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ECONOMICS OF PLOWING PRODUCTIVITY (APPLICATION STUDY FOR BARELY CROP)

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ABSTRACT: This study aimed to find out the plowing method which maximize the profit of barely planting, and the proper plowing methods which minimize the tractor fuel consumption. The study was conducted at the College of Agricultural in Mutah University in Karak, located south Amman at the growing seasons (2001/2002). The disk plow has been used to plow a sandy clay loam soil with 10% moisture using three operating speeds (5.5, 7.0, and 9.0 km/hr), three disk angles (35, 55 and 45 degrees), three till angles (15, 25 and 25 degrees) and two plowing depths (15 and 25 cm). The study showed that the optimum plowing method which maximized the profit (3879 Jilis) was at speed of about 5.5 km/hr, 45° disk angle, 15° till angle and 25 cm plowing depth. The regression model indicated that the significant factors decreasing the costs with R²=87% and with significant model about 1% were plowing depth, disk angle and till angle. The study recommended to take into consideration the significant results when plowing to seed barely and to repeat the study in different locations of Jordan with different crops and plows.

Key Words: Barely production, Profit, Plowing methods.

INTRODUCTION

Jordan concerned with supports and encourages the development plans in the agricultural sector through many programs and policies of completing the agricultural infrastructure and by using technology in agricultural production. This lead to a significant increase in quantity and quality of the agricultural products (Department of Statistics, 1999).

Karak which located at the southern part of Jordan, is considered one of the important areas for field crop production specially barely. Karak barely planted area forms about 15.5% of the total barely planted area in Jordan (DOS, 1998), whereas the attention has been given for the barely crop in Karak governorate.

Barely productivity is dependent on many factors as the used tools, implements and farm equipment, and its optimum usage rate for the agricultural conditions and the planted crop. The interest of increasing crop productivity using different methods of plowing will lead to optimum usage of the available resources. Minimizing the usage of agricultural resources is considered as one of the principal factors that affect the growth of the agricultural sector (Al Najake, 1985). Accordingly, the importance of increasing production raised through the usage of different methods of
plowing. The disk plow is considered one of the common farm tools used in southern part of Jordan. It is characterized as a proper plow for the dry and hard soils full of stones and it reserves soil moisture after plowing better than the moldboard plow (Mamkgah, 2002). The disk plow can be used in very hard soils (Ali L.H. and T.F. Demian, 1978) and for soils with high organic matter, as it does not convert the soil surface completely resulting of efficient use of organic matter (Ghain A.Y. and Al-Shareef, 1984).

The plowing depth considers as one of the major factors affect the growth rate and energy requirements. One cm deeper plowing means impact of 100 m³ of soil in one hectare. This impact means more work which needs more energy that needs fuel supply. It leads to the increase of production costs (Mamkgah, 2002). Plowing different locations using different plows at plowing depths (10-15 cm) and (20-25 cm) Al Tahan found that the plowing at 10-15 cm depth using disk plow significantly surpasses the other treatments in the production of total cereals in the first location and the average of the two locations (Al Tahan, 1990).

The disk and the tilt angles were considered as the important factors affecting the fuel consumption. Bukhari et al. (1992) reported that the fuel requirements were increased with increasing in disk and tilt angles. Increasing disk and tilt angles lead to the pulverization of soil and improving its aeration, this improved there productivity (Bukhari, S., L. et al. 1992). Moreover, Plouffe et al. (1995) found that the draft components increased with speed due to the greater acceleration of soil, while the vertical force component remains nearly constant.

Forages, specifically barely, is considered as one of the most important products for the livestock fortune. The demand on forages is connected with the final demand on meat and yogurt. Despite the fact that researches studied the cost of forages and field crops production, most economic researchers and economical decision makers in Jordan suffer of the lack of data and scarcity of studies deal with the cost production of barely using different plowing methods.

Due to the scarcity of published data, it is necessary for this case study to give necessary information for farmers, investors and decision makers for improvement.

Study Objectives: According to the introduction, this study aimed to achieve the following objectives:
1. Studying the effect of plowing angle, disk angle, and plowing depth on the profitability of barely production.
2. Find the optimum combination of disk angle, tilt angle, plowing depth and operating speed to get the complete use of the tractor power and save energy loss in order to decrease the plowing costs for barely planted areas.

1094
MATERIALS AND METHODS

The experiment was conducted in the 2001/2002 growing season in the Agricultural Research Station managed by Mu'tah University in Al Rabah area which follows Karak governorate, south Jordan. This district is known as a semi-arid region dependent on rainfall, famous with planting the cereals. The average annual rainfall in the study area is about 350mm and the soil in the location was sandy clay loam soil.

The disk plow attached with a 60 kilowatts Kubota tractor model M6300 (4WD) manufactured in 1993, with four strokes, four cylinders diesel engine model V4300-1A capacity 4292 cm³. During the experiment rear wheels were drivers only. The plow has three disks with 43 cm diameter for each disk and has a 113 cm width.

The design of this experiment were a complete randomized block design, with four replicates for each treatment. The treatments factors were: the plowing depth (10 and 20 cm), the operating speed (5.5, 7.3 and 9.0 km/h), the disk angle (35, 45, and 65 degrees) (the lift angle (15, 20 and 25 degrees). The blocks were planted with barley. The seeds were harvested to find out the average of production.

Statistical Package for Social Studies (SPSS) was used to analyze the data. The descriptive analysis were run using the simple statistical indicators, Spearman correlation using stepwise regression to determine five mathematical models (Log-Log regression common effect linear, multiple logarithmic, square model, and common effect nuded). The Log-Log regression was the best one which represented the relationship between the operating speed, plowing depth, disk angle and lift angle as a dependent variables with the fuel consumption.

RESULTS AND DISCUSSION

The optimum plowing method which maximize the profit

The level of input which maximizes the profit, can be determined through the quantitative analysis through the determination of the returns from the productions and determination of the costs for each level of input to find the level which maximize the profit. The quantitative analysis needs to know the input quantities used which is presented through the fuel consumption and the total production of barley. And it needs to know the price of inputs, which was 0.13 JD/liter for diesel, and the production unit price 0.927 JD/kg. The total costs is the result of the multiplication of the price unit with quantity of input. The total return calculated through the multiplication of the product quantity with the production unit price. The net profit value is the maximum positive difference between the total returns and the total costs. Table (1) shows the input quantity of diesel used, the total production of barley, and the optimum combination of plowing factors which lead to maximize the profit. The maximum positive difference between the returns and costs (which means the profit) was 356.61 JD/hectare which achieved by a
Combination of disk angle 45 degrees, tilt angle 25 degrees, plowing depth 25 cm, and operating speed 5.5 km/hr. using this method of plowing the production of seeds was the maximum where it was 4190 kg/hectare. Diesel cost using this method was 180 JD/hectare. The average profit in the experiment was 285 JD/hectare, the median of the profit was 281.2 JD/hectare, while the minimum profit was 25.2 JD/hectare and the maximum was 386.6 JD/hectare. This is as a result of deep plowing of 25 cm, large disk and tilt angles which produced the best quality of plowing to increase the productivity in spite of the increasing of fuel consumption.

Table 1: The optimum combination of using different plowing methods

<table>
<thead>
<tr>
<th>Disk Angle (Degrees)</th>
<th>Tilt Angle (Degrees)</th>
<th>Plowing Depth (cm)</th>
<th>Operating Speed (km/hr)</th>
<th>Percentage of Energy (kJ/kg)</th>
<th>Cost of Diesel (JD)</th>
<th>Fuel Cost (JD)</th>
<th>Net Profit (JD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>25</td>
<td>25</td>
<td>5.5</td>
<td>0.25</td>
<td>180</td>
<td>25</td>
<td>256</td>
</tr>
<tr>
<td>40</td>
<td>20</td>
<td>20</td>
<td>5.0</td>
<td>0.20</td>
<td>150</td>
<td>15</td>
<td>225</td>
</tr>
<tr>
<td>35</td>
<td>15</td>
<td>15</td>
<td>4.5</td>
<td>0.15</td>
<td>120</td>
<td>10</td>
<td>240</td>
</tr>
<tr>
<td>30</td>
<td>10</td>
<td>10</td>
<td>4.0</td>
<td>0.10</td>
<td>100</td>
<td>10</td>
<td>200</td>
</tr>
<tr>
<td>25</td>
<td>5</td>
<td>5</td>
<td>3.5</td>
<td>0.05</td>
<td>80</td>
<td>5</td>
<td>200</td>
</tr>
<tr>
<td>20</td>
<td>0</td>
<td>0</td>
<td>3.0</td>
<td>0.00</td>
<td>60</td>
<td>0</td>
<td>60</td>
</tr>
</tbody>
</table>

1096
The effect of plowing methods on the fuel consumption.

Through studying the relationship between the amount of fuel consumption and the other variables, it was found that there is direct significant relationship at probability 100% between the fuel consumption with disk angle and the plowing depth.

By the usage of regression, the Log-log regression that shown in equation (1) was the best function which represents the relationship between the consumed diesel (liter/hectare) as a dependent variable with plowing depth, operating speed, disk angle and the tilt angle as independent variables.

\[
\log Y = -1.133 + 0.833 \log x_1 + 0.722 \log x_2 + 0.0993 \log x_3 \quad \ldots (1)
\]

\[
R^2 = 0.367 \quad \text{Adjusted } R^2 = 0.859 \quad F = 106.723 \quad DW = 2.338
\]

Whereas:

- \( x_1 \) = plowing depth
- \( x_2 \) = plowing angle
- \( x_3 \) = tilt angle

\( Y \) = the diesel used quantities per hectare planted with barley.

According to the economical theories concepts, and the statistical and measurement tests, the indication of the determined variable are in harmony with the economical theory and the scientific logic. The factor denomination \( R^2 \) was 97%, which indicates that the variable of the model explain about 97% of changes in diesel consumption in the plowed area unit. The significance level (1%) was used in (t) test and the total significant value at (1%) also for (F) test. The value of Durbin-Watson factor is located in the inconclusive area at significant level 1%, which indicates that there is no final decision concerning the phenomenon of the autocorrelation and there is no significant correlations between the model variables.

Through the stepwise regression, the variables which maximum affect the fuel consumption was the plowing depth, which explains about 59.4% of the differences in the quantities of fuel consumption and has direct relationship in the model. This means as the depth of plowing increased it increases the fuel consumption.

The second important variable that affect the quantity of fuel consumption was the disk angle which explains about 20.4% of the difference caused. It has direct relation which means that increasing of disk angle caused increasing in fuel consumption. This is in agreement with Manshagh (2002) who reported a significant effect of some variables on fuel consumption when using disk plow.

The third factor was tilt angle which explained 7.9% of the differences, with diverse relationship in the model, with increasing the tilt angle the fuel consumption decreased. This could be explained by the increase in tilt
angle which decreased the disk penetration and decreased the disk surface exposed to soil.

RECOMMENDATIONS
According to the previous results, maximum profit could be achieved for barley farms at Al Karak area by using the disk plows with tilt angle 25 degrees, disk angle 45 degrees, plowing depth 25 cm, and operating speed 5.5 km/hr. But if the objective is to decrease fuel consumption, the study recommended to use plowing depth at 15 cm with 25 degrees disk and 45 degrees tilt angle.

Further studies recommended at different locations of Jordan, with different crops and plows.

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اقتصاديات إنتاجية الحرارة
(دراسة تطبيقية على محصول الشعير)

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المختص العربي

استهدفت الدراسة تحديد أساليب الحرارة المحتملة لزيادة محصول شعير وتحقيق تطهير حرارة المرجعية الواعدة المحتملة ذات دقة 10% عند ثلاث سرعات للحرارة (3.7، 5.6، 9.5) درجة مئوية، وذلك في ترازات ميل البرس (15، 20، 25) درجة، ضمن عقدين من الحرارة (15، 25) درجة. وتوصلت الدراسة إلى أن مستوى الأمثل للمعطيات المبهر كان 387 بالمائة، عند سرعات حرارة 5.6 درجة، و 25 درجة لرازه الحرارة، و 55 درجة لرازه الحرارة، ومتوسط نموذج الأحداث إلى أن الملتقيات المحتملة ذات الأثر في تطهير الكافك عند مستوى تفسير 87% ودرجة نسبة 1% كانت في المرة الأولى وعلاقة طارئة على الحرارة، وفي المرة الثانية علاقة طارئة زاوية الحرارة، وفي المرة الثالثة علاقة عناية رازه الحرارة. وتم تدوين الدراسة بأخذ الإنتاج المبهرة بين الأثر عند حرارة محصول الشعير، وإعادة الدراسة في معالجة مختارة من الأردن وعلى مصلح وتوزيع مختارة.