In semi-arid regions, search of higher agricultural productivity was done through intensification of production systems. This production system is the source of many negative effects on the environment, soil and crop productivity, which led to being questioned. Direct sowing is an alternative system whose foundations are respect for the environment, protection of soil and crop productivity. This work conducted on the experimental station site ITGC- Setif, Algeria, with the objective of studying the effect of the two systems on soil properties and behaviour of the durum wheat crop. The results indicate that the no-tillage has a significant effect on the rate of organic matter in the layer (0-5 cm) with 2.89 %. Soil moisture showed significant variation throughout the growing cycle. The conventional system keeps a relatively higher moisture at the beginning of cycle as that noted for the no-tillage systems, 22.60%, 20.17%, respectively. The situation is reversed at the end of the cycle, in favour of no-tillage (9.50% and 7.33%, respectively). The results also indicate that the Da and penetrometer resistance were significantly higher in no-tillage compared to conventional systems (Du: 1.44; 1.35 respectively; RP: 12.51; 7.40 respectively). It has better vegetation height, greater number of spikes / m2 and positive differences for biological yield and grain yield. No-tillage keeps the advantage of a higher weight of 1000 grains but has the disadvantage of an infestation rates by weeds. The results also show some differences between the two systems for the previous crop, which reveal that the lentil treatment positively affects both soil properties and yield and its components.

Keywords—No-tillage, Conventional systems, previous crop, durum wheat, yield and components.

I. INTRODUCTION

At the semi-arid region in Algeria, agriculture is rain-fed and therefore subject to the availability of water in the soil. The rainfall is insufficient, irregular, a sizeable temperature range, combined with high evapotranspiration resulting in intermittent drought (Chenafi et al., 2011 Pala et al., 2007). Soils are generally low fertility, low productivity and carrying very green cover sparse (Djaidjaa, 2012).

Cereal production is dependent on climate conditions and technical itinerary: rotation, soil preparation, fertilizer use and the control of the weed flora. The strategy based on the intensive work, the worked fallow and more inputs (Mrabet, 2002). However, this way of doing accompanied by many negative effects on the environment, which led to this being question in many parts in the world (Lyons et al., 2003; Lopez Billido., 1992; Kribaa et al, 2001).

To remedy, several authors recommend the adoption of the conservation agriculture through direct seeding (Mrabet, 2000; Lahmar and Ruellan, 2007). Among the major advantages of conservation agriculture, there is conservation of water and soil, improvement of biology and organic matter in the soil. The application of this system is based on zero-tillage, control of weeds and crop rotations to agro-economic interest (El gharras et al., 2009 ; Mrabet, 2010). To this end, the introduction of legumes in cereal systems offer several advantages, such as enriching the soil with nitrogen, reducing soil-borne diseases (Lyons et al, 1995), better weed management (Colbach, 1996) and also better cereal yields compared to monoculture.

This study examines the effect of different types of rotations on some soil parameters: dynamics of water, penetrometric strength, bulk density etc ... and the productivity of a durum wheat crop, in terms of direct sowing.

II. MATERIAL AND METHODS

The experimentation was carried out during 2011/12 growing season at Sétil experimental station of ITGC (Algeria), situated at an altitude of 962 m and the geographical coordinates 36° 08’ N, 5° 20’ E. The site is characterized by a hot and dry summer and a cold and wet winter (Chennafi et al., 2006). The adopted experimental device is the split-plot with two factors studied. It consists of three blocks each divided into two parcels, each carrying a soil working system (factor 1). The plot is divided into two basic sub-plots, wearing the previous crops (factor 2). The total elemental plots amounted to 12. The surface of the basic plot is 180 m2. Sowing was conducted January 12, 2012 at a dose of 130 kg.ha-1 using a conventional drill for conventional work and with a special drill brand Semeato Personale Drill—17. Combined with sowing, Mono-Ammonium Phosphate fertilizer background (MAP, of 15.52.0) was applied with 80 kg/ha. Later (21/03/2012) Sulfazot fertilizer (SO3, 26% N.35 was brought tillering for both modes with a rate of 120 Kg/ha.

The plant material used is durum wheat (Bousselam variety) which is a new achievement of the ITGC-Setif. It is...
characterized by a late vegetative cycle of five days compared to Waha variety and precocity, about fifteen days less than Mohamed Ben Bachir local variety; it is also characterized by a high yield compared to these varieties (Annichiarico et al., 2005), which are mostly grown in Algeria.

III. MEASUREMENTS ON THE SOIL AND CROP

The measures focused on the ground, namely the evolution of soil moisture horizons 0-10 cm, 10-20 cm, 20-30 cm, the double weighing method (gravimetric) throughout the vegetative stages of wheat. The weight water content H% is deducted from Duchafour’s formula (1997). To know the effect of the factors studied, the bulk density is measured by taking samples of 250cm³ volume, after drying, the sample is weighed. The ratio of weight to volume, determines the Da (g/cm³). The rate of water infiltration into the soil is measured on the ground in saturated granular media. It was determined according to the formula of Decagon (2005). The penetrometer resistance (compaction) was measured with a penetrometer, the procedure is to push the cone of the device into the ground and measure the force to be applied and the value displayed determine the index of the cone (25N). Compaction is obtained according to the formula:

\[ Rp \ (N/cm^2) = \text{value displayed} \times \text{constant factor (20N/cm^2)}; \]

10N/cm² = 1 kg/cm².

We note that other measurements on culture were done concerning the yield and its components. Statistical analysis was done using SAS software v.9.0.0, to determine the effect of the factors studied on different measured variables. The results were subjected to analysis of variance (ANOVA), followed by Newmans -Keuls test at 5% to separate homogeneous groups

IV. RESULTS AND DISCUSSION

A. Climate analysis

The comparison of the recorded rainfall between the last two campaigns 2010/2011, 2011/2012 and 1997/2012 period shows differences in the amount and distribution. The 2011/2012 campaign can be described as exceptional and typical Mediterranean climate due to the inter seasonal irregularities and fall of more than 15 days subsequent snow during the month of February at the emergence stage. The total rainfall from September to June corresponding to the cereal crop cycle was 358.2, 408.7 and 329mm, respectively. An average of 15mm/year between 2010/2011 and 2011/2012 crop cycle was 358.2, 408.7 and 329mm, respectively. An average of 15mm/year between 2010/2011 and 2011/2012 campaign (Figure, 1). The analysis of the thermal regime indicates that low temperatures were between mid-November and mid-February. This prevents vegetative development and the same situation is observed for the last two campaigns. As regards the high temperatures, the months of September to June recorded an average of 25 °C. The decrease in rainfall and temperature rise began in the month of May to the end of the cycle, coinciding with the period of flowering and grain filling.

B. Effect on the soil properties

Effect on the soil moisture evolution

Humidity levels measured on plots throughout the crop cycle reflect the water retention capacity of the topsoil and the efficiency of the structure established in terms of water retention. The results indicate that no-tillage affects the distribution of soil moisture in terms of crop transpiration and soil evaporation. At the first depth (0-10 cm), humidity is different for the two systems. The humidity is at its maximum at the first time (63DAS) for the conventional work, it reached 22.92 % with the previous wheat and 22.29% for the previous lentil. The deviation of the recorded water content at that date for the direct seeding compared to the conventional value is 2% and 3%, respectively. We note a rapprochement for the four curves at the fifth sampling date. At the seventh date, the humidity reaches its lowest value for TC with 7.76% and 6.9% respectively recorded for wheat and lentils, while for direct seeding it reaches its maximum with 9% for the two previous cropping. For the last date, humidity stabilizes at 9% for no-tillage technique and 8% for the conventional system (Figure 1). At the second depth, the situation is different; the moisture values are quiet similares for all dates. Moisture peaked for both techniques at the first date, reaches 23% for CT and 21 % for SD, and then it starts to decrease and stabilize at 11% at the last sampling coinciding with the maturation stage (157 DAS). The same trend was observed in the third depth (20-30 cm), compared with the second depth, except at the third date where direct seeding is well behind and the last date is recorded significantly higher rates for Direct sowing ; this may be due to the strong evaporation of the water in the worked soil. The figure shows that the moisture is unavailable at this depth, which remains heavily colonized by the roots (Zen Zi-Li , 2004). This allows the plant to find a water sufficiency at the end of the cycle. Our results are consistent with those of Pala et al. (2000), who noted that there is little difference in the evolution of soil moisture of culture set up under conventional tillage compared to no-tillage. However, Sadeghi and Bahrani (2009) found that no-till stores more water than conventional tillage. This effect is explained by the presence of residue cover-till soil. The residues reduce the proportion of soil water.
evaporated. These authors observed a higher moisture remaining at the end of the cycle under no-tillage compared to conventional tillage. Smika (1990) states that no tillage produces 10% more grain and has 9% more soil moisture compared to conventional tillage system (Figure 1).

D. Water infiltration rate (permeability)

The results recorded gave better permeability for conventional tillage when comparing to no-tillage system. The presence of a legume as a precedent crop plays a positive role in this sense, and improves soil permeability compared to wheat cropping (Figure 3). Water seeps into the soil of the conventional tillage approximately twice more fast than in untilled soil. These results corroborate with those reported by Touahria (2011) which states that the infiltration of water into the ground is lower in no-tillage compared to what it is on conventional system. Angar et al. (2011) mention that there is an increase in the infiltration rate over time of pipes in no-tillage plots and stability to see a stop at the conventional tillage plots. The advantage of no-tillage can be explained by the increase of the amount of organic matter in the top few centimetres of soil (Findeling et al., 2001).

E. Soil compaction (penetrometer resistance)

Measurements of the penetrometer resistance using a penetrometer are one of the frequently used indicators to provide an overview on the state of soil compaction and constraint opposes the soil root growth. The results indicate soils in direct seeding were more compacted than tillage system (Figure 4). Bellemou (2012), see clearly the effect of agricultural tools passage on soil compaction, a best result was obtained in soils conducted in direct seeding compared to the conventional work.
F. Effect on yield and its components

The yield is a complex character, which is appreciated by the values of its different components (Gate, 1995). The effect of previous crop and systems components on performance highlights: The number of plants/m² highest is recorded by the conventional system with a value of 258 plants/m², while the no-tillage registers 221 plants/m². For both systems, these values are low. The density of spikes varied significantly depending on the operating mode of the soil, the previous crop and interaction (F1 * F2). This indicates that the studied factors have caused changes on this variable. The highest population counted was in the conventional system. The values in cropping systems are 290.18 and 215.69 spike/m² respectively for conventional system and no-tillage. However, in previous ones, the lentil has a value of 278.91 spike/m², against 226.96 for wheat. Rotating Lentil/wheat gives 51.95 and 25.95 spikes/m², respectively, from the wheat/wheat and the average of the test.
No significant variation was observed in spike fertility, however the results indicate that the no-tillage has the highest number of grains (27.07), while the conventional system showed a value of 25.32 grain/spike. Treatment lentil/wheat has a superiority of the number of grains per spike of 3.88 compared to wheat/wheat, but this value is not significant. Grignac (1981) argues that the 1000 kernel weight decreases considerably because the high temperatures and water deficit during grain filling. According to this author, the optimal weight of 1000 grains that allows obtaining higher returns must be greater than 48g. In our experiment, we obtain 33.43 grains for direct seeding and to 31.74 grains for conventional seeding. This parameter also depends on the continuity of the nitrogenous nutrition until maturation (Soltener 2001). Couvreur (1985) says that a high potential evapotranspiration or high temperatures for the month before heading induce the formation of small grains.

Values of grain yield, show a non-significant difference between the two soil manure working and the interaction (F1*F2). However, a significant difference between the two previous recorded. The results are contrary to what is reported by Hammel (1995) that gets poor yields in no-till compared to the conventional system. In this study, the results are closer for the two techniques with a slight delay for direct seeding. A partial explanation of the lower yields in direct seeding is due to the high presence of weeds.

![Graph showing relative water content of different treatments studied](image)

**Fig. 9:** relative water content of different treatments studied

The leaf relative water content indicates a significant effect for the system as a factor. However, the previous crop and the interaction (F1 * F2) have a non-significant variation. Analysis of the leaf relative water content, the average values indicates a marked advantage for direct seeding with an average of 79.84 % against 76.43 % for the conventional system (Figure 9).

V. CONCLUSION

The results of this study indicate that no-tillage is a worthy alternative to intensify production of durum wheat in the semi-arid conditions. The no-tillage agriculture (direct sowing) has a significant effect on the rate of soil moisture, which shows significant differences between the conventional system and the no-tillage, throughout the growing cycle. The conventional technique keeps a relatively higher moisture at the beginning of cycle as that noted for the no-tillage against by the end of the cycle. The trend shows that moisture early in the cycle, the surface horizons are wetter than the deeper horizons. The situation is reversed at the end of the cycle (122 DAS), where the deep horizons keep a moisture to the surface horizons. In this regard, it appears that direct sowing has a higher moisture content in the conventional.

The results also indicate that the apparent density and penetrometer resistance were significantly higher in no-till compared to conventional sowing. Direct seeding has a number of grains per ear and weight of 1000 grains higher compared to conventional work, which keeps the advantage of number of spike/m². The results indicate that the previous lentil enhances the expressive potential of grain yield in Bousselam that achieves 25.43 q.ha-1, with a gap of 8.97 q ha-1, with respect to previous plots wheat.

The results reveal that the lentil as previous crop influences positively the physical properties of the soil. These results suggest that the technique of direct seeding has the advantage of a rapid implementation of culture, without expensive preparation of the seedbed. This technique is interesting in arid and semi-arid areas, where the preparation of the seedbed is rather difficult in the absence of early rain. It is the leading cause of late planting it provides.
The advantage of saving time and reducing production costs, as it also brings the advantage of increased performance. She deserves to be better studied for its widespread adoption in place of the conventional technique that shows little respect for the environment and the sustainability of the production system.

REFERENCES


