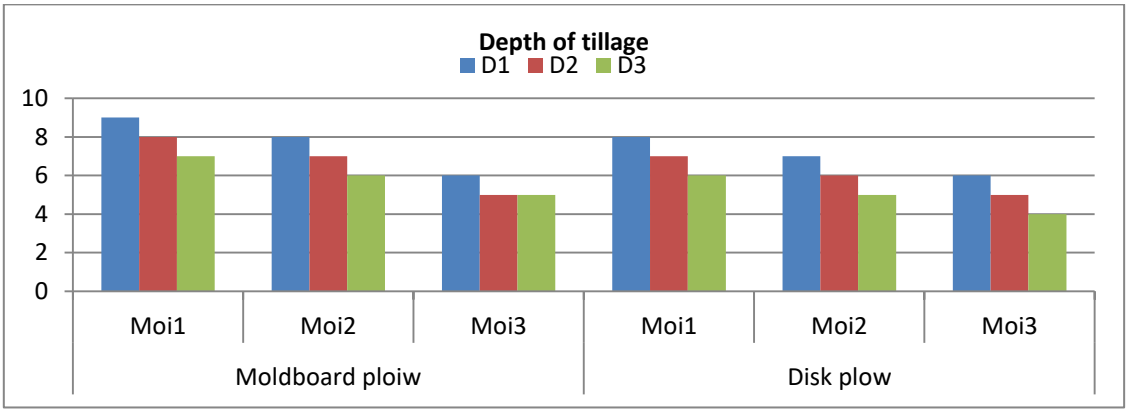

Fig. 3 The effect of soil moisture and tillage depth on the plant branches number for two tillage machines .

Table 4 The effect of the tillage machines types , tillage depth and soil moisture on number grains in spike .

	The overlap between Machines , Moisture and tillage depth				
Machines	Moisture	Depth tillage cm			The overlap between tillage machines and soil moisture
		13	15	17	
Moldboard plow	12%	83	81	79	81
	14%	81	78	74	78
	16%	72	69	65	69
Disk plow	12%	81	79	74	78
	14%	75	71	67	71
	16%	72	64	59	65
L.S.D=0.05	1.72				2.11
Average of tillage depth		77	74	70	
L.S.D=0.05		2.72			
Tillage machines	The overlap between tillage machines and tillage depth				Average of tillage machines
Mold board plow	79	76		73	76
Disk plow	71	71		67	71
L.S.D=0.05	3.55				2.87
Soil moisture	The overlap between soil moisture and tillage depth				Average of soil moisture
12%	82	80		77	80
14%	78	75		71	75
16%	72	67		62	67
L.S.D=0.05	3.13				4.11

Note: LSD means least significant difference

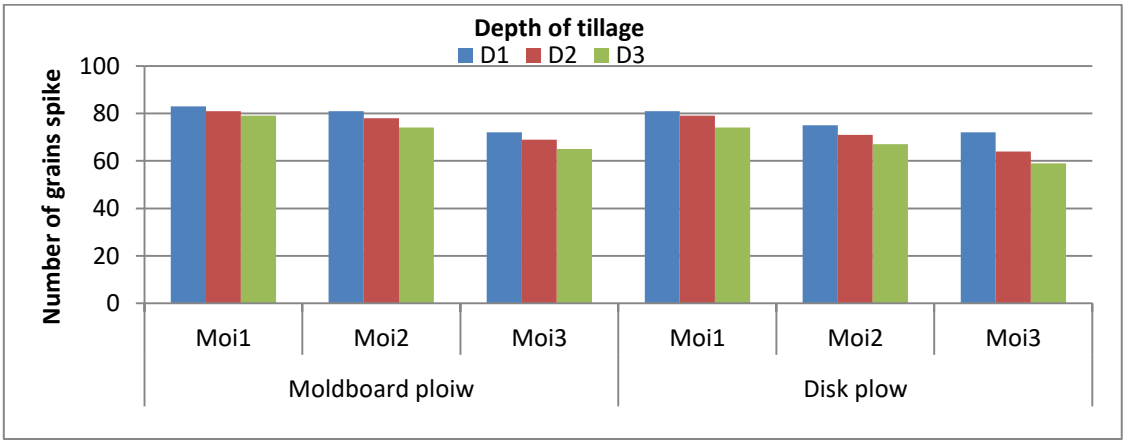

Fig. 4 The effect of soil moisture and tillage depth on number of grains spike for two tillage machines .

3.5. Number of spikes per square meter

The influence of the tillage machines, depth of tillage, and soil moisture on number of spike per square meter , is shown in Table 5. The increasing the moisture leads to decreasing of number of spike per square

meter ,the results were 190 , 175 and 165 spike/m^2 respectively for different levels of soil moisture. This is due to soil fragility and improved number of spikes per square meter when decreasing soil moisture This is consistent with (Marin *et al*.,2011),increasing the depth of tillage leads to decrease number of spike per square meter , and the results were 182, 176 and 170 spike / m^2 respectively for different levels of tillage depth . This is due to Soil fragility and improved growth crop and positively reflected on increasing number of spikes per square meter with decreasing tillage depth These results are consistent with the results that gained by (Al sharifi 2003). However the moldboard plow is significantly better than the disk plow . and The results were 178 and 174 spike /m^2 respectively . This is due to the efficiency and engineering design of the machine and finishing the works with less time as compared the disk plow .The levels of the number of spike per square meter at different conditions is shown in fig **5** for two machines (moldboard and disk plow) , moisture and tillage depth .

Table 5 The effect of tillage machines types , tillage depth and soil moisture on number of spike per square meter .

	The overlap between Machines , Moisture and tillage depth				
Machines	Moisture	Depth tillage cm			The overlap between tillage machines and soil moisture
		13	15	17	
Moldboard plow	12%	198	191	189	193
	14%	182	179	172	178
	16%	176	166	159	167
Disk plow	12%	192	187	183	187
	14%	175	171	168	171
	16%	170	163	154	162
L.S.D=0.05	7.23				6.08
Average of tillage depth		182	176	170	
L.S.D=0.05		N.S			
Tillage machines	The overlap between tillage machines and tillage depth				Average of soil machines
Mold board plow	185	179		173	178
Disk plow	179	174		168	174
L.S.D=0.05	2.76				2.09
Soil moisture	The overlap between soil moisture and tillage depth				Average of soil moisture
12%	195	189		186	190
14%	179	175		170	175
16%	173	165		157	165
L.S.D=0.05	N.S				7.02

Note: LSD means least significant difference

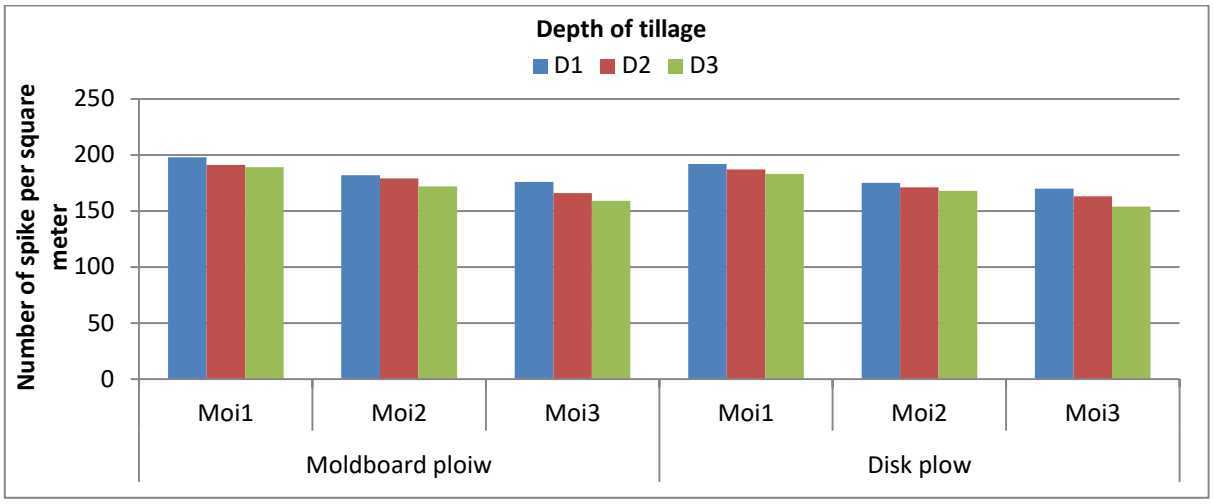

Fig. 5 The effect of soil moisture and tillage depth on number of spike per square meter for two tillage machines .

3.6. Production of wheat

The influence of the tillage machines, depth of tillage, and soil moisture on production of wheat Ton/D, is shown in Table 6. The increasing the moisture leads to decreasing of production of crop, the results were 1.35, 1.25 and 1.04 Ton/D, respectively for different levels of soil moisture . Soil resistance to penetration increasing is one of the factors influencing the productivity of wheat yield through its effect on root extension and plant production growth with soil moisture decreased. This is consistent with (Rashidi., 2007), increasing the depth of tillage leads to decrease production of wheat, and the results were 1.41, 1.16 and 1.06 Ton/D respectively for different levels of tillage depth. The production of wheat crop decrease when tillage depth increase and due to increase in percentage of slipping that leads to decreasing physical qualities of soil. These results are consistent with the results that gained by (Al sharifi 2003). However the moldboard plow is significantly better than the disk plow. and The results were 1.25 and 1.17 Ton/ Du respectively . This is due to the efficiency and engineering design of the machine and finishing the works with less time as compared the disk plow .The levels of the production of wheat at different conditions is shown in fig **6** for two tillage machines (moldboard and disk plow), moisture and tillage depth .

4. Conclusions

The moldboard plow is significantly better than the disk plow in all studied condition ,the soil moisture 12% was significantly superior to two levels 14% ,16% and tillage depth 13cm was significantly superior to the other two tillage depth 15 and 17cm in all studied properties . The best result was obtained by moldboard plow at soil moisture 12% and 13cm tillage depth .

Table 6 The effect of tillage machines types , tillage depth and soil moisture on production of wheat .

	The overlap between Machines , Moisture and tillage depth				
Machines	Moisture	Depth tillage cm			The overlap between tillage machines and soil moisture
		13	15	17	
Moldboard plow	12%	1.66	1.33	1.21	1.40
	14%	1.52	1.14	1.11	1.26
	16%	1.21	1.09	0.99	1.09
Disk plow	12%	1.53	1.26	1.11	1.30
	14%	1.48	1.13	1.09	1.23
	16%	1.06	1.02	0.87	0.98
L.S.D=0.05	0.06				N.S
Average of tillage depth		1.41	1.16	1.06	
L.S.D=0.05		N.S			
Machines	The overlap between tillage machines and tillage depth				Average of tillage machines
Mold board plow	1.46	1.19	1.10		1.25
Disk plow	1.35	1.14	1.02		1.17
L.S.D=0.05	0.05				N.S
Soil moisture	The overlap between soil moisture and tillage depth				Average of soil moisture
12%	1.60	1.30	1.16		1.35
14%	1.50	1.14	1.10		1.25
16%	1.14	1.06	0.93		1.04
L.S.D=0.05	N.S				N.S

Note: LSD means least significant difference

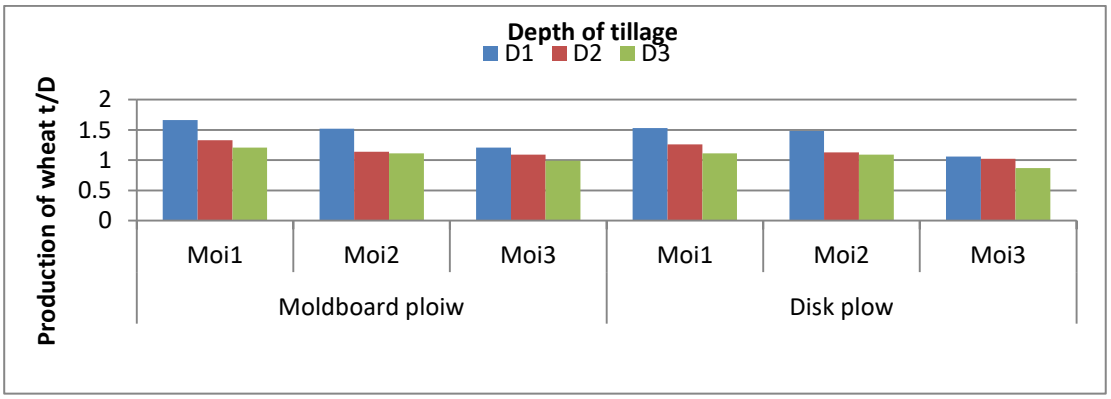

Fig. 6 The effect of soil moisture and tillage depth on production of wheat for two tillage machines .

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