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EFFECT OF SOME SOIL LEVELLING AND MECHANICAL PLANTING METHODS ON SOYBEAN PRODUCTION.

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ABSTRACT

Field experiments were carried out at. El-Gemmiza Research station El-Garbia Governorate to study the effect of some different levelling methods (Traditional and LASER) and planting methods (seed drill, mechanical planter and pneumatic planter) on soybean yield. Also, the effect of levelling method on performance and characteristics of planting machine was considered.

The results revealed that, when the LASER levelling was used instead of the traditional land levelling. The planting method by pneumatic planter at forward speed 3.15 km/h gave maximum values of germination ratio (92.27 %), uniformity (94.47%) and total yield (1.45 Mg/ fed). For all the used treatments, the planting forward speed increase tends to decrease germination ratio, uniformity and total yield of soybean crop. The yield case of LASER levelling and pneumatic planting method was maximum in comparison with other methods.

INTRODUCTION

Soybean is considered one of the important industrial and nutrient products. Its seeds contain high percentage of both protein (40%) and oil (about 20 %). For these reasons, it is considered one of the goals of the agricultural policy of Egypt. The mechanical methods used in cultivating soybean crop were seldom compared with the other important crops. Soybean yield depends to a great extent on many factors such as improving soil structure of seedbed and using a suitable method of planting. Hinz (1978) stated that precision land levelling using controlled equipment increased crop yield not less than 20 %. El-Ansary et al (1995) found that LASER levelling increased grain yield by 22.38 % and straw yield by 26.31 % in case of mechanical seeding and manual broadcasting respectively. Embaby (1985) carried out a research work to study the performance and productivity of mechanical planting equipment when planting sunflower seeds in flat and furrow soil under varios field dimensions. He concluded that the planting by machine in flat soil surpassed the planting in furrow soil in all the mechanical criteria evaluations. Kupresanin (1984), showed that pneumatic seed drill gave better distribution of seeds within the row than mechanical drill. Sunflower seed yield was significantly increased but the increase was small (121kg/ha). Abo El-Ees (1985) showed that, the method of seed drilling was very effective. This is due to its effect on uniformity of depth and spacing. Mechanical seed drilling leads to more uniform spacing and sowing depth resulting in higher yield. Frisby and Summers (1979) found that the fuel

consumption rate increased by increasing forward speed during planting operations. Renoll (1981) illustrated that machine performance rate was influenced by machine width and speed. He deduced at a new relationship for predicting the effective field capacity for row-crop machines. Abd El-Mawgood (1990) studied the performance of different planting machines (seed drill and planter) in sunflower planting at various conditions of speed and size of holding. He concluded that the seed drill field capacity was higher than that of a four row planting machines. Moustafa (1993) studied the effect of the different planting methods for soybean on distribution of seeds, emergence period and germination ratio. He found that the optimum uniformity of seeds distribution and uniformity of planting depth under mechanical planting especially (pneumatic planter). The highest number of branches and highest amount of grains yield on plants were obtained under pneumatic planter. He also added that the mechanical planting (pneumatic planter and seed drill) saved about 67.6 and 31.6 %, respectively, of seeds per feddan compared by manual planting. Jasani *et al.* (1993) showed that soybean sawing rates of 40 , 50 , 60 and 70 kg seeds / ha (Kg/fed) produced seed yields of 1.36 , 1.76 and 1.78 Mg / ha, respectively.

The main objective of the present research was to study the effect of levelling and planting methods on soybean yield.

MATERIALS AND METHODS

The present work was carried out on a clayey soil at El-Gemmiza Research station, Gharbia Governorate in 2002 season. The aim of the present study was to investigate the effect of two methods of levelling (Traditional levelling and LASER levelling) and three sowing methods on soybean yield.

Levelling Implement:

A hydraulic leveler (El-Bihira co.) 361 cm length, 78.0 cm width, 79.0 cm height and 2.22 m^3 capacity with and without the LASER device was used to perform both the LASER and the conventional levelling operations.

Sowing machines:-

Three different sowing machines were used in the present study (seed drill, mechanical planter, and pneumatic planter). Their specifications are summarized in Table 1.

Table 1: The specification of the sowing machines.

Specification	Seed drill	Mechanical planter	Pneumatic planter
Model	Tye	Friuli Super	Gaspardo 520
Source	U.S.A.	Italy	Italy
No. of rows	20	4	4
Spacing of rows, cm	15	60	60
Metering device	Ground wheel	Ground wheel	Air
Working width, cm	300	240	240
Control	Hydraulic	Hydraulic	Hydraulic

Two different tractors were used in the study:

(I) The first is ford Tw.10 120 hP (for levelling operation).

(ii) The second is Nasr 60 hP (for planting operation).

Experimental procedure:-

The field experiments were carried out during soybean planting season. Seedbed preparation was chiseling twice followed by disc harrow. Two levelling methods LASER and traditional levelling were used three planting methods were seed drill, mechanical planter and pneumatic planter. Four travel speeds of 3.15, 4.10, 5.32 and 6.28 km/h were applied in the study All treatments were replicated three times and mean data were calculated. In both manual and mechanical planting methods, the rows spacing and hills in the same were almost adjusted to be 60 cm and 10 cm, respectively. The average number of seeds was ranged from 4 to 6 seed per hill under manual planting; meanwhile this was only done in the mechanical planting. The manual planting and mechanical planting by seed drill plots were thinned to one plant per hill after three weeks from planting. The planting depth was adjusted to 3 cm.

Experimental measurements: -

The following measurements were arranged as follows:-

1- The germination ratios (g).

Two weeks after sowing and irrigation the germination ratio was calculated by the following formula: -

$$(g = p / d) \quad \text{.....(1)}$$

Where:-

p= Average plant number per squared meter,

d = Average number of delivered seeds per squared meter,

The d values were calculated during the seed drill calibration.

2- Planting distribution around the row center:

After germination (two weeks after sowing and irrigation) the numbers of plants through asides of the row center line were counted to determine the seed dispersion.

3-Estimation of energy requirements :-

The rate of fuel consumption was calculated according to Rangasamy *et al.*, (1993) as follows:-

The total power consumed by the planting machine was calculated by using the measured fuel consumption during planting operations under different variables of the study. The following formula was used to estimate power consumption by the planting machine according to Embaby (1985).

$$Ep = \left(F_c \times \frac{1}{60 \times 60}\right) P_f \times L.C.V. \times 427 \times \eta_{th} \times \eta_m \times \frac{1}{75} \times \frac{1}{1.36} \text{ (kW)} \quad \text{.....(2)}$$

Where:-

F_c= Fuel consumption, l/h;

P_f = Density of fuel (for solar fuel = 0.85 kg /l),

L.C.V. = Lower calorific value of fuel (for solar fuel 10000 k cal/kg),

427 = Thermo-mechanical equivalent, kg. m /k cal,

η_{th} = Thermal efficiency of the engine (40%) and

η_m = The mechanical efficiency of the engine (80%).

Estimation of the required energy for planting operation was carried out using the following equation;

$$\text{Energy requirements (kW. h/Mg)} = \frac{\text{power requirement (kW)}}{\text{Machine planting capacity (Mg/h)}} \quad \text{.....(3)}$$

4- Crop yield :

Crop samples were collected from one square meter from of crop. The average number of spikes per feddan, grain yield and straw yield (kg/ feddan) were calculated for all treatments in.

RESULTS AND DISCUSSION

This study was carried out to evaluate the effect of levelling and planting methods on growth and productivity of soybean plants. The study also includes the effect of levelling methods and the forward speed on the performance of planting machines. The results indicated the following:

1- The germination ratio

Fig 1 shows that germination ratio was decreased by increasing the forward speed for the all machines used. When the forward speed increased from 3.15 to 6.28 km/h, the germination ratio decreased from 82.77 to 76.72 %, from 85.48 to 78.70 % and from 87.54 to 79.63% for the seed drill, mechanical planter and pneumatic planter, respectively, at traditional levelling. This can be attributed to the fact that at high speeds, some of the seeds were left uncovered. Also, with high speeds, of the feeders plate cells % was decreased, that are due to the in sufficient depth, recovery of seeds or seed damage.

It is also obvious that germination ratio increased with LASER levelling compared with traditional levelling for all planting machines Fig.2. The highest mean of germination ratios were found to be 84.82, 89.36 and 92.27 % for seed drill, mechanical planter and pneumatic planter, respectively at forward speeds 3.15 km/h with LASER levelling. This may be attributed to the improved distribution uniformity of water.

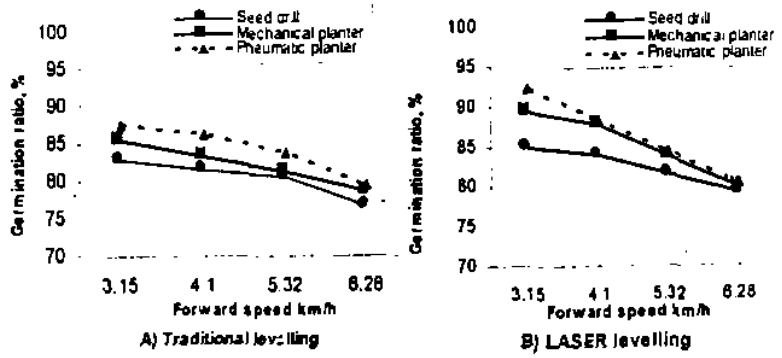

Fig 1: Germination ratio as affected by different forward speeds and different planting machines at different levelling methods

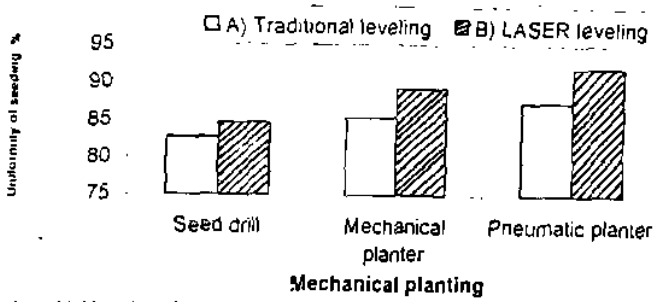

Fig 2: Uniformity of seeding, % and mechanical planting under different leveling methods

2- Uniformity of seeding:

The uniformity of seeding decreased by increasing the forward speed for all used planting machines Fig.3. For all planting machines, the seeding uniformity value of LASER levelling was better than that of the traditional one.Fig.4.

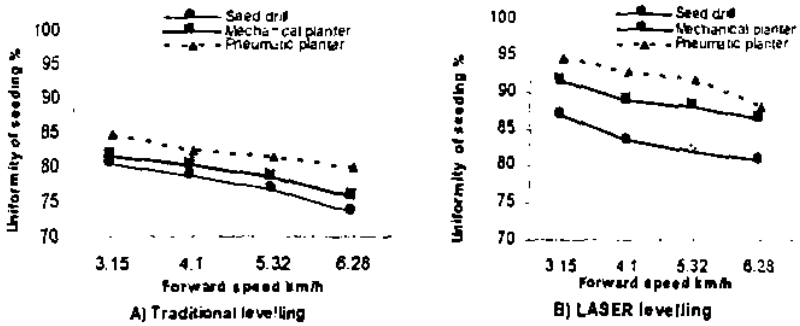

Fig 3: Uniformity of seeding as affected by different forward speeds and different planting machines at different levelling methods.

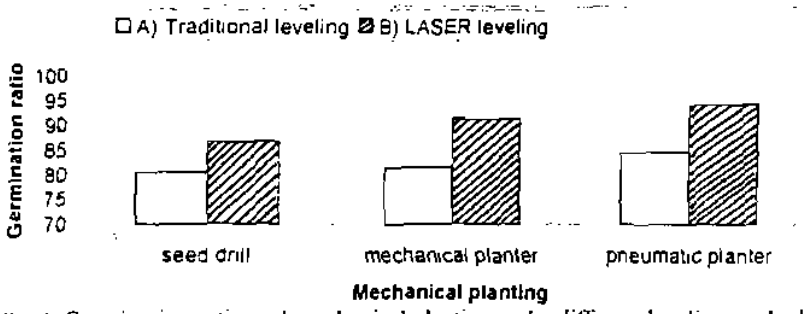

Fig 4: Germination ratio and mechanical planting under different leveling methods

3-Fuel consumption rate:-

The data showed that for all planting machines, the fuel consumption rate (l/h) increased by increasing forward speed as shown in Fig.5. The specific power requirement for all planting machines increased by increasing forward speed. When the forward speed increased from 3.15 to 6.28 km, the power requirement increased from 15.71 to 17.85, from 13.56 to 17.87 and from 12.61 to 16.66 kW for pneumatic planter, mechanical planter and seed drill, respectively, at traditional levelling. The power required by pneumatic planter is more than that required by other planting machines). This can be due to heavy mass of pneumatic machine. Fig.6.

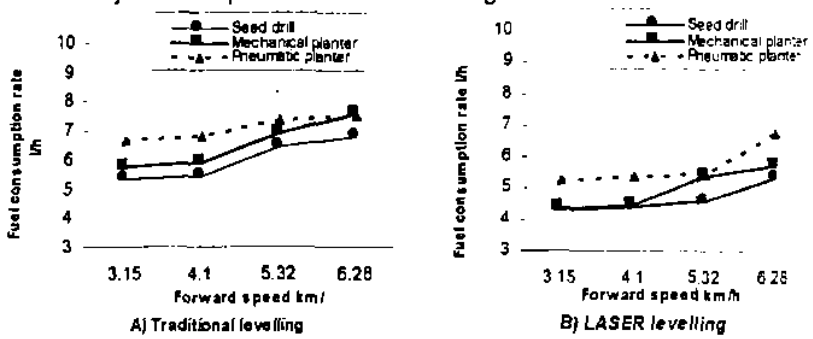

Fig 5: Fuel consumption rate as affected by different forward speeds and different planting machines at different levelling methods.

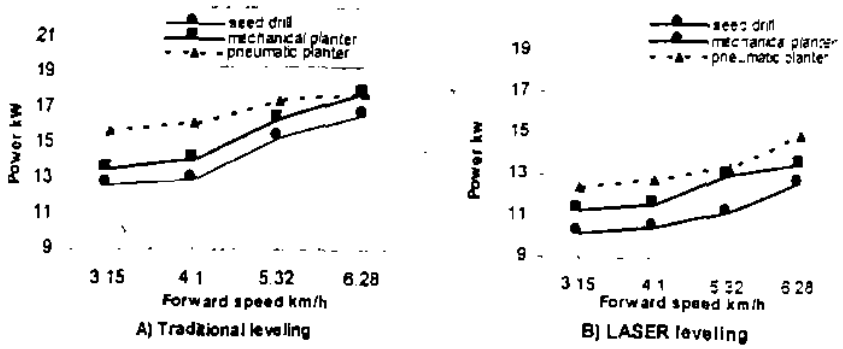

Fig 6: Power requirement as affected by different forward speeds and different planting machines with different leveling methods.

4-Total yield:-

The effect of different treatments of land levelling, planting method and planting forward speed on total yield of soybean Mg /fed is illustrated in Fig.7. The total yield was affected by planting forward speed for both levelling methods. The speed of 3.15 km/h gave the maximum yield; 1.29, 1.32 and 1.45 Mg/fed for seed drill, mechanical planter and pneumatic planter, respectively, with LASER levelling method. Fig.8. This was due to the reduction of, the planting efficiency (germination ratio) by increasing the forward speed. The highest yield (1.45 Mg /fed) was obtained by using

pneumatic planter with LASER levelling. However the least yield (0.79 Mg/fed) was obtained by using seed drill with traditional levelling. It is remarkable that LASER levelling increased seed yield by 15 % over traditional levelling. This was due to the more accurate levelling, which resulted in maximum sprouting ratio. These results are in harmony with those obtained by Mc Clung *et al.* (1985), and Seif El-yozal et al (1986). The drilling and sowing methods less resulted in seed yield than the other methods. This is due to the increase in number of plants per unit area that increases competition of light, minerals and water.

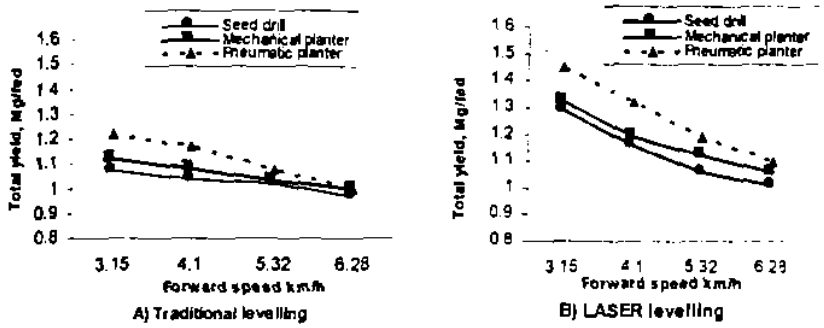

Fig 7: Total yield as affected by different forward speeds and different planting machines at different leveling methods.

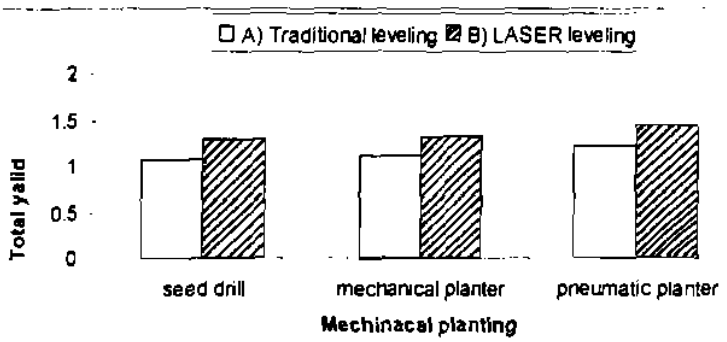

Fig 8: Total yield and mechanical planting under different leveling methods.

CONCLUSION

Regarding the effect of soil levelling and planting methods on soybean yield, results show that the pneumatic planter at LASER land levelling recorded the maximum values of germination ratio 92.27%, uniformity seeding 94.47% and total yield 1.45 Mg/fed. That indicates the importance of utilization of the LASER land levelling and pneumatic planter at planting soybean crop.

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تأثير بعض طرق التسوية والزراعة الميكانيكية علي إنتاجية محصول فول الصويا

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يعتبر فول الصويا من المحاصيل الغذائية والصناعية الهامة لاحتواء بذوره على نسبة مرتفعة من البروتين (٤٠ %) بالإضافة إلى نسبة لا بأس بها من الزيت (٢٠%) وبالرغم من كثرة آلات الزراعة مازالت معظم المساحات المنزرعة بفول الصويا تزرع يدويا.

وقد أجرى هذا البحث بمحطة البحوث الزراعية بالجميزة محافظة الغربية بهدف تقيم أداء بعض آلات الزراعة باستخدام طريقتي التسوية التقليدية والتسوية بالليزر واشتملت الدراسة على ثلاثة من آلات الزراعة وهي:-

السطارة (Seed drill) و آلة الزراعة في جور الميكانيكية (Mechanical planter) و آلة الزراعة في جور الهوائية (Pneumatic planter)

تم تقدير نسبة الإنبات وانتظامية التوزيع والقدرة اللازمة والطاقة المستهلكة في عملية الزراعة كما تم تقدير الإنتاجية للآلات قيد البحث.

وكانت أهم النتائج المتحصل عليها كما يلي:-

١- أمكن الحصول على أعلى نسبة إنبات ٩٢,٢٧% وكذلك على أعلى انتظامية ٩٤,٤٧% عند استخدام آلة الزراعة في جور الهوائية بأقل سرعة تشغيل ٣,١٥ كم / ساعة في حالة التسوية بالليزر.ويرجع ذلك إلى نعومة سطح التربة وتجانس غطاء التربة على البذور.

٢- أعطت التسوية بالليزر أقل القيم لمعدل استهلاك الوقود لآلات الزراعة قيد البحث بالمقارنة بالتسوية العادية، وكانت نسبة النقص في استهلاك الوقود ٨,٧٥ ، ٩,٠٣ ، ١٤,٢٥ % باستخدام آلتي الزراعة في جور الهوائية والميكانيكية والسطارة على التوالي. كما وجد أن الزيادة في السرعة الأمامية للزراعة تؤدي إلى زيادة معدل استهلاك الوقود.

٣- باستخدام التسوية الليزر تفوق متوسط الإنتاج العام لمحصول فول الصويا بمقدار ١٣ و ١١ و ٩,٥ % مقارنة بالتسوية العادية في حالة الزراعة آلتي الزراعة في جور الهوائية والميكانيكية والسطارة على التوالي.

- أعطت التسوية بالليزر و الزراعة في جور الهوائية عند سرعة أمامية ٣,١٥ كم / ساعة أعلى قيما للإنتاج الكلي ١,٤٥(ميجا جرام / فدان). كما لوحظ انخفاض طفيف في إنتاجية فول الصويا عند زيادة السرعة الأمامية لآلات الزراعة المستخدمة.

بناء عليه يوصي بالتسوية بالليزر و الزراعة بآلة الزراعة في جور الهوائية بسرعة ٣,١٥ كم/ساعة عند زراعة محصول فول الصويا.