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MECHANIZATION OF HULLESS BARLEY PLANTING AND HARVESTING

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ABSTRACT: The experiments were carried out in an area of two feddans during the agricultural season of 2005/2006 at "Kafer El-Hamam" research station for planting hulless barley (Giza 129) in clay soil aimed to choose proper methods of planting and green harvesting that produce highest productivity of green yield and dry yield. Two planting methods were investigated manual spreading and drilling by seed drill. Two harvesting methods were studied: mechanical by mounted mower and manual for green harvesting of hulless barley through two times, after 50 and 70 days from planting under four different forward speeds of 1.5, 2.8, 4.2 and 5.3 km/h and three different cutting heights of 5, 7.8 and 11.6 cm.

The experimental results showed that the highest productivity of forage under the use of seed drill, at cutting height of 5 cm under different planting methods and different times of cutting, the suitable speed was 4.2 km/h for green harvesting of hulless barley under the same last conditions of speeds and cutting heights, the green harvesting of hulless barley affected on the dry yield. The productivity of dry yield was highest after green harvesting with 50 days from planting at cutting height of 5 cm and forward speed of 4.2 km/h under seed drill. The highest productivity of dry yield after green harvesting with 70 days from planting at cutting height of 11.6 cm and the forward speed was 4.2 km/h under planting by seed drill.

Key words: Seed drill, mounted mower, green harvesting , dry yield, energy requirement and cost.

INTRODUCTION

The barley is considered one of the important cereal crops. Because it is planting under difficult conditions compared to another cereal crop, it is endure the dryness, increasing the soil salinity and decreasing the soil fertility.

The cultivated area of barley in Egypt is about 350000 fed in the North West coast and Sinai, and about 150000 fed in the new lands that irrigate with modern irrigation systems (Abd El-Fatah 2002).

(Mechanizing the operations related to barley production is needed for increasing its yield). The productivity of traditional cultivation can be increased by incorporating improved components of planting and harvesting methods. The hulless barley is one of kind's barley, it is contributing pursuit in plugging the wheaten interstice, where Egypt produce about 6 million ton of wheat and consume about 14 million ton and there is an interstice of about 8 million ton increasing in consumption from the production of wheat. Now after planting hulless kinds of barley, it can be used in making bread by mixing it with the flour of wheat the mix ratio from (15 to 20 %), addition the flour of hulless barley to the flour of wheat increase the quality of flour than using wheat or barley only and the hulless barley contains high percent of protein, it is reached to 9 to 14 %.

Abd El Rahman and Khalifa 1980 indicated that cutting barley plants when they were 30cm height gave 4.40 ton/fed, fodder cutting treatment decreased in significantly yield components, grain yield per plant and per feddan .The plots left without cutting out yielded the other plots in yield its components.

Abd-Alla 1984 found that mowing barley plants at 50 days caused significantly reductions in 1000-grains weight. Mowing barley plants at 50 days from sowing provided 3.518 ton green forage/fed or 427.574 kg dry forage/fed in this respect, Bonus cultivar exhibited significantly increase of dry forage yield comparable with Giza 121 one. Cutting barley plants exhibited significantly increments in number of spikes/m^2, grain and straw yield as compared with unmowing ones.

Awady *et al.* 1996 found that the optimum fuel consumption values were 9.3 and 8.4 L/h for cutting wheat and barley crops and the cutting energies for unit area by using double-knife mower were quite greater than those required by using single-knife mower.

He added that the criterion costs per feddan for harvesting both of wheat and barley crops were about 16.34 and 17.5 LE/Fed for using mower. Meanwhile these costs were about 80 and 60 LE/Fed under manual harvesting for wheat and barley crops, respectively.

Box *et al.* 1999 reported that the actual number of emerged plants

ranged from 75 plants/m^2 to 95 plants/m^2 for hulless barley and from 120 to 140 plants/m^2 for covered barley. Variations in plant establishment and seeding rate make interpretation of grain yields comparisons between hulless and covered barley very difficult. To compensate, the number of seeds sown/m^2 in yield trials in 1999 were increased from 150 to 180 seeds/m^2.

Awady *et al.* 2001 found that at different gate-openings of Pakistany "Naeem" grain-drill were 10, 20, 30 and 40 mm, discharge decreased by 4.94, 2.55, 1.29 and 0.8 % respectively, when the speed was increased from 20 to 50 rpm (from 0.097 to 0.259 m/s feeder speed). He mentioned that the CV of grain spacing in laboratory tests ranged from 4.9 to 6.13 % at forward-speed range of 2.18 and 5.46 km/h. But the CV of plant spacing in field tests ranged between 5.61 and 7.31 % when forward speed ranged between 2.2 and 6.4 km/h in sowing barley.

El-Saharigi *et al.* 2001 stated that the highest barley grain productivity (1.5 – 1.95 ton/fed) was obtained by using straight band sowing by grain drill with straight distributors and laser land-leveling while the lowest yield of (0.966 ton/fed) was obtained by using manual broadcasting and normal land leveling.

Moussa *et al.* 2004 compared two different planting methods drilling at spaces 15 cm and manual broadcasting under different plowing systems as mentioned previously for barley crop. The seeding rates were adjusted at 40 and 55 kg/fed for seed drill and manual broadcasting treatments respectively. The highest yield was 1655 kg/fed with the system of using chisel plow two passes and sowing by seed drill comparing with the system of using rotary tiller and manual broadcasting which gave the least yield 1426/fed.

Skinder and Wilczewski 2004 stated that the spring barley was sown each year in the first decade of April. The sowing rate was established based on 1000 grain weight and functional value of the sowing material at a planned post-emergency plant density of 320 plants per 1 m^2.

This work aimed to:

1- Evaluate the performance of different planting methods.

2- Compare different methods of harvesting.

3- Recommend the suitable planting method, green harvesting timing, cutting height and forward speed for producing higher productivity of green yield (silage) and dry yield.

MATERIALS AND METHODS

The field experiments were carried out in an area of two feddans at "KAFER EL-HAMAM" research station through successful season of 2005 to investigate the effect of different planting and harvesting methods on Hulless Barley yield production (Giza 129) variety. The mechanical analysis of the experimental soil was shown in table (1).

Table 1. Soil mechanical analysis

Sand %	Silt %	Clay %	Texture
16.75	34.55	48.7	Clay soil

Materials

Tractor New- Holland power at rate speed 80 HP (58.83 kW).

Tractor Massey Ferguson power at rate speed 40 HP (29.41 kW).

Chisel plow locally made, 7 tines, working width 175 cm and total mass 200 kg.

Land leveler locally made, hydraulic control, working width 305 cm and total mass 370 kg.

Seed drill 20 rows, model TYE and working width 270 cm.

Mounted mower model GASPARDO, working width 175 cm and total mass 210 kg.

Hulless barley seed *Hordeum vulgare,*L. was obtained from Agriculture research institute at Giza, Egypt.

Methods

Ten treatments, named A, B, C, D, E, F, G, H, I and J were investigated

A: Manual planting + dry manual harvesting.

B:Manual planting + green harvesting after 50 days from planting under three cutting heights and four cutting speeds using tractor mounted- mower + dry manual harvesting.

C:Manual planting + manual green harvesting after 50 days from planting under three cutting heights + dry manual harvesting (control pieces).

D:Manual planting + green harvesting after 70 days from planting under three cutting heights and four cutting speeds using tractor mounted- mower + dry manual harvesting.

E:Manual planting + manual green harvesting after 70 days from planting under three cutting heights + dry manual harvesting (control pieces).

F:Mechanical planting by seed drill + dry manual harvesting.

G:Mechanical planting by seed drill + green harvesting after 50 days from planting at three cutting heights and four cutting speeds using tractor mounted-mower + dry manual harvesting.

H: Mechanical planting by seed drill + manual green harvesting after 50 days from planting under three cutting heights + dry manual harvesting (control pieces).

I: Mechanical planting by seed drill + green harvesting after 70 days from planting at three cutting heights and four cutting speeds using tractor mounted-mower + dry manual harvesting.

J: Mechanical planting by seed drill + manual green harvesting after 70 days from planting under three cutting heights + dry manual harvesting (control pieces).

Planting Methods

Two different planting methods: drilling at spaces 15 cm and manual broadcasting. The seeding rate was about 45 kg/fed and 39 kg/fed. of seeds under manual and seed drill, respectively. The plant depth was adjusted to be 2.5 to 3 cm at forward speed of 4.5 km/h. Fertilization, irrigation and weed control were the same in all treatments according to the technical recommendations.

Green Harvesting

The cutting operation was carried out through two different planting methods manual and seed drill, two different ages of green plants at 50 and 70 days from planting and three different cutting heights of green plants of 5, 7.8 and 11.6 cm under different workable speeds of 1.5, 2.8, 4.2 and 5.3 km/h while the manual green harvesting was carried out using the conventional method under three cutting heights 5, 7.8 and 11.6 cm.

Green Plant Characteristics

Several characters were measured during growth, yield attributes and harvesting periods such as:

Average plant height in cm [measured from soil surface to the top of main stem], number of tillers/plant, weight of forage/m^2, number of plants/m^2 and plant stems diameter mm.

Field Capacity and Field Efficiency

The theoretical field capacity was determined using the formula:

$$TFC = S \times W / 4200 \quad [fed./h]$$

Where:

TFC= the theoretical field capacity of the machine [fed. /h].
S = travel speed m/h.
W = rated width m.

The effective field capacity is the actual average rate of field coverage by the amount of actual time [lost + productive time] consumed in the operation. It can be determined from the following equation:

$$EFC = 60 / Tu + Ti \quad [fed./h.]$$

Where:

EFC = the effective field capacity of the machine.
Tu = the utilized time per feddan in minutes.
Ti = the summation of lost time per feddan in minutes.

The field efficiency is calculated by using the following formula:

$\eta f = EFC / TFC \times 100$

Where:
ηf = the field efficiency of the machine.

Dry Harvesting Method

Manual harvesting: using the conventional method.

Dry Plant Characteristics

To evaluate the yield of seed the following measurements were conducted:

Average plant height in cm, number of tillers/plant, number of spikes/ m^2, spikes length cm, number of grains/spike [calculated as an average for each treatment], thousand grain weight, grain yield (kg/fed) and straw yield (kg/fed).

Powers Required

Estimated by the refilling method:

The required power was calculate by using the following formula. [Embaby 1985]

$P=Fc \times \rho \times 1/3600 \times Lcv \times 427 \times \eta th \times \eta m \times 1/75 \times 1/1.36$, kW

Where:
P: power, kW.
Fc: the fuel consumption L/h.
ρ: the density of fuel 0.85 kg/ L.
Lcv: lower calorific value of fuel, (10000 – 11000 kcal/kg).
ηth: thermal efficiency value of engine, (0.30 – 0.35).
ηm: the mechanical efficiency of engine, (0.80 – 0.85).
427:thermo-mechanical equivalent, kg.m/kcal.

Energy Requirements

Energy requirements can be calculated by the following equation:

Energy requirements (kW.h / fed) = Power required (kW) / Effective field capacity (fed. /h).

Cost Analysis

The cost of performing the different operations was estimated considering the conventional method of estimating fixed and variable costs.

RESULTS AND DISCUSSION

The data were recorded for different experiments and discussed as follows:

Field Capacity and Efficiency for Planting and Harvesting Operations

Figs. 1 and 2 showed the values of field capacity and efficiency in the case of using manual planting and seed drill. The recoded values

of field capacity and efficiency were 1.0 fed/h and 67% for manual planting, whilst they were 1.69 fed/h and 58.47% for seed drill under workable speed of 4.5 km/h and width of 2.7 m.

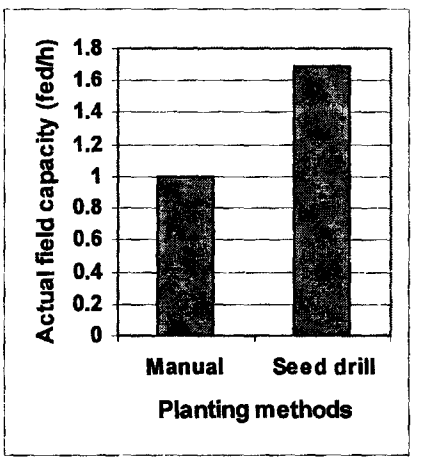

Fig.1. Field capacity of different planting methods.

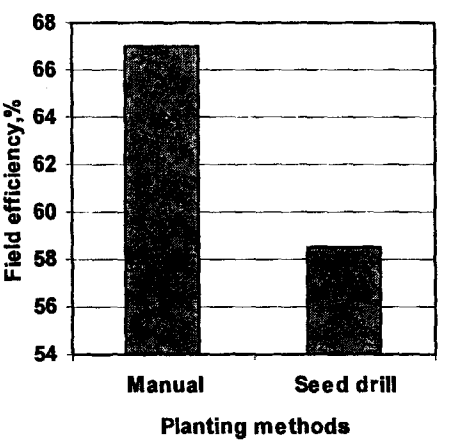

Fig. 2. Field efficiency of different planting methods.

Figs. 3 and 4 show the field capacity and field efficiency of manual and mechanical method of harvesting under different forward speeds. Result obtained for mechanical method show a markable drop in the field efficiency with consequent sharp rise in the field capacity as the forward speed increased.

It is noticed that the increase of forward speed from 1.5 to 5.3 Km/h followed with an increase in the field capacity values from 0.49 to 1.13 fed/h in the case of using mounted mower for green harvesting after 50 and 70 days from planting. While the field capacity was 0.125 fed/h under manual harvesting for green and dry yield. On the other hand, the increase of forward speed from 1.5 to 5.3 Km/h, at moisture contents of 84 and 82 % for ages 50 and 70 days, respectively, the moisture content was 16 % for dry yield was accompanied with a decrease in the field efficiency values from 78.4 to 51.1 % under the same previous condition and it was 47.5 % for manual harvesting (green and dry).

The major reason for the reduction in field efficiency is due to the reduction in theoretical time consumed in comparison with the other items of time losses.

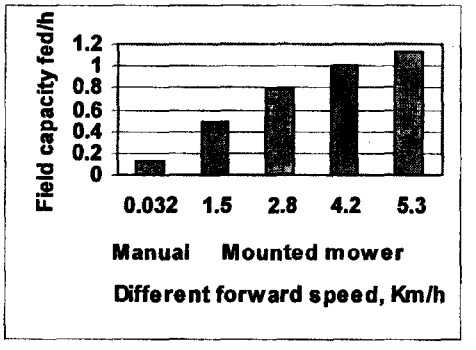

Fig. 3. Field capacity for harvesting operation.

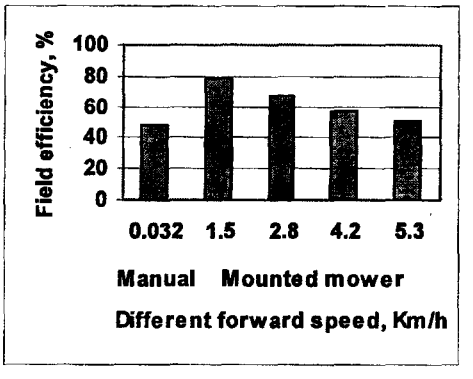

Fig. 4. Field efficiency for harvesting operation

Effect of Harvesting Operation on the Productivity of Hulless Barley after 50 Days from Planting under Different Planting Methods.

Figs. 5 and 6 show the productivity of forage after green harvesting of hulless barley (forage) with using mounted mower under different planting methods, harvesting speeds and cutting heights. It is clear that, in the case of using mounted mower the increase of speed caused and increase the productivity of forage till certain speed after that the productivity of forage decrease with increasing speed that may be back to use the slow speeds 1.5 and 2.8 km/h due to find out uncutting plants and torn parts because some of plants exhibited to the knife more than ones and increasing the forward speed to 4.2 km/h due to decrease the losses, increasing the forward speed anther time to 5.3 km/h due to increase the losses because the knife of mounted mower left out plants without cutting . And increasing the cutting height due to decrease the productivity of forage because finding out parts of stem in field without cutting that back to the heights of cutting.

The highest productivity of forage was 6181 kg/fed under mechanical harvesting under height of 5 cm and forward speed of 4.2 km/h for mechanical harvesting under seed drill. It was 5553 kg/fed under the same speed and cutting height but the planting method was manual planting.

The lower productivities of forage under manual planting and mechanical planting by seed drill were 3700 and 4056 kg/fed respectively under mechanical harvesting with forward speed of

1.5 km/h and cutting height of 11.6 cm.

The productivities at control pieces were higher than the productivities under using mounted mower in green harvesting because the harvesting method in control pieces was manual and the losses was few. The highest productivity of forage in control pieces were 5560 and 6195 kg/fed under manual and seed drill respectively at cutting height of 5 cm.

From the obvious results it can be noticed that the productivity of forage with using seed drill was highest than using manual planting under different speeds and cutting heights, that is may be due to the uniformity of distribution. And the proper cutting height of hullss barley at age 50 days from planting was 5 cm and the proper speed was 4.2 km/h. under the different planting methods, and the lower productivity produced under forward speed of 1.5 km/h and cutting height of 11.6 cm that is due to the losses between the different cutting heights and forward speeds.

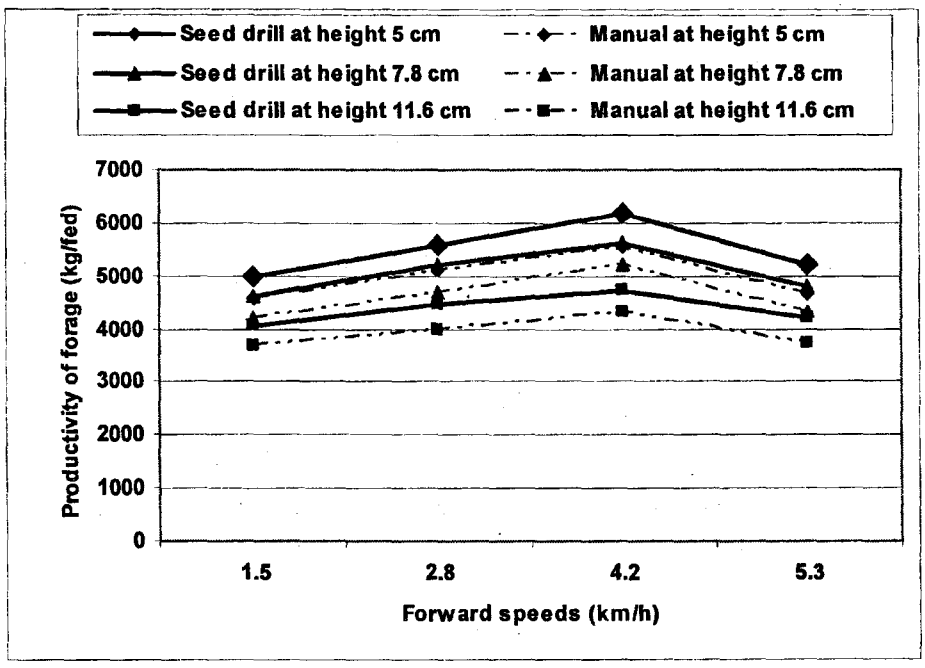

Fig. 5. Effect of mechanical harvesting operation on the productivity of forage after 50 days from planting under different planting methods.

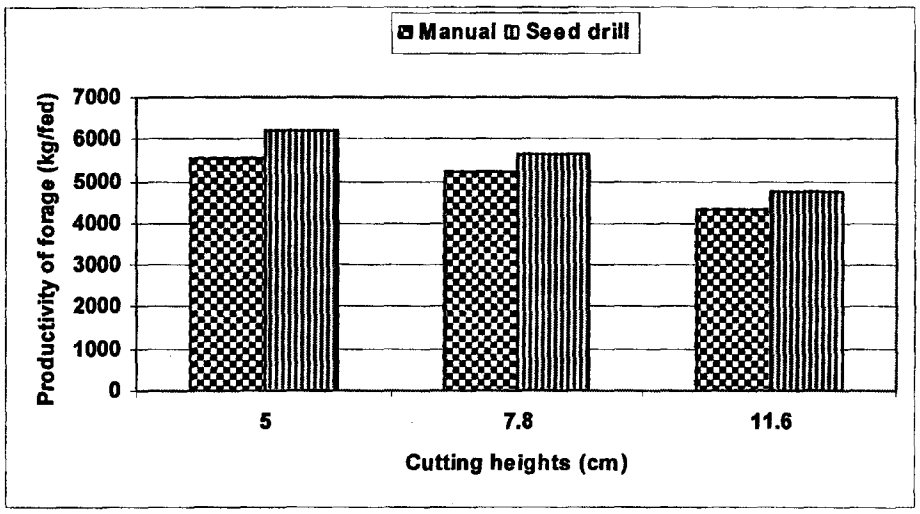

Fig. 6. Effect of manual harvesting operation on the productivity of forage after 50 days from planting under different planting methods.

Effect of Harvesting Operation on the Productivity of Forage after 70 Days from Planting under Different Planting Methods.

Figs. 7 and 8 show that the productivity of forage after green harvesting of hulless barley (forage) with using mounted mower under different planting methods, different harvesting speeds and cutting heights. It is cleared that, in the case of using mounted mower the increase of speed caused and increase the productivity of forage till certain speed after that the increase of the productivity of forage decrease with increasing forward speed that may be back to use the slow speeds 1.5 and 2.8 km/h due to find out uncutting plants and torn parts because some of plants exhibited to the knife more than ones and increasing the forward speed to 4.2 km/h due to decrease the losses, increasing the forward speed anther time to 5.3 km/h due to increase the losses because the knife of mounted mower left out plants without cutting . And increasing the cutting height due to decrease the productivity of forage because finding out parts of stem in field without cutting that back to the heights of cutting.

The highest productivity of forage was 12814 kg/fed under mechanical harvesting under height of 5 cm and forward speed of 4.2 km/h under seed drill. It was 11550 kg/fed under the same speed

and cutting height but the planting method was manual planting.

The lower productivities of forage under manual planting method and seed drill were 7492 and 7908 kg/fed respectively under mechanical harvesting with the forward speed of 1.5 km/h and cutting height of 11.6 cm.

The productivities at control pieces were higher than the productivities at using mounted mower in green harvesting because the harvesting method in control was manual. The highest productivity of forage to control pieces were 11571 and 12830 kg/fed under manual and seed drill at cutting height of 5 cm.

From the obvious results it can be noticed that the productivity of forage with using seed drill was highest than using manual planting under different speeds and cutting heights, that is may be due to the uniformity of distribution.

The proper cutting height of hullss barley at age 70 days from planting was 5 cm and the proper speed was 4.2 Km/h. under the different planting methods and the lower productivity produced under forward speed of 1.5 km/h and cutting height of 11.6 cm that is due to the losses between the different cutting heights and forward speeds.

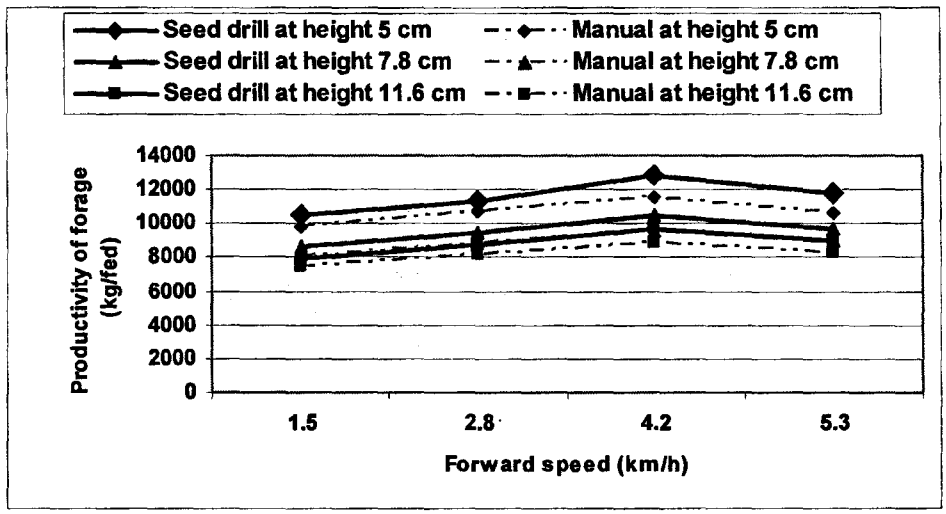

Fig. 7. Effect of mechanical harvesting operation on the productivity of forage after 70 days from planting under different planting methods.

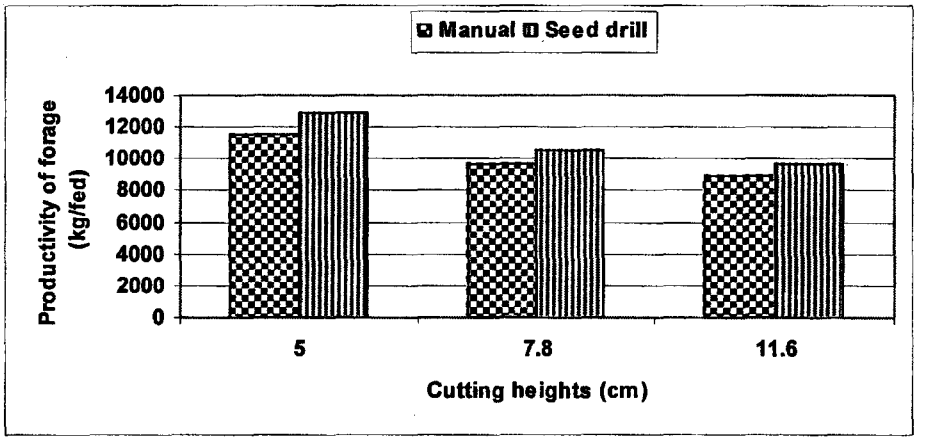

Fig. 8. Effect of manual harvesting operation on the productivity of forage after 70 days from planting under different planting methods.

The Hulless Barley Grain Yield under Different Planting Methods

The productivities were 2370 and 2142 kg/fed under seed drill and manual respectively, grain yield of barley crop planted with seed drill was higher than the yield of crop planted with manual method.

Effect of Planting and Harvesting Methods on Crop Yield after Green Harvesting at 50 Days from Planting

From fig. 9 it can be observed that the productivities of dry yield and straw after green harvesting at age 50 days from planting with using seed drill was higher than using manual planting, that can be attributed to the mass of1000 grains, the spike length, stem length and number of grains/ spike were higher in seed drill than manual planting. The best productivities of dry yield and straw for hulless barley after green harvesting at age 50 days from planting was resulted in the case of using cutting height of 5 cm and forward speed of 4.2 Km/h. under the different planting methods.

It is noticed also that the highest productivity of grain yield was 2070 kg/fed under seed drill at cutting height 5 cm and forward speed 4.2 km/h and it was 1956 kg/fed under manual at the same cutting height and forward speed.

The lower productivities were 1758 and 1655 kg/fed for seed drill and manual planting method respectively under forward speed of 2.8 km/h and cutting height of 7.8 cm.

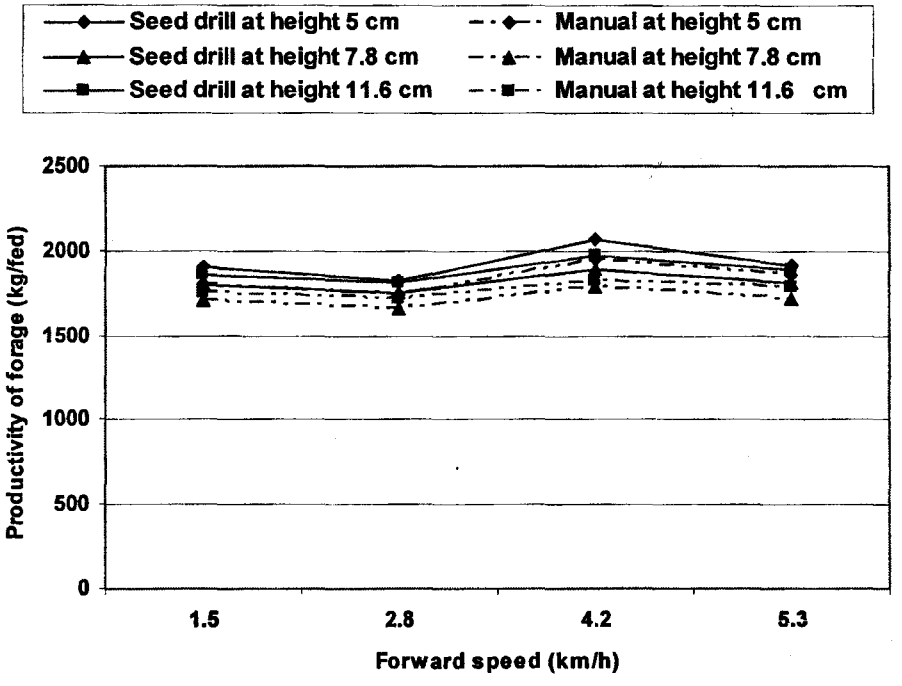

Fig. 9. Effect of green harvesting for hulless barley after 50 days from planting on dry yield under the different planting methods

This may be due to the decrease of the green losses ratio at forward speed 4.2 km/h because they were (0.22, 0.21 and 0.19 %) and (0.12, 0.23 and 0.25 %) under different cutting heights named 5, 7.8 and 11.6 cm under seed drill and manual planting respectively.

Effect of Planting and Harvesting Methods on Crop Yield after Green Harvesting at 70 Days from Planting

From fig. 10 it can be observed that the productivities of dry yield and straw after green harvesting at age 70 days from planting with using seed drill was higher than using manual planting, that can be attributed to the mass of1000 grains, the spike length, stem length and number of grains/ spike were higher in seed drill than manual planting. The best productivities of dry yield and straw for hulless barley after green harvesting at age 70 days from planting was resulted in the case of using cutting height of 11.6 cm and the best speed of 4.2 Km/h. under the different planting methods.

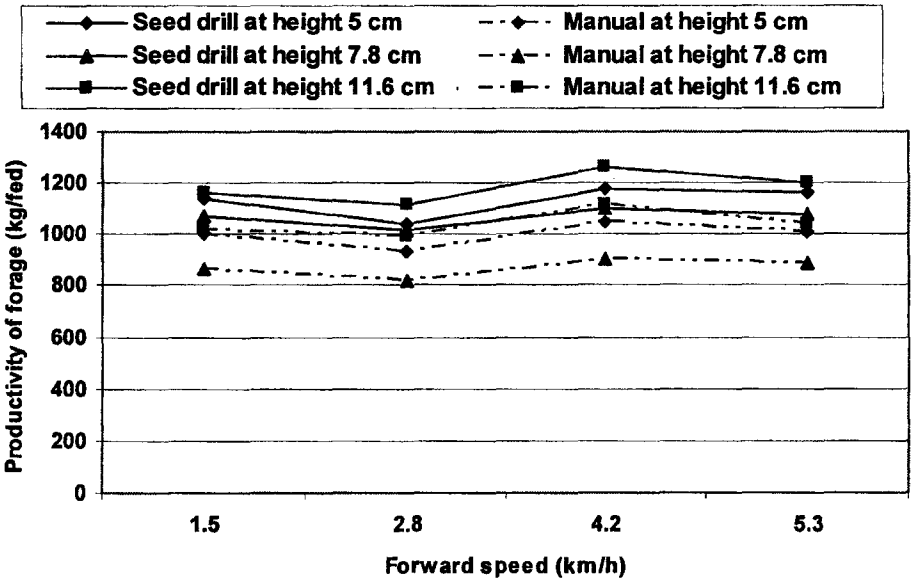

Fig. 10. Effect of green harvesting for hulless barley after 70 days from Planting on dry yield under the different planting methods.

It is noticed also that the highest productivities of grain yield was 1260 kg/fed under seed drill at cutting height 11.6 cm and forward speed 4.2 km/h and it was 1116 kg/fed under manual at the same cutting height and forward speed.

The lower productivities were 1020 and 816 kg/fed for seed drill and manual planting method respectively under forward speed of 2.8 km/h and cutting height of 7.8 cm.

This may be due to the spike was at height from 8 to 11 cm at this age because the productivities was higher than other green cutting heights.

The losses ratio at green harvesting was lower at forward speed of 4.2 under the different planting methods, they were (0.12, 0.1 and 0.15 %) and (0.18, 0.13 and 0.20 %) under seed drill and manual planting at cutting heights (5, 7.8 and 11.6 cm) respectively.

Effect of Planting and Harvesting Methods on Fuel Consumption, Power and Energy Requirements

Tables 2 and 3 show that the fuel consumption was 5.7, 4.1, 4.5, 5, 5.4 and zero Lit/fed for using seed drill and mechanical harvesting at first speed of 1.5 km/h, mechanical harvesting at

second speed of 2.8 km/h, mechanical harvesting at third speed of 4.2 km/h and mechanical harvesting at fourth speed of 5.3 km/h and manual planting and harvesting, respectively. Power requirements were 14.25, 10.25, 11.25, 12.5, 13.5, 0.074 and 0.92 kW, that is due to the fuel consumption. While the energy requirements values were 8.43, 20.91, 14.42, 12.5, 11.94, 0.074 and 7.4 kW.h/fed under the same methods respectively.

Cost Analysis

Fig. 11 show the total cost for every treatment whereas the highest total cost production was (347.26 and 335 L.E/fed) at seed drill, manual green and dry harvesting at speed 0.032 km/h (T4), and at manual planting, manual green and dry harvesting at speed of 0.032 km/h (T3) respectively. The least total cost of production was (175 and 187.26 L.E/fed) at manual planting and manual dry harvesting at speed of 0.032 km/h (T5), seed drill and manual dry harvesting at speed of 0.032 km/h (T6) respectively. That is due to the price of machine, machine condition, price of fuel and labor wages.

Table 2. Fuel consumption, energy and power requirements under different planting methods

Planting methods	Field capacity Fed/h.	Fuel cons. Lit/h	Power kW	Energy hp.h/fed.	Energy kW.h/fed.
Manual	1	—	0.074	0.1	0.074
Seed drill	1.69	5.7	14.25	11.5	8.43

Table 3. Fuel consumption, power and energy requirements under different harvesting operations (green and dry).

Harvesting methods	Field capacity Fed/h.	Fuel cons. Lit/h	Power kW	Energy requirements hp.h/fed.	kW.h/fed.
Manual harvesting	0.125	—	0.92	10	7.4
Mounted mower	0.49	4.1	10.25	28.44	20.91
	0.78	4.5	11.25	19.61	14.42
	1.00	5	12.5	17	12.5
	1.13	5.4	13.5	16.25	11.94

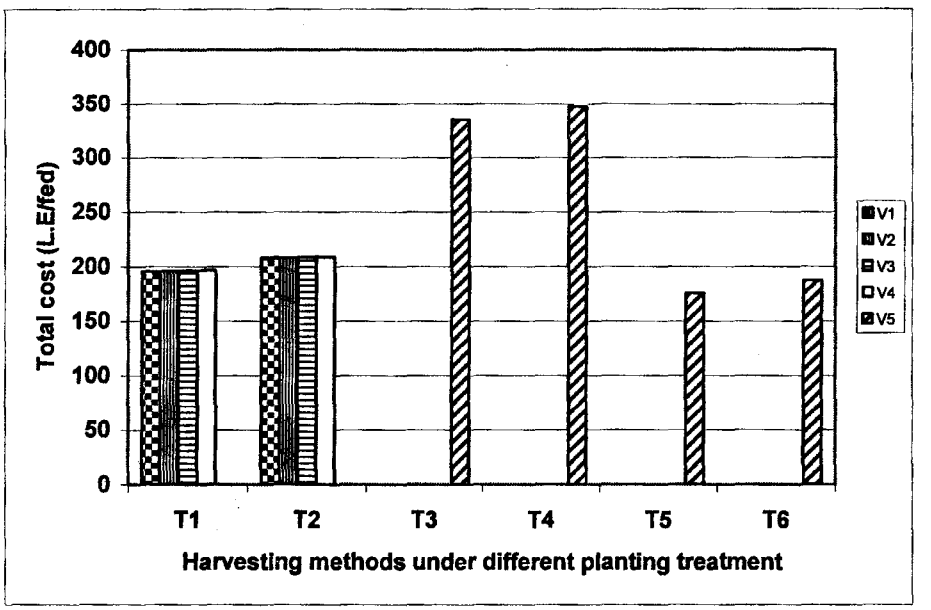

Fig. 11. Show the total cost for each treatments

CONCLUSION

From the obtained data can be concluded as following:

The productivity of forage with using seed drill was higher than using manual planting under different speeds and cutting heights. The proper cutting height of hullss barley at ages 50 and 70 days from planting was 5 cm and the proper speed was 4.2 Km/h. under the different planting methods. The highest productivity of forage was 6181 kg/fed under mechanical harvesting and height 5 cm and forward speed of 4.2 km/h under seed drill. It was 5553 kg/fed under the same conditions but the planting method was manual planting at 50 days but it were 12814 kg/fed under mechanical harvesting under height of 5 cm and forward speed of 4.2 km/h under seed drill. It was 11550 kg/fed under the same conditions but the planting method was manual planting at 70 days.

The productivities were (2370 and 2142 kg/fed) under seed drill and manual planting method respectively, grain yield of barley under using seed drill was higher than the yield planted with manual method.

The productivities of dry yield and straw after green harvesting at

ages 50 and 70 days from planting with using seed drill were higher than using manual planting, that may be back to the both of mass of1000 grains, the spike length, stem length and number of grains/ spike were higher in seed drill than manual planting.

The proper productivities of dry yield and straw after green harvesting at age 50 days from planting were under using cutting height of 5 cm and forward speed of 4.2 Km/h. under the different planting methods. The highest productivity of grain yield was 2070 kg/fed under seed drill at cutting height 5 cm and forward speed of 4.2 km/h and it was 1956 kg/fed under manual planting with using both of the same cutting height and forward speed.

The proper productivities of dry yield and straw for hulless barley after green harvesting at age 70 days from planting with using cutting height of 11.6 cm and the proper speed of 4.2 Km/h. under the different planting methods. The highest productivity of grain yield was 1260 kg/fed under seed drill at cutting height of 11.6 cm and forward speed of 4.2 km/h and it was 1116 kg/fed under manual planting method with using both of the same cutting height and forward speed.

The least total cost of production was (175 and 187.26 L.E/fed) at manual planting and manual dry harvesting at speed of 0.032 km/h (T5), seed drill and manual dry harvesting at speed of 0.032 km/h (T6) respectively. That is due to the price of machine, machine condition, price of fuel and labor wages.

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ميكنة زراعة وحصاد الشعير العاري

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أجريت هذه الدراسة بمحطة بحوث كفر الحمام بالشرقية خلال الموسم الشتوي ٢٠٠٥/٢٠٠٦ على محصول الشعير العاري صنف جيزة ١٢٩ الهدف من هذا البحث اختيار أفضل طريقة للزراعة و أفضل طريقة للحصاد الأخضر و عمر الحصاد و ارتفاع الحش و السرعة المثلي للحصاد للحصول على أعلى إنتاجية.

تمت التجارب الحقلية لمقارنة طريقتين للزراعة وطريقتين للحصاد الأخضر عند عمرين مختلفين و ثلاث ارتفاعات للحش و أربع سرعات.

تم تقييم طريقتين مختلفتين للزراعة هما الزراعة اليدوية (نثرا) و الزراعة الآلية بالسطارة.

تم مقارنة طريقة الحصاد الاخضر التقليدية (استخدام الحصاد باستخدام المنجل) بالطريقة الآلية (الحصاد بالمحشة).

تم دراسة الطرق الآلية للحصاد تحت تأثير ثلاث ارتفاعات للحصاد الأخضر (٥ و٧,٨ و ١١,٦ سم) وكذلك أربع سرعات مختلفة (١,٥ و ٢,٨ و ٤,٢ و ٥,٣ كم/ساعة).

وقد أوضحت النتائج ما يلي:

الإنتاجية عند الزراعة بالسطارة كانت أعلى من الزراعة نثرا فكانت ٢٣٧٠ كجم/فدان عند الزراعة بالسطارة بينما كانت ٢١٤٢ كجم/فدان عند الزراعة نثرا.

زيادة السرعة الأمامية للحصاد الأخضر من ١,٥ إلى ٤,٢ كم/ساعة تحت الحصاد الاخضرعند ٥٠ و ٧٠ يوم من الزراعة أدت إلى زيادة الإنتاجية ثم قلت الإنتاجية عند الاستمرار في زيادة السرعة إلى ٥,٣ كم/ساعة لان استخدام السرعات البطيئة أدت إلى ترك نباتات غير مقطوعة كذلك تعمل على تكرار القطع في النبات الواحد أكثر من مرة مما أدي إلي تكون فواقد أما عند السرعة ٤,٢ كم/ساعة تكون الفواقد اقل ما يمكن لان هذة السرعة أدت الى سرعة قطع النباتات من أول مرة كذلك زيادتها إلي ٥,٣ كم/ساعة أدت إلى زيادة الفواقد مرة أخرى نتيجة ترك نباتات دون قطع. فتصل الإنتاجية إلى أقصاها وتكون ٦١٨١ كجم /فدان عند ارتفاع حش ٥ سم و سرعة ٤,٢ كم/ساعة تحت الزراعة تسطير بينما تكون ٥٥٥٣ كجم /فدان عند ارتفاع حش ٥ سم و سرعة ٤,٢ كم/ساعة تحت الزراعة نثرا وذلك عند عمر ٥٠ يوم ولكن عند عمر ٧٠ يوم فكانت أقصى إنتاجية ١٢٨١٤ كجم/فدان و ١١٥٥٠ كجم/فدان تحت نفس سرعة و ارتفاع الحش وطريقتي الزراعة تسطير ونثر على التوالي.

أعلى إنتاجية للمحصول الجاف بعد الحصاد الأخضر عند عمر ٥٠ يوم كان عند سرعة حصاد اخضر ٤,٢ كم/ساعة و ارتفاع حش ٥ سم فكانت ٢٠٧٠ و ١٩٥٦ كجم/فدان تحت الزراعة تسطير و نثر على التوالي.

أعلى إنتاجية للمحصول الجاف بعد الحصاد الأخضر عند عمر ٧٠ يوم كان عند سرعة حصاد اخضر ٤,٢ كم/ساعة و ارتفاع حش ١١,٦ سم فكانت ١٢٦٠ و ١١١٦ كجم/فدان تحت الزراعة تسطير و نثر على التوالي.

كانت اقل طاقة مستهلكة ٢,٦٦ كيلو وات/طن عند استخدام السرعة ٢,٤ كم/ساعة وارتفاع ٥ سم تحت الزراعة نثرا بينما كانت ٣,٤٣ كيلو وات/طن عند استخدام السرعة ٢,٤ كم/ساعة وارتفاع ٥ سم تحت الزراعة تسطير عند الحش الأخضر عند عمر ٥٠ يوم وكانت اقل طاقه عند ٧٠ يوم ١,٥٨ و ٢,٠٣ كيلو وات/طن عند نفس السرعة وارتفاع الحش.

كانت أعلى تكلفة للزراعة نثرا و الحصاد اليدوي ٨١,٦٨ جنية /طن بينما كانتا اقلها تحت استخدام السرعة الأمامية ٤,٢ كم/ساعة و ارتفاع قطع ٥ سم وذلك عند استعمال السطارة والحش الأخضر المحشة عند عمر ٥٠ يوم كانت ٢٥,٢٤ جنية/طن بينما كانت ١٤,٨٨ جنيه/طن عند استخدام نفس الارتفاع و السرعة لكن عمر الحصاد الأخضر كان ٧٠ يوم من الزراعة.