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Effect of some tillage methods and sowing dates on bulk density, soil moisture and sorghum yield in the rainfed areas of northern Gedarif , Gedarif State , Sudan

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ABSTRACT

The study was carried out during three consecutive seasons (2005/06, 2006/07 and 2007/08) under rain-fed conditions, to investigate the effect of some tillage methods and sowing dates of sorghum (*Sorghum bicolor L.*) on soil moisture content, bulk density and sorghum grain yield in northern Gedarif area, at the pilot farm of the Faculty of Agricultural and Environmental Sciences, University of Gedarif, Gedarif, Sudan. The experiment was laid out in a split plot design with three replicates. Main plots were assigned to three tillage methods; which were: Zero tillage (ZT), offset disc as post harvest tillage(PHT) and farmers practice which was wide level disc (WLD) as control, while sub-plots were assigned to two sowing dates which were early sowing date (S1) and late sowing date (S2). Post-harvest tillage treatment (PHT) resulted in significantly higher soil moisture content in the three growing seasons compared to the other two treatments. Combined analysis indicated that ZT resulted in significantly higher soil bulk density in comparison with WLD and PHT treatments for the three depths. The 3-years average grain yield for PHT, WLD and ZT were 1113 kg/ha, 976 kg/ha and 885 kg/ha, respectively. The respective increase in yield was 26% and 14%.

INTRODUCTION

The term zero – tillage is used for production systems where the crop is seeded into standing stubble without any preceding tillage. FAO (2001) reported that direct seeding refers to seeding / planting without preparing a proper seed bed. However, post harvest tillage is done after crop harvest for soil water conservation and weed control.

High yields and returns of sorghum can be obtained by the selection of the appropriate tillage and seeding machinery. Salih and Mohamed (1990) tested sub – soiling to a depth of 45 cm together with disc harrowing to 25 cm depth, the three bottom disc and minimum tillage and found a

significant increase in sorghum grain yield with the use of sub – soiling , followed by disc harrowing.

Sharma *et al* . (1988) found that the soil bulk density, penetration resistance and temperature of surface layers decreased with tillage intensity in clay and clay loam soil. Pabin *et al* . (2003) found that reduced tillage and zero-tillage resulted in higher soil bulk density compared to conventional tillage. Similarly, Lampurlanes *et al* . (2003) showed that notillage resulted in the highest soil bulk density (mean of 1.34 mg m^{-3}) followed by minimum tillage (1.27 mg m^{-3}) and sub-soil tillage (1.22 mg m^{-3}).

The influence of tillage on fodder sorghum yield in clay soil of Khartoum North area was studied by Fadel AL Mola (1989). Using deep tillage, conventional tillage, shallow tillage and no tillage. His results showed no significant differences due to these systems on soil moisture content , bulk density and sorghum grain yield .

Elawad (1994) studied the effect of four tillage treatments combinations, which were no tillage, ridging only, ridging + split ridging and disc plowing + harrowing + ridging on sorghum yield. He found no significant differences in grain yield between the different treatments. However, the highest yield was obtained under the combination of disc plowing + harrowing + ridging, while the lowest yield was under no-tillage treatment.

The objectives of this work were to study the effects of some tillage methods and sowing dates of sorghum on soil moisture content , bulk density and sorghum grain yield in northern Gedarif area.

MATERIALS AND METHODS

Field experiments were carried out during 2005/06, 2006/07 and 2007/08 seasons, under rain - fed conditions , to study the effect of selected tillage methods and sowing dates of sorghum on soil moisture and bulk density and sorghum yield in northern Gedarif area . The study was conducted at the pilot farm of the Faculty of Agricultural and Environmental Sciences , Gedarif University in the northern region of Gedarif city (latitude 12° 45´ N, longitude 35° 15´ E, elevation of 540 masl). The experiment was laid out in a split plot design with three replicates. The main plots were assigned to the three tillage methods which were zero tillage (T1) , offset disc harrowing as post harvest tillage (T2) and wide level disc plowing , which is the local farmers practice as control (T3) , whereas the sub plots were assigned to sowing dates. The main plot was 36 x 12 m, while the sub plot was 15 x 12 m. Zero tillage system, which limits the soil disturbance, was used except for opening small holes for seed placement . Offset disc harrowing to 20 cm depth was carried out for three consecutive seasons on the second week of November as post harvest tillage. The wide level disc (WLD) was used as primary tillage during the summer time on July just before the rainy season to mix the previous crop residues in the soil.

Early sowing dates were 7th , 12th and 9th of July for 2005/06,
2006/07 and 2007/08 seasons, respectively, (S1). Late sowing dates were 9th, 5th and 4th of August for 2005/06, 2006/07 and 2007/08 seasons , respectively.

Grain yield was determined for an area of 20 m^2 selected randomly from each plot. **Soil bulk density**

Soil bulk density was determined for three depths of 0 - 15, 15 - 30 and 30 - 45 cm with the use of core sampler method as described by Blake (1965) . Bulk density samples were taken at harvesting time for 3 points randomly per each plot. The soil core was weighed, oven dried at 105C^o for 24 hr and then reweighed. The dry bulk density was expressed as the ratio of dry soil mass to the core sampler volume: Bulk density (BD) = MS/Vt where

MS = Mass of soil solid (g)
Vt = Total volume of soil (cm^3)

Soil moisture content

Soil samples were randomly taken from three depths of 0-15, 15-30 and 30-45 cm at three locations for gravimetric soil moisture determination. Samples were taken about 3 m from the near edge, middle and lower parts of the plot.

Generally, sampling was performed one to two days after each effective rain, normally above 10 mm. The soil samples were weighed fresh. Then they were oven- dried at 105C° for 24hr and reweighed. The gravimetric moisture content was calculated according to Michael (1978) by expressing the percentage of moisture on dry mass basis. Soil moisture (%) = [(W - W1)/ W1] × 100 where

W = weight of moist soil (g)
W1 = weight of oven dry soil (g)

RESULTS AND DISCUSSION Meteorological data

Table 1 shows the meteorological data for the three seasons .The lowest annual rainfall (368.1 mm) was received during the first season (2005/06), and then 463.6 mm and 495.2 mm during 2006/07 and 2007/08, respectively. July and August were the most rainy months, had the highest relative humidity % (RH %) and lowest mean air temperature compared to the other months. Low temperature and high RH reduced evaporation during July and August. During other months, increased evaporation rates were 12 mm/day. The highest sunshine was recorded during November with a range of 9 – 9.5 hr/day for the experimental seasons , whereas the lowest shine sun hours were 6.3 to 6.6 hr/day during August. For the three experimental seasons, wind speeds measured at 2 m high indicated high values during early rainy season and low values during rainy mid-season, and late season (Table 1).

Effect of tillage on soil bulk density

Table 2 shows significant differences among treatments for the three seasons and their combination. Generally , soil bulk density decreased with depth. Similar findings were reported by Eltom (1989). In the 1st season and for each tillage treatment, there was no significant difference between the WLD and the other two treatments for soil bulk density with regard to the upper two depths (0-15 and 15 – 30 cm). Zero tillage only obtained 1.13 g/ cm³ which was significantly higher at 30-45 cm depth compared to
1.10 g/ cm³for PHT and WLD (1.113 g/ cm³).

In the second season, the results showed significant differences between ZT and PHT for the two upper depths, but there was no significant difference between WLD and PHT and between WLD and ZT. However, the result indicated no significant effect on soil bulk density for the third depth in the second season and this might be attributed to the less tillage effect on soil pore volume for such depth . In the third season , the results followed a similar trend with respect to level of significance with the exception of higher values, whereas the third depth showed no significant difference between treatments.

The combined analysis indicated that ZT recorded significantly higher soil bulk density than the WLD and PHT in the order of 1.144 g/cm³, 1.129 g/cm³, and 1.116 g/cm³, respectively for the three depths. This might be due to the effect of soil tillage on soil pore volume in relation to the unit weight of soil particles, which resulted in low soil bulk density. Similar findings were reported by Sharma *et al.* (1988) who indicated that the bulk density decreased with tillage in clay soils. Similarly Pabin *et al*. (2003) and Lampurlanes *et al* (2003) indicated that the reduced tillage and zero-tillage resulted in higher bulk density compared to the conventional tillage.

Table 2. Effect of tillage on soil bulk density (g /cm³) for three seasons .

Treatments	Seasons					
	1st season (FS) (2005/06)			2nd season (SS) (06/20072)		
	Soil depth (cm)			Soil depth (cm)		
Type of tillage	0-15	15-30	30-45	0-15	15-30	30-45
Zero tillage (ZT)	1.157a	1.114a	1.130a	1.133a	1.120a	1.100a
Post harvest (PHT)	1.127b	1.103b	1.100c	1.100b	1.087b	1.093a
Wide level disk (WLD)	1.140ab	1.123ab	1.113b	1.117ab	1.100ab	1.083a
Mean	1.141	1.123	1.117	1.117	1.102	1.092
C.V %	0.77	0.51	0.6	0.37	0.3	2.9
S.E ±	0.005	0.003	0.003	0.002	0.001	0.015

	Seasons			Combined		
	3rd season (TS) (2007/08)					
	Soil depth (cm)			Soil depth (cm)		
Tillage	0-15	15-30	30-45	0-15	15-30	30-45
Zero tillage (ZT)	1.143a	1.123a	1.117a	1.144a	1.129a	1.116a
Post harvest (PHT)	1.117b	1.097b	1.073a	1.114c	1.096c	1.o89b
Wide level disk (WLD)	1.133ab	1.117ab	1.107a	1.130b	1.113b	1.101b
Mean	1.131	1.112	1.099	1.130	1.113	1.102
C.V %	0.69	0.6	1.73	0.64	0.49	1.68
S.E ±	0.005	0.004	0.38	0.003	0.002	0.006

Means followed by the same letter(s) are not significantly different at 0.05% level of probability according to Duncan 's Multiple Range Test.

Effect of tillage and sowing date on soil moisture content

Soil moisture content was measured one to two days after effective rainfall throughout the growing seasons. Tables 3 shows the results of soil moisture analysis under both tillage and sowing date treatments for season 2005/2006 . The data for the other two seasons were not shown because these tables are too large to be presented in a publication and the trend in these seasons is similar to that shown by season 2005/2006. The majority of samples taken showed significant differences at ($P \leq 0.05$) and ($P \leq 0.01$) for the soil moisture content due to tillage alone or tillage after crop sowing treatments in all of the three growing seasons.

Moisture content decreased with the increase in depth , which was due to the tillage effect on the top the soil. Similar results were reported by Milles and Starast (1991). The pronounced effect of rain water gradually decreased when the rainy season had been advanced and more water had penetrated throughout the whole profile, which resulted in equal amount of soil moisture per profile layer .Post-harvest tillage (PHT) resulted in the highest retained moisture in the three seasons and showed significant differences compared to the other two tillage treatments for the majority of samples. Zero tillage (ZT) and wide level disk (WLD) treatments showed no significant differences. The increased soil moisture content under the PHT might be due to the sealing of cracks provided by this treatment in addition to probability of carryover of some moisture from the previous season, whereas for the ZT treatment, this residual moisture might have been lost through the long open cracks. These results are in good agreement with the findings of Kovac (1984) . The early sowing date resulted in more soil moisture content compared to the late sowing which was probably due to good early vegetation cover under the former treatment that provided good conditions for evaporation suppression and surface runoff restriction. However, the interaction between PHT and the early sowing date resulted in significantly higher ($P \leq 0.05$) soil moisture for the majority of soil samples.

The results clearly indicated that PHT treatment was found to be a superior practice for moisture conservation compared to the other treatments. This was due to the loose soil which enhanced maximum rainwater infiltration. This phenomenon was confirmed by the findings of Kepner *et al.* (1972) .

Table 1. Meteorological data for Gedarif Station for three seasons(2005/2006/07 an 2007/08).

	2005/06							**2006/07**						
Meteorological Parameters	Jun	Jul	Aug	Sep	Oct	Nov	Mean	Jun	Jul	Aug	Sep	Oct	Nov	Mean
Air temp(c°)	38.7	33.5	33.0	35.0	37.4	38.0	35.9	38.8	43.4	32.7	33.4	36.6	37.0	35.5
RH (%)	58	76	79	61	52	47	62.0	59	75	79	72	59	39	63.8
ET (mm/day)	10.6	6.9	5.2	5.9	8.0	12.0	8.2	11.0	6.6	5.0	5.7	8.3	11.9	8.1
Rainfall (mm)	21.5	107.7	151.3	82.6	5	-	61.4	87.3	67.7	166.4	118.2	24	-	77.3
Rain days	2	8	13	8	1	-	5.3	6	6	10	7	1	-	5.0
Sunshine hrs	8.3	5.8	6.5	7.5	8.3	9.1	7.6	8.9	6.9	6.0	7.6	8.2	9.0	7.8

Table 1. continued.

	2007/08						
Meteorological parameters	Ju	Jul	Aug	Sep	Oct	Nov	Mean
Air temperature (c°)	38	32.0	31.8	34.1	36.8	37.7	35.1
RH (%)	59	82	82	72	58	50	67.2
ET (mm/day)	11	7.2	5.5	5.1	8.4	11.7	8.2

Rainfall (mm)	39	120.5	261.5	64.8	8.8	-	82.5
Rain days	4	12	11	3	2	-	5.3
Shine sun hrs	8	5.1	6.3	8.7	8.1	9.5	7.6

Treatments	Sample 1 Rain fall: 15mm Soil depths (cm)			Sample 2 Rain fall : 24.3mm Soil depths (cm)			Sample 3 Rain fall : 6.5mm Soil depths (cm)		
Type of tillage	0-15	15-30	30-45	0-15	15-30	30-45	0-15	15-30	30.45
Zero tillage (ZT)	36.0b	29.30b	21.4b	34.8b	25.2b	23.5a	34.8b	31.4b	27.3ab

Post harvest tillage (PHT)	40.8a	32.7a	26.4a	41.2a	34.3a	26.2a	45.8a	36.2a	29.0a
Wide level disk (WLD)	33.6c	29.3b	22.7ab	33.7b	25.9b	18.6a	38.9b	31.8b	25.0b
Mean	36.8	30.4	23.5	36.6	28.5	22.8	39.8	33.13	27.1
C.V%	5.9	11.1	17.1	7.9	5.9	30.62	13.3	9.6	14.04
S.E ±	0.88	1.4	1.6	1.2	0.68	2.84	2.2	1.3	1.6
Sowing Date									
Early (S1)	38.6a	34.4a	25.6a	37.2a	30.2a	23.7a	38.9a	31.0b	26.5a
Late (S2)	34.9b	26.5b	21.4b	35.9b	26.7b	21.9a	40.6a	35.3a	27.7a
Mean	36.8	30.4	23.5	36.6	28.5	22.8	39.8	33.13	27.1
C.V%	5.9	11.1	17.1	7.9	5.9	30.62	13.3	9.6	14.04
S.E ±	0.72	1.12	1.3	0.97	0.56	2.32	1.8	1.1	1.3
Interaction									
S1xZT	37.4b	33.9ab	22.3bc	34.6b	28.0c	26.4a	33.2b	30.0bc	24.8b
S1xPHT	43.1a	36.8a	28.3a	41.8a	36.7a	26.6a	45.7a	34.7ab	27.5b
S1xWLD	35.3bc	32.4bc	26.2ab	35.2b	25.9cd	18.0a	38.0b	28.3c	27.1b
S2xZT	34.5bc	24.6d	20.4cd	34.9b	22.4d	20.6a	36.4b	32.7ab	29.8b
S2xPHT	38.4b	28.5cd	24.5abc	40.6a	31.9b	25.7a	45.9a	37.7a	30.5a
S2xWLD	31.9c	26.3d	19.3d	32.1b	25.9cd	19.2a	39.7b	35.4ab	22.9b
Mean	36.8	30.4	23.5	36.6	28.5	22.8	39.8	33.13	27.1
C.V%	5.9	11.1	17.1	7.9	5.9	30.6	13.3	9.6	14.04
S.E ±	1.25	1.95	2.3	1.68	0.97	4.02	3.04	1.8	2.2

Table 3. Continued

Treatments	Sample 4	Sample 5	Sample 6
	Rain fall : 19mm	Rain fall: 26mm	Rain fall:16mm
	Soil depths (cm)	Soil depths (cm)	Soil depths (cm)

Type of tillage	0-15	15-30	30-45	0-15	15-30	30-45	0-15	15-30	30.45
Zero tillage (ZT)	32.3b	27.3b	26.3b	34.2b	30.3b	26.8b	33.2b	25.9b	19.1
Post harvest tillage (PHT)	38.3a	35.9a	34.0a	41.4a	37.3a	34.5a	37.6a	30.3a	21.1
Wide level disk (WLD)	31.3b	25.4b	20.3c	33.9b	32.4b	25.4b	31.7c	22.5b	16.1
Mean	33.98	29.5	26.9	36.5	33.34	28.9	34.2	26.3	18.8
C.V%	6.6	8.38	12.1	6.9	10.8	5.8	4.9	14.0	27.2
S.E ±	0.92	1.01	1.32	1.03	1.5	0.68	0.68	1.5	2.1
Sowing Date									
Early (S1)	32.30b	29.2a	27.0a	36.7a	31.4b	30.6a	34.5a	27.7a	22.1
Late (S2)	35.14a	29.8a	26.7a	36.3a	35.2a	27.2b	33.8a	24.8b	15.4
Mean	33.98	29.5	26.9	36.5	33.34	28.9	34.2	26.3	18.8
C.V%	6.6	8.38	12.1	6.9	10.8	5.8	4.9	14.0	27.2
S.E ±	0.75	0.82	1.32	0.84	1.2	0.56	0.55	1.2	1.7
Interaction									
S1xZT	30.6c	27.3b	26.7b	34.9b	28.5b	26.4c	33.8b	28.3b	22.9a
S1xPHT	36.3ab	36.8a	33.3a	42.4a	34.8b	35.2a	37.5a	33.1a	24.6a
S1xWLD	31.5c	23.6b	21.0c	33.0b	31.1b	30.2c	32.2b	21.7b	18.9ab
S2xZT	33.9bc	27.2b	25.9b	33.5b	32.2b	27.2d	32.6c	23.7b	15.4ab
S2xPHT	40.3a	35.1a	34.7a	40.5a	39.8a	33.8a	37.8a	27.4ab	17.6ab
S2xWLD	31.1c	27.2b	19.6c	34.8b	33.7b	20.6b	31.1b	23.4b	13.3b
Mean	33.98	29.5	26.9	36.5	33.34	28.9	34.2	26.3	18.8
C.V%	6.6	8.38	12.1	6.9	10.8	5.8	4.9	14.0	27.2
S.E ±	0.29	1.43	1.32	1.46	2.1	0.97	0.59	2.1	2.9

Effect of tillage and sowing date on grain yield

The effect of tillage treatments and sowing dates and their interaction on grain yield of sorghum are shown in Table 4. There were significant differences in crop yield among tillage methods , sowing dates and their interactions in all seasons at the 5 % and 1 % level. Yields for the three seasons indicated that season 2006/07 resulted in higher yield compared to the other two seasons. Regarding the tillage methods effect, significantly higher grain yield was produced under PHT compared to WLD and ZT in all seasons. The increase in grain yield was found to be 21% and 12%, 29% and 17% and 27% and 12% over ZT and WLD for the first , second and third seasons , respectively.

The combined analysis revealed significant differences among the tillage methods and sowing dates for sorghum grain yield. The 3-years average grain yield under PHT, WLD and ZT were 1113, 976 and 885 kg/ha, respectively. Significantly greater yield had been recorded under PHT compared to the other tillage methods at the 5 % significance level and out yielded production under ZT and WLD by about 26 % and 14 %, respectively. This was probably due to improvement of soil physical properties, such as infiltration rates , under the PHT tillage method . Similar conclusions were reached by Oveson and Appleby (1971), as they reported that tilled plots produced higher yields than non-tilled ones. Munawar *et al* (1990) who indicated that the mean yield was higher under tilled plots than no tillage for wheat and maize. The high grain yield under PHT compared to WLD may be attributed to the positive effect of depth of tillage on soil water holding capacity. Similar results were observed by Salih and Mohamed (1990) .They stated that deep harrowing resulted in a significant increase in grain yield over minimum tillage.

The results indicated that early sowing (S1) resulted in significantly higher grain yield than late sowing (S2) in all growing seasons. This was probably due to the fact that the early sown plants utilized early rain water that resulted in good crop establishment , while late –sown plants did not make use of early rain fall . Similar results were obtained by Hassan (2002) who reported that early sowing of sorghum (second week of July) significantly increased grain yield compared to late sowing (first to second week of August) in Gadambaliya area. The results disagreed with the findings of Taha (2002) who reported that sorghum grain yield was significantly low in the first sowing date (July 13) compared to the second (August 7) and third (August 25) sowing dates . The PHT interaction with the early sowing date resulted in higher yield in comparison with all other interaction combinations. This indicated that the tillage method of PHT had a yield advantage over zero tillage and WLD method for both sowing dates. This was probably due to the early rain captured by the early crop and good moisture storage provided by the PHT, which was reflected in better crop establishment.

Table 4. Effect of tillage methods and sowing date on grain yield (kg/ha).

Treatments	Seasons			Combined effect
	2005/06	2006/07	2007/08	
				Tillage methods (T)
Zero tillage (ZT)	402.01c	1225.37c	999.45c	885.1
Post harvest (PHT)	487.92a	1578.23a	1272.07a	1112.7a
Wide level disk (WLD)	437.63b	1350.98b	1140.45b	976.4b
Mean	442.52	1394.32	1137.32	991.4
C.V %	3.82	5.03	5.12	4.6
S.E ±	6.9	28.6	23.75	12.0
Sowing date (S)				

Early (S1)	458.1a	1470.53a	1237.74a	1055.5a
Late (S2)	426.4b	1318.1b	1036.90b	927.3b
Mean	442.52	1394.32	1137.32	991.4
C.V %	3.82	5.03	5.12	4.6
S.E ±	5.6	23.4	19.39	10.3
Interaction (TxS)				
S1xZT	419.5cd	1332.37bcd	1100.5bc	950.8d
S1xPHT	507.8a	1661.9a	1380.13a	1183.3a
S1xWLD	447.0bc	1417.33bc	1232.6ab	1032.3c
S2xZT	384.5d	1175.1d	898.40d	819.3f
S2xPHT	468.0ab	1494.57ab	1164.0bc	1024.2b
S2xWLD	428.3bc	1284.63cd	1048.3cd	920.4e
Mean	442.52	1394.52	1137.32	991.4
C.V %	3.82	5.03	5.12	4.6
S.E ±	9.8	40.5	33.59	17.8

Means followed by the same letter(s) are not significantly different at 0.05% level of probability according to Duncan 's Multiple Range Test.

Conclusions

The following conclusions could be drawn from the study:

1. Post- harvest tillage was superior in moisture conservation as compared to zero-tillage and wide level disc.
2. Zero-tillage resulted in significantly higher soil bulk density than wide level disc and post harvest tillage.
3. Post -harvest tillage produced significantly higher grain yield compared to wide level disc and zero-tillage in all growing seasons. It is recommended to use post- harvest tillage and early sowing for increased sorghum yield

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الخلاصة

اجريت الدراسة خلال ثلاثة مواسم متتالية (06/2005 , 07/2006 و 08/2007) تحت ظروف الامطار , لدراسة تأثير بعض طرق الحراثة وتاريخ الزراعة لمحصول الذرة على المحتوى الرطوبى للتربة والكثافة الظاهرية لها . أجريت الدراسة في المزرعة التجريبية لكلية العلوم الزراعية والبيئية ، جامعة القضارف ، مدينة القضارف ، السودان . أستخدم في التجربة تصميم القطع المنشقة حيث خصصت القطع الرئيسية للحراثة (الحراثة الصفرية ، الحراثة ما بعد الحصاد والحراثة بإستخدام أخذت القياسات .المحراث القرصي العريض) بينما خصصت القطع الثانوية لتاريخ الزراعة (الزراعة المبكرة والمتأخرة) المرتبطة بمعدلات التسرب . أعطت معاملة الحراثة ما بعد الحصاد أعلى محتوى لرطوبة التربة في المواسم الثلاثة وأظهرت اختلافات معنوية مقارنة مع المعاملتين الأخيرتين. أشار التحليل إلى أن معاملة الحراثة الصفرية سجلت أعلى قيم للكثافة متوسط انتاج حبوب الذرة الرفيعة للثلاثة الظاهرية مقارنة مع معاملات الحراثة بالدسك العريض و الحراثة ما بعد الحصاد . كجم / هكتار ، 976 كجم / هكتار و 885 كجم / هكتار لمعاملات الحراثة ما بعد الحصاد ، الحراثة 1113 مواسم كانت و بالدسك العريض و الحراثة الصفرية على التوالي. حققت معاملة الحراثة ما بعد الحصاد زيادة معنوية فى الانتاجية أذ بلغت الزيادة في انتاج الحبوب 26 ٪ و 14 ٪ للحراثة بالدسك العريض.