EFFECT OF TILLAGE MANAGEMENT PRACTICES AND HUMIC ACID APPLICATIONS ON SOME ENGINEERING PROPERTIES OF PEANUT

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Abstract

Field experiments were conducted during three successive growing seasons 2016, 2017; 2018 to study the effect of Tillage Management Practices and humic acid applications on some engineering properties of peanut (Arachis hypogaea L.) Giza 5 variety at the experimental farm of National Research Centre (NRC), El-Nubaria, Beheira Governorate, Egypt. The field experiment was a split-plot design. The main plots were divided to tillage management practices. three tillage management practices were used: Conservation agriculture (T1): Under this method the soil was left without any land preparation, Chisel plows one pass then harrowing once (T2) and Chisel two passes then harrowing twice (T3). On the other hand, three levels of humic acid applications (0, 1 and 2 gram/litre), (H1, H2 and H3) respectively under surface drip irrigation system. The results show that the geometric characteristics under study for peanut bean yield had a positive and significant response with the application management of tillage and humic acid. The data indicated that the interaction between Chisel two passes then harrowing twice (T3) and applying (2 g/l) of humic acid exceeded the other treatments on all engineering properties of peanut.

Keywords: Tillage system, Sandy soil, Chiesl plows, Humic acid, Engineering properties, Peanut.

Introduction

According to researcher (Netari et al., 2008), which proved that peanuts are among the most important crops in the world for oil production. The peanut plants of the Arachis hypogaea Linnaeus cultivars grow in the soil, and the peanut plants are very rich in protein and oil in terms of nutrition. The peanut kernel is a very rich source of edible oil with 43-55% and the protein content is about 25-28 the atmosphere surrounding the grain is a very good raw material for fertilizers, fuel and feed and also used as a good insulating material. Despite the high potential of economic peanuts, processing can be done in a major way and those processes that take a very long time and the conditions are tired and difficult and not healthy and include a product is poor and inefficient because the cracking and fragmentation of peanuts by shelling is expensive, and to know the characteristics of those physical and mechanical nucleus Such as any other agricultural product that is of great importance to facilitate the process of design and continuous development of machinery and agricultural mechanization equipment for various agricultural operations, for example from harvesting, shelling, cleaning, transportation, separation, delivery, storage, packaging, drying and expulsion of mechanical oil and Treatment products (Davies, 2009); (Mansour et al., 2016a,b,c); (Mansour et al., 2014); (Mansour and Aljughaiman, 2015) and (Mansour and El-Melhem, 2015).

The natural characteristics and quality of soil are very important for their favorable conditions for their crops (Rachman et al., 2003). Soil suitability for plant biological activity and growth is a good indication of physical and chemical soil properties (Mulumba and Lal, 2008); (Tayel et al., 2012a,b); (Mansour, 2015a,b) and (Mansour et al., 2015a,b,c,d,e).

Since soil is the primary natural resource, its quality has an integrated management effect for most soil characteristics, which in turn can determine the extent of production and sustainability of the cultivated crops (Anikwe and Ubuchi, 2007; Franzluebbers, 2002). Good tillage practices have a significant and positive impact on the properties of physical soils, since it is necessary to select the most appropriate plowing species that improves soil soil physical properties, growth and good production of agricultural crops (Jabro et al., 2009). Pasture production is also very important and effective for the establishment of productive crops (Atkinson et al., 2007). Seed systems help to create an environment conducive to crop production, development and sustainability without any hindrance (Licht and Al-Kaisi, 2005; Pibars and Mansour (2015, 2016); Pibars et al., (2015); Tayel et al., (2015, a,b,c,d,e);(2016);(2018).

Better management of soil resources has always relationship with maintaining the soil quality in field. The key for successful management system is the adoption of suitable tillage practice (Bajpai and Tripathi, 2000), which influences seed germination and
root distribution. Tillage practice brings several changes in soil physical properties and essential for developing economically viable and easily adoptable tillage practices to increase yields of groundnut crop (Ramachandran et al., 2015). In spite of the large number of field studies already conducted towards tillage effects on the physical structured soils by many researchers, even though information is lacking in long term tillage effect on crop growth (Green et al., 2003).

Sandy soils cover vast areas in Egypt. Therefore, reclamation of these soils is the main target for the horizontal expansion of our cultivable land. Unfortunately, sandy soils have very poor hydrophysical and nutritional values. Thus, the use of soil amendments is of vital importance to improve physical, chemical and nutritional characteristics of these soils. Humic acid is one of the most important liquid and supplemental compounds of soil organic fertilizers. Its molecular structure makes it possible to provide multiple benefits for crop productivity. It also helps in the process of compact and heavy soil fertilization of soil and also assists in the transfer of important nutrients from the soil to the plant. And helps to maintain water in the soil for longer periods and helps to increase the rate of germination of seeds and helps to improve the ventilation of the soil and the formation of good water in the area of growth of roots and also stimulates plant gatherings in the ground (Mackowiak et al., 2001).

Humic acid essentially helps the movement of micronutrients from soil to plant. Hermann et al. (2000) stated that the positive effect of HA and organic fertilization on the yield capacity of soil consists of many components. First, these components concern nutrient supply to plants. Second, physical soil properties are affected resulting in differences in root penetration, gas exchange and water supply.

The targets of this research study the effect of tillage system and humic acid applications on some engineering properties of peanut (Arachis hypogaea L.) Giza 5 variety on sandy soil.

Material and Method

Site Description

The field experiments were conducted between May and October during three seasons 2016 and 2017, 2018 respectively, at the experimental farm of National Research Centre (NRC), El-Nubaria, Beheira Governorate, Egypt (30.8667 N, 30.1667 E, and mean altitude 21-m above sea level). The soil texture is sandy, and its samples were taken every 15 cm from 0 to 60 cm. The soil physical analysis are show in Tables (1). Experimental Design

The field experiment was a split-plot design. The main plots were divided to tillage management. three tillage management were used: Conservation agriculture (T1): Under this method the soil was left without any land preparation, Chisel plows one pass then harrowing once (T2) and Chisel two passes then harrowing twice (T3). On the other hand, three levels of humic acid applications (0, 1, and 2 gram/litre), (H1, H2 and H3) respectively, under surface drip irrigation system. The peanut crop (Arachis hypogaea L.) Giza 5 variety was grown in north-south rows with 0.2 m spacing between plants and 0.7 m between rows.

Table 1: Some soil physical properties of the experiment of site.

<table>
<thead>
<tr>
<th>Sample depth, cm</th>
<th>Coarse Sand</th>
<th>Fine Sand</th>
<th>Silt</th>
<th>Clay</th>
<th>F.C.</th>
<th>W.P.</th>
<th>A.W.</th>
<th>B.D.</th>
<th>Texture class</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-15</td>
<td>8.4</td>
<td>78.6</td>
<td>7.5</td>
<td>5.5</td>
<td>12.0</td>
<td>4.1</td>
<td>7.9</td>
<td>1.56</td>
<td>Sandy</td>
</tr>
<tr>
<td>15-30</td>
<td>8.6</td>
<td>78.7</td>
<td>7.3</td>
<td>5.4</td>
<td>12.0</td>
<td>4.1</td>
<td>7.9</td>
<td>1.58</td>
<td>Sandy</td>
</tr>
<tr>
<td>30-45</td>
<td>8.5</td>
<td>78.5</td>
<td>7.8</td>
<td>5.2</td>
<td>12.0</td>
<td>4.1</td>
<td>7.9</td>
<td>1.63</td>
<td>Sandy</td>
</tr>
<tr>
<td>45-60</td>
<td>8.8</td>
<td>78.7</td>
<td>7.6</td>
<td>5.9</td>
<td>12.0</td>
<td>4.1</td>
<td>7.9</td>
<td>1.62</td>
<td>Sandy</td>
</tr>
</tbody>
</table>

B.D. : Bulk density

Determination of Engineering Properties

Determination of Moisture Content

The initial moisture content of peanut was determined using ASABE standard (2008) described in (Payman et al., 2011) on dry basis. Triplicate samples (pods) of 100 g were dried in air convection oven set at temperature of 100 °C and monitored for a period of 72 hrs. At the end moisture content was calculated on dry basis using the relationship described by Simonyan et al. (2009):

\[ M_{wb} = \frac{W_1 - W_2}{W_1} \times 100 \]

Where:

\[ M_{wb} = \text{Moisture content (w.b.);} \]
$Wi = \text{Initial mass of peanuts (kg)}$, and
$Wd = \text{dry mass of the samples (kg)}$.

The resultant moisture contents of groundnut was 29.1% for the pods. All the physical properties of the groundnut were determined at these moisture levels with four replications at each treatment.

**Determination of Density**

The density of a groundnut sample was defined as the ratio of the mass of a sample of the groundnut to the solid volume occupied by the sample.

$$\rho = \frac{M}{V} \text{ (g/cm}^3\text{)}$$

The bulk density was determined by filling a graduated cylinder of 500 mL with the groundnuts up to its brim from a height of about 150 mm and the excess was removed by striking off the top with stick and weighing the contents of cylinder. The bulk density ($\rho$) of groundnut pods was then calculated by dividing the mass ($M$) to the volume ($V$) of 500 mL (Aydin, 2007).

**Sphericity and geometric means of peanut pods**

The sphericity and the surface area of groundnut pods were calculated according to Baryeh (2001). One hundred pods were selected randomly for the experiment, in order to determine the size and shape of the peanut. For each peanut pod (Figure 1), the three principal dimensions, namely length ($L$), width ($W$) and thickness ($T$) were measured using a digital micrometer screw gauge with an accuracy of 0.01 mm.

The geometric mean diameter, $D$, arithmetic mean diameter, $Da$ and Sphericity, $S$ of the axial dimensions of pods by using the following relationships as stated by (Olajide and Igbeka, 2003)

$$D = (LWT)^{1/3}$$
$$Da = \frac{L+W+T}{3}$$
$$S = \frac{(LWT)^{1/3}}{L}$$

where:
$L =$ length (mm),
$W =$ width (mm) and
$T =$ thickness (mm).

The surface area ($A$) was calculated in accordance with (Odesanya et al., 2015) as

$$A = \pi D^2 \text{ (cm}^2\text{)}$$

Where:
$D =$ Geometric mean diameter (cm).

**Determination of Angle of Repose**

The angle of repose was determined by using wooden box and two plates; fixed and adjustable. The wooden box was filled with the groundnut sample and the adjustable plate was gradually lifted until the material start to slide over the inclined surface at this point the angle of inclination was recorded as the angle of repose for the groundnut samples (Muhammad et al., 2015).

**Results and Discussion**

**Effect of Tillage Management on Some Engineering Characteristics of peanut:**

The data shown in Table (2) for most of the engineering properties of the peanut have a very high response to the management of tillage. It is clear from the statistical analysis in the same table of data for these characteristics that there are significant differences for all transactions at a significant level of 5%.

Table (2) show that the length of peanut pods were 45.5, 41.5 and 33.7 mm at Chisel two passes then harrowing twice, Chisel plows one pass then harrowing once and Conservation agriculture respectively. The width and thickness for the three tillage management decreased from 21.1 mm, 18.47 mm to 14.4 mm and from 12.7, 12 to 9.37 in Chisel two passes then harrowing twice, Chisel plows one pass then harrowing once and Conservation agriculture respectively.

The highest geometric mean diameter $D$ (cm) and arithmetic Mean diameter $Da$ value (23, 26.4 cm) were obtained under Chisel two passes then harrowing twice. On the other hand, the lowest values (16.56, 19.17 cm),
obtained under the conservation agriculture. The highest surface area (A), and the lowest one was (27.75, 23.70 cm²), obtained by Chisel two passes then harrowing twice and Conservation agriculture, respectively.

The obtained data indicated that tillage management (chisel two passes then harrowing twice T3) exceeded on both mass and volume of peanut pod. This may be attributed to improving soil characteristics such as aggregate size and good distribution of water and nutrients.

The values of bulk density of the pods are 1.25 g/cm³, 1.22 and 1.09 under Conservation agriculture, Chisel plows one pass then harrowing once and Chisel two passes then harrowing twice respectively.

The idea of the peanut shelling machine is based on the density of the peanut granules, which helps to know the size and capacity of the casserole, and also to estimate the maximum load possible for the unit area, which can be carried by the machine to carry out the bombing without collapse. Since the true density of the peanut grains is estimated to be less than the density of water (1000 kg/m³), this is evidence that the peanuts will float on the surface of the water so this can be used to conduct the separation of peanuts from any impurities and other substances heavier than water.

Concerning, sphericity and angle of Repose the tillage management could written in the following ascending order Conservation agriculture < Chisel two passes then harrowing twice < Chisel plows one pass then harrowing once.

Table 2: Main effect of tillage system on physical properties of peanut pods

<table>
<thead>
<tr>
<th>Tillage system</th>
<th>Length L (mm)</th>
<th>Weight W(mm)</th>
<th>Thickness T(cm²)</th>
<th>Surface area, A (cm²)</th>
<th>Geometric mean diameter, D (mm)</th>
<th>Arithmetic Mean Diameter, Dₘₐₓ (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>33.7 c</td>
<td>14.4 c</td>
<td>9.37 c</td>
<td>16.75 a</td>
<td>16.56 c</td>
<td>19.17 c</td>
</tr>
<tr>
<td>T2</td>
<td>41.5 b</td>
<td>18.47 b</td>
<td>12 b</td>
<td>13.91 b</td>
<td>20.91 b</td>
<td>24 b</td>
</tr>
<tr>
<td>T3</td>
<td>45.5 a</td>
<td>21.1 a</td>
<td>12.7 a</td>
<td>8.66 c</td>
<td>23 a</td>
<td>26.4 a</td>
</tr>
</tbody>
</table>

(T1): Conservation agriculture, (T2): Chisel plows one pass then harrowing once and (T3): Chisel two passes then harrowing twice.

Table 3: The effect of tillage system on physical properties of peanut pods

<table>
<thead>
<tr>
<th>Tillage system</th>
<th>Mass, M (g)</th>
<th>Volume, V(cm³)</th>
<th>Density, ρ(g/cm³)</th>
<th>Sphericity (%)</th>
<th>Angle of Repose, (°)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1</td>
<td>346.7 c</td>
<td>276.7 c</td>
<td>1.25 a</td>
<td>49.4c</td>
<td>28.82c</td>
</tr>
<tr>
<td>T2</td>
<td>411 b</td>
<td>351 b</td>
<td>1.22 b</td>
<td>51.67a</td>
<td>34.16a</td>
</tr>
<tr>
<td>T3</td>
<td>426.7 a</td>
<td>388 a</td>
<td>1.09 c</td>
<td>50.67b</td>
<td>33.76b</td>
</tr>
</tbody>
</table>

(T1): Conservation agriculture, (T2): Chisel plows one pass then harrowing once and (T3): Chisel two passes then harrowing twice(T3)

Discussion

The importance of the geometric characteristics of peanuts is that the identification of pods forms is indicative of the nature and method of passage of peanuts on the oscillating surfaces during the treatment of this product.
Data presented that most of all engineering parameters of peanut had a significant and positive response with tillage management and humic acid. (Akins and Afuakwa, 2010) Concluded tillage treatments significantly affected soil penetration resistance, dry bulk density. The disc ploughing followed by disc harrowing treatment presented the lowest soil penetration resistance and dry bulk density, and no tillage treatment produced the highest soil penetration resistance and dry bulk density. The physical properties of the soil are affected by direct and strong tillage operations. The selection of the tillage and the traffic nature of the seeds and horns of the Sudanese beans on the fluctuating surfaces during the processing procedures for the grains and seeds produced is very important of agricultural crops (Jabro et al., 2009). This resulted in a decrease in pressure in the soil (Gasso et al., 2013). This resulted in the water movement through the random system of agriculture with references (McHugh et al., 2009) and water-use efficiency (Wang et al., 2009), and higher crop yields (Wang et al., 2009), Mansour (2015), Mansour and Aljughaiman (2015), Mansour and El-Melhem (2015), Mansour et al. (2015 a; b), Mansour et al. (2016 a; b; c), and Mansour et al. (2018). The preparation of the seedbed and the appropriate germination medium are important for increasing growth, which will help increase crop productivity (Atkinson et al., 2007). Tillage processes and systems help to achieve the ideal conditions for plant growth and development, which increases crop productivity significantly and without hindrance (Licht and Al-Kaisi, 2005, Tayel et al., 2015, 2016 and 2018).

Soil is a key natural resource and soil quality is the integrated effect of management on most soil properties that determine crop productivity and sustainability (Anikwe and Ubochi, 2007). These findings were in harmony with those obtained by (Tayel et al., 2015b). They mentioned that most of engineering parameters of the onion bulb had a significant response with the tillage systems. The beneficial effect of humic acid could be attributed to the enhancing of easily nutrients release into soil solution and to encourage their penetration through plant roots, as well as to develop antagonistic impacts toward pests and plant diseases (Ho and Hwan, 2000). These findings were in harmony with those obtained by (Ebtisam I. Eldardiry et al., 2012) humic acid application had a highly significant effect on improving soil characteristics such as aggregate size, soil pH and EC as compared with control treatment. Humic acid was superior on increasing these values. HA application had a highly significant effect on improving soil characteristics and increased grain yield of maize compared with control treatment.

In these concern, (Singaravel et al., 1998) found that the humic acid contains auxins, which influence cell division and stem that gave the cell walls the ability to expand. So, humic acid can contribute, in increasing seed sesame yield and improving both its protein and oil contents. Mahmoud (2006) found that the individual treatment of humic acid increased seeds and straw yields, oil and protein contents in peanut crop. Similar conclusion was also suggested by Nasef, (2004) and Borhamy, whereas Humic acid soil application improve soil EC with increasing Humic concentration (Ebtisam et al., 2012). These findings were in harmony with those obtained by Badawy (2008) he pointed out that the growth of plants is affected by direct and indirect method, which is strongly affected by the fertilizer of humic acid, has proved positive links to the content of humus and soil organic matter, and the direct methods are based on certain factors entrusted with the provision of energy microorganisms in the soil, and have a

### Table 4: The effect of tillage system on physical characteristics of peanut pods

<table>
<thead>
<tr>
<th>Tillage system</th>
<th>Length (L/mm)</th>
<th>Weight (W/g)</th>
<th>Thickness (T/cm²)</th>
<th>Surface area, A (cm²)</th>
<th>Geometric mean diameter, D (mm)</th>
<th>Arithmetic Mean Diameter, D&lt;sub&gt;am&lt;/sub&gt; (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>H&lt;sub&gt;1&lt;/sub&gt;</td>
<td>46.3 a</td>
<td>19.3 a</td>
<td>12.5 a</td>
<td>16.01a</td>
<td>22.34 a</td>
<td>26.03 a</td>
</tr>
<tr>
<td>H&lt;sub&gt;2&lt;/sub&gt;</td>
<td>39.9 b</td>
<td>17.9 b</td>
<td>11.6 b</td>
<td>10.03 b</td>
<td>20.19 b</td>
<td>23.1 b</td>
</tr>
<tr>
<td>H&lt;sub&gt;3&lt;/sub&gt;</td>
<td>34.5 c</td>
<td>16.7 c</td>
<td>10 c</td>
<td>10.28 c</td>
<td>17.95 c</td>
<td>20.43 c</td>
</tr>
</tbody>
</table>

(H1): zero humic acid, (H2): one (g/l) and (H3): two (g/l)

### Table 5: Main effect of tillage system on physical properties of peanut pods

<table>
<thead>
<tr>
<th>Tillage system</th>
<th>Mass, M (g)</th>
<th>Volume, V(cm&lt;sup&gt;3&lt;/sup&gt;)</th>
<th>Density, ρ(g/cm³)</th>
<th>Sphericity (%)</th>
<th>Angle of Repose, α&lt;sup&gt;0&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>H&lt;sub&gt;1&lt;/sub&gt;</td>
<td>433.3a</td>
<td>367.67a</td>
<td>1.23 a</td>
<td>48.433c</td>
<td>30.54c</td>
</tr>
<tr>
<td>H&lt;sub&gt;2&lt;/sub&gt;</td>
<td>390 b</td>
<td>335.67 b</td>
<td>1.18 b</td>
<td>51.400b</td>
<td>31.96 b</td>
</tr>
<tr>
<td>H&lt;sub&gt;3&lt;/sub&gt;</td>
<td>361c</td>
<td>312.33c</td>
<td>1.14 c</td>
<td>52.00a</td>
<td>34.23c</td>
</tr>
</tbody>
</table>

(H1): zero humic acid, (H2): (1g/l) and (H3): (2g/l)
significant impact on conservation. The proportion of water in the soil, which affects the building of soil and helps the release of plant nutrients from mud minerals in the soil, which helps to provide rare minerals in the soil, the result of fertility of the soil significantly and noticeably.

**Conclusions**

This Study focuses on the effect of tillage management practices and humic acid applications on some engineering properties of peanut in Egypt. The presented data clearly indicated that the most of engineering parameters of peanut had a significant and positive response with tillage management practices and humic acid applications. The data indicated that the interaction between Chisel two passes then harrowing twice (T3) and applying (2 g/l) of humic acid exceeded the other treatments on all engineering properties of peanut

This will help to increase seed germination rate and help to increase the shelf life of the seeds by reducing harmful insects as well as minimizing pest damage. It also addresses any concerns related to crop pollution, helps increase the seed content of oil. Will ultimately help raise the standard of living for peanut farmers and manufacturers in the country, and help increase and grow their domestic investments.

It also will significantly increase exports of high-quality peanuts, bringing foreign currency from overseas, helping to boost overseas investment. In conclusion, through the results of this research, the engineering properties of the grains and grains of peanuts can be chosen for the quality of the product based on the surface area of the seeds of peanut producing and the degree of seed germination. Accordingly, it is possible to obtain recommendations in this research to help the designers of machines and equipment grains and peanuts through the data contained in this research so that these data are sufficient for this purpose.

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