COMBINED MECHANIZATION SYSTEM'S POWER REQUIREMENTS FOR COTTON CROP (SEED-BED PREPARATION AND PLANTING)

M.E.M. METWALLI

Agricultural Engineering Research Institute, Agricultural Research Center, Dokki, Egypt.

(Manuscript received 13 May 1998)

Abstract

Combined mechanization systems of primary tillage (plows) and planting methods (manual and mechanical) for cotton crop were studied on clayey soil. Strain gage instrumentation, as a measuring technique, was used to measure the pull force and the torque at left and right rear wheels of tractor for cotton seed-bed preparation. Also, the penetration force was measured before and after tillage operations and soil clods were measured after tillage. In addition, the yield was determined at picking times where the picking was manual.

Statistical analyses of these data showed that the best combinations were "moldboard plow at 5km/h + manual planting "," chisel plow at 5 km/h + manual planting "," chisel plow at 5 km/h + planter "and "chisel plow at 4 km/h + planter" respectively. Also, the torque ratio between left and right wheels was unity with chisel plow and eight times with moldboard plow. The power ratio between rear wheels axis and drawbar was equal to two with chisel plow and four with moldboard plow.

INTRODUCTION

Tillage is considered the primary farm mechanization that aims to prepare the seed bed and improve environmental conditions for plant growth. The chisel plows are commonly used in seed-bed preparation in Egypt. Hendric and William (1971) stated that the total power requirements increased with tillage depth, but the specific power requirement in general decreased. El-Sayed *et al.* (1994) used three tillage systems to prepare the seed-bed to grow cotton. These tillage systems were traditional tillage (chisel plow-twice + leveling scraper), minimum tillage (disk harrow-twice + leveling scraper), and improved tillage (chisel plow-twicet+disk harrow-twice + leveling scraper). They found that the maximum energy required was obtained with chisel plow. Meanwhile, the energy required for traditional and improved tillage techiques surpass that under minimum tillage. Also, the cotton yield is highly affected by tillage, where the highest yield was obtained with the improved tillage technique. Abd El-Wahab (1994) reported that more than 50 % of the power required for agricultural production is consumed in soil tillage. Hamad *et al.* (1994) stated that the tillage system composed of "chisel plow two passes followed by disk harrow "gave the best soil pulverization and highsoil porosity and less bulk density value compared with other systems composed of "chisel plow; one pass followed by disk harrow "and "moldboard plow followed by disk harrow" on clay loam and silty clay soils. Also, they indicated that the tillage has greatly improved on fine than medium textures. El Ashry *et al.* (1994) reported the instrumentation system for measuring the tractor performance developed at the Research and Test Station of Tractor and Farm Machinery, Sabahya, Alexandria-Egypt in cooperation with Tractor Test Laboratory, Nebraska, U.S.A. Morad and El-Shazly (1994) studied the effect of some parameters on rotary plow performance. They concluded that the kinematic index (ratio of rotor peripheral to forward velocities), tillage pitch, operating depth, and soil moisture content are the important parameters affecting the performance of the rotary plow. Also, minimization of energy requirements and improvement of tillage efficiency can be obtained under the following conditions: kinematic index of 2.2, tilling pitch of 10 cm, and moisture content of 21%.

The objectives of this work are to:

1. Evaluate the combined mechanization systems of primary tillage (type of plow and forward speed) and planting method (manual and mechanical),
2. Study the power requirement with tillage operation at drawbar and rear wheels axis for chisel and moldboard plows, and
3. Measure the torque at left and right rear wheels of tractor and the pull force on draw bar.

MATERIALS AND METHODS

The present work was carried out at Etay El-Baroud Agricultural Research Station, Behaira Governorate, Egypt, using Giza 75 cotton variety. The soil was of loom-clay type texture, the previous crop was clover and the plant residue height was 20 cm approximately, and the moisture content was 21%.

2.1 Tractors:

Three tractors were used in the present work. Two tractors (John-Deere 4055 and Deutz "DX 6.30") used for tillage and the third (Nasr "65") used for planting.

A. John-Deere tractor:

John-Deere 4055, six cylinders, diesel engine, water cooled system, 120 hp. The tractor mass is about eight tons, 4 x 4. Rear and front tire sizes are 18.4 R38 and 14.9 R 26 respectively. This tractor has a strain gage torque type sets fixed on rear wheel axes at left and right positions to measure the torque on rear wheel axes. Also, a data acquisition system and computer unit were fixed in the tractor cabin to record the data. This tractor was used for measurement and primary tillage.

B. Deutz "DX 6.30" tractor:

Deutz "DX 6.30", six cylinders, diesel engine, air cooled system, 110 hp. The tractor mass is about six tons, 4x4. Rear and front tire sizes are 18.9 /15-34 and 14.9-24 respectively. This tractor was used for primary and secondary tillage.

C. Nasr "65" tractor:

Nasr "65", four cylinders, diesel engine, water cooled system, 65 hp. The tractor mass is about two and half tons, 2x4. Rear and front tire sizes, are 14.8-28 and 12.8-16.8 respectively. This tractor was used for operating the planter.

2.2. Equipment:

2.2.1. Plows:

Chisel and Mold-board plows were chosen to carry out this research.

A. Chisel plow (RAU):

A seven mounted shares chisel plow (RAU) was used. It was manufactured by "Behera Co.", composed of three rows at 50 cm spacing between rows. The shares distribution on rows is 2, 2, and 3 from front to rear at 75 cm spacing between each two shares on the same row and 25 cm spacing between each two st aggered shares is 25 cm. The share beam height is 50 cm (fig. 1). The share beam has a sheer bolt to absorb the shocks from soil and clods and to make protection to share and share beam. The shares are imported from Germany.

B. Moldboard plow:

A three (Mounted) bottoms moldboard plow was used. It was manufactured by "Tanta Motors Co.", composed of three bottoms fixed on frame 60 cm high and man-

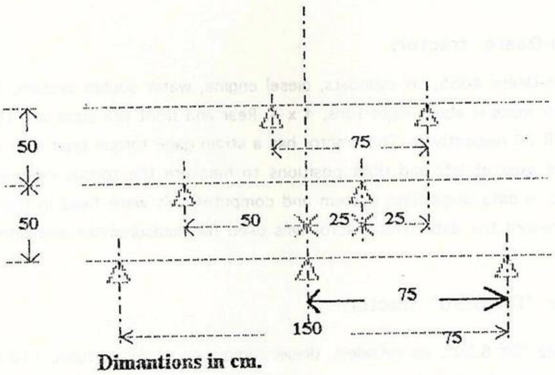

Fig. 1. Schematic of chisel plow 7 tines "RAU".

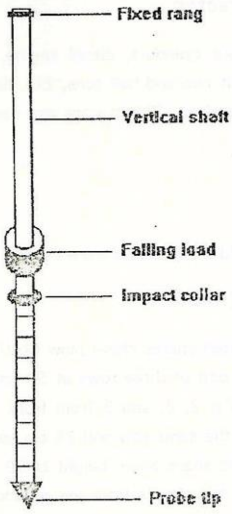

Fig. 2. Schematic of penetrometer.

ufactured from square cross section of four inches width and thickness of six mm. The bottoms have an improvement by adding a small scraper at front of the bottom to penetrate soil easier. The bottom height is 50 cm and the net cutting width of the bottom is 35 cm, and the total cutting width of plow is 105 cm. The shares are imported from Italy.

2.2.2. Disk harrow:

A heavy trailed disk harrow, model "Jean de bru s.a. " imported from France, was used to harrow the soil clods by two cross passes. The diameter of disk is 45 cm and the set has six disks fixed on one axis. The spacing between disks is 20 cm, and the disk harrow has four disk sets; two at front and two at rear with angle between each two sets. A single-acting piston is fixed on frame to lift and lower land wheels to control harrowing depth.

2.2.3. Furrow opener:

A four-units furrow opener was used to open furrows for manual planting of plots.

2.2.4 Cotton planter:

A Brazilian planter (Jomil) was used to plant the mechanical plots. It consists of four planting units.

2.3. Treatments:

Three treatments were studied and tested in this research

2.3.1 Plows:

Two types chisel and moldboard plows were experimented with .

2.3.2 Tillage forward speed:

Three forward speeds (3, 4 and 5 km/h) were used in treatment. In addition 2.5 and 6 km/h were used in side experiment.

2.3.3 Planting method:

Two planting methods were used to plant treatment plots, half of these plots was planted by labor, after opening the furrows, and the rest of plots was planted by planter as a mechanical method.

The experimental design was conducted in a Randomized Complete Block Design in three replications, and data were analyzed as vectorial analysis (2x3x2).

2.4. Instrumentation:

2.4. Data acquistion system:

It is a measuring system incorporating one or more transducers that interpret the signal to provide a quantitative assessment of a principal characteristic of the substance being sensed. The instrument uses standard procedures, by extracting the information through:

1) Sensing the substance with the transducer.

2) Interpretation of the signal and translating it.

The data acquisition instrument consists of transducers, A/D conversion cards, display and lap-top computer. The transducers are used to measure pull and torque. A/D conversion cards analyze output signals which come from transducers to digital form. Display is digital for output data. The lap top computer is "486 Gateway" four MB. RAM, one drive (3.5 "drive) and hard disk 80 MB. The computer has the software "DAS3" to deal with output signals.

2.4.2. Strain-gages pull dynamometer:

A pull dynamometer was constructed to measure pull force using strain gages. This dynamometer can measure about 2000 N pull, and the circuit of strain gages is shown in Fig. 1. The strain gage circuit was connected to A/D card in the data acquisition system fixed in tractor cabin. The pull meter was calibrated before measurement. This instrument was constructed by machining down a middle section of a drawbar to measure the draft of the towed implements with reduced section of 0.6 "#0.75" For the electrical portion of the strain bridge, there are four active strain gages, two in each side were mounted axially on the reduced cross section part and wired in a wheatstone bridge circuit. No loads other than draft were applied to the pull meter (fig. 3).

2.4.3. Strain gages torque meter:

The axial torque transducer consists of the existing tractor axle and a strain gage circuit bridge for torque measurements mounted on it as shown in Fig.2. The steel axel was 87 mm diameter. Four strain gages torque type (M1, M2) were attached at 45^{o} to each side of the test tractor axis, with a four-arm bridge to measure the train caused by torque applied to the transducer. This arrangement in a bridge circuit gives an added total output. Four strain gages constructed one circuit on each side and each circuit was connected to A/D card in data acquisition system. The arrangement of the strain gages is on the test tractor along axel. Signals from the strain gages were transferred to the instrumentation through a slip ring assembly, mounted on each end of the tractor axel (fig. 4).

2.4.4. Profile meter:

It consists of a wooden table (0.6 m x 3.0 m) fixed on steel frame angle cross-sections 1.5", small tubes 10 mm internal diameter and 10 cm length fixed on lower bar of frame at spacing of 10 cm. A circular cross-section area 9 mm diameter solid steel of length 100 cm was used to record the levels of soil on square paper fixed on the wooden table.

2.4.5. Impact penetrometer:

This penetrometer consists of a 30^{o} circular stainless steel cone, driving shaft 9.5 mm diameter with 60 cm length, hammer guide 9.5 mm diameter with 315 mm. stroke and two-kgs steel hammer mass. The driven shaft was marked at every two cm (Fig. 2).

2.4.6. Sieves:

Six sieves with mesh 100, 75, 50, 25, 19 and 12.5 mm. were used to separate the clods in respect to diameter distributions.

The soil clod main diameter was determined according to RNAM (1983) as follow:

$$d_{sc} = \frac{1}{W}(d_1A+d_2B + d_3C+d_4D+d_5E+d_6F+d_7G)$$

where, d_{sc} = soil clod main diameter, mm.

$d_1, d_2, d_3, \ldots\ldots, d_7$ = the main mesh diameters of range, mm.

A,B,C, ..., G = soil clod residuces over sieves (by mass), kg.

W = soil sample weight, kg.

2.5. Measurements:

2.5.1 Soil physical properties determination:

The samples were taken from three layer sizes, 0-10, 10-20 and 20-30 cm,

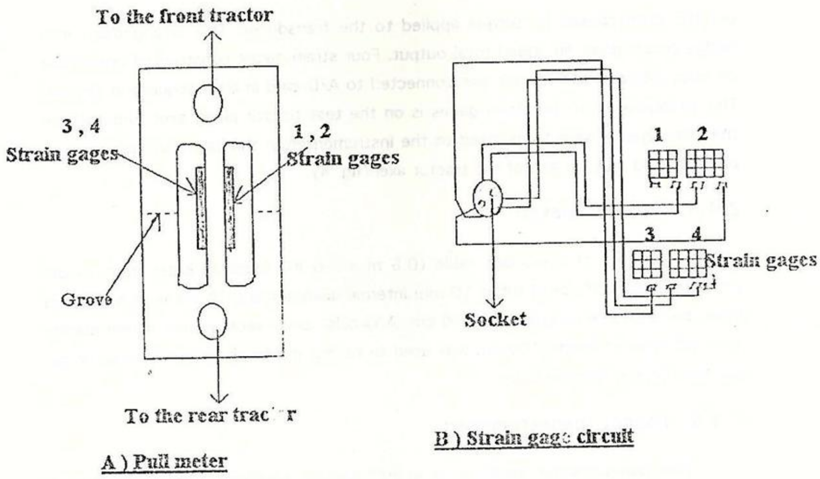

Fig. 3. Pull meter dynamometer.

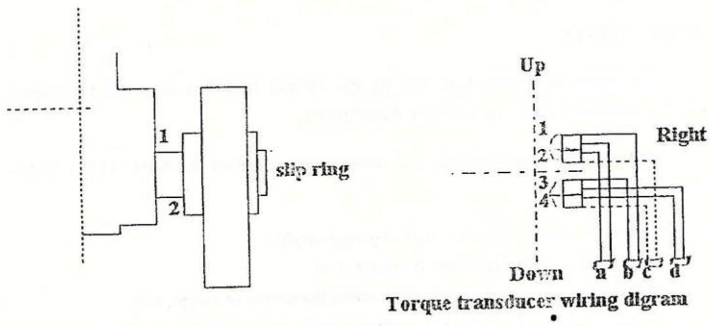

Fig. 4. Torque meter transducer.

depth randomly to determine the moisture content (m.c.) and soil texture. These samples were taken by standard cylinders 60 mm. internal diameter with 40 mm. height to determine the m.c. and bulk density, and unnatural samples were taken to determine soil texture. The m.c. samples were dried in oven at 105^{o} and weighed. This work was repeated to reach the equilibrium weight. And the texture samples were pounded and (wetted by enough water to make a mixture) and forced by centrifugal force. Samples were put in lab. for two days, after that, the soil texture was specified by the determination of sand, loam and clay percentages.

2.5.2. Soil penetration measurement :

The impact penetrometer was used to measure the soil penetration from random places in each treatment. The following procedure was followed for measuring the pentration resistance:

1. The penetrometer cone was driven into the soil up to zero level of penetrometer.
2. The hammer, of 2-kg mass, dropped from a constant height of 315 mm.
3. The soil specific resistance to penetrometer consists of two parts. The first part is due to the hammer potential energy. The other part is the weight of both the hammer and the penetrometer itself. Accordingly, the following equations may be used:

$$E = n.w_h.d + z.(w_h + w_p), \text{ and,}$$

$$P = \frac{dE}{dZ} \qquad \text{(Metwalli, 1987)}$$

where

E = energy needed for driving the penetrometer into the soil,
n = number of impacts.,
Wn = weight of hammer,
d = storke of one impact,
z = final depth.,
w_p = weight of the penetrometr itself, and
P = penetration resistance.

2.5.3. Determination of plowing depth by profile meter:

The soil levels were recorded before and after tillage to determine the mean depth of plowing through the plowing path the following procedure was followed:

1. A square paper sheet was fixed on the wooden table of the profile meter.,

2. The profile meter was placed at specific marked place on two supports.,

3. The soil levels under profile meter were recorded on the square paper before tillage operation.,

4. The profile meter was removed out and the tractor with plow plowed the soil.,

5. The profile meter was fixed again on the same specific place.,

6. The soil levels after plowing were recorded on the same square paper, and the plowed soil was removed out to unplowed soil layer and the levels of soil were recorded again. The differences between first level before tillage and levels of unplowed soil layer were calculated to determine the depth of plowing. Also, the mean depth of plowing was checked by a measuring tape taking the adjacent unplowed soil surface as a reference.

2.5.4. Forward speed measurement:

The forward speed was measured by panel gauge in tractor cabin and checked by measuring the traveling distance and it's time. The following formula was used to calculate the forward speed:

$$S = \frac{D}{T} \times 3.6$$

where :
S = forward speed, km/h,
D = traveling distance, m, and
T = traveling time, S.

2.5.5. Rotating speed of the tractor rear-wheels:

The following procedure was followed to calculate the rotating speed:

1. A mark was fixed on the rear wheel,

2. During the tractor movement, a stop watch was started when the mark was at soil surface, then stoped after ten complete revolutions of the tractor rear wheel.

3. The time of ten revolutions was recorded and the rotating speed of rear wheel was calculated by the following formula:

$$Sr = \frac{10 \times 60}{t}$$

where :

Sr = rotating speed of rear wheel, r.p.m. and

t = time, s.

2.5.6. Torque on tractor rear wheels:

The following procedure was followed to determine the torque on rear wheels axes:

1. For left and right rear-wheels, the data acquisition system channels were specified (one channel for each wheel).
2. The data acquistion system channels were cleared from any previous data to zero level.
3. The constant calibrated data were entered to the specified channels by the computer unit.
4. Tractor traveling and plowing data were recorded in computer after the data acquisition system switch was put on "start".
5. At the end of plowing path, the data acquistion system switch was put on "off". The recorded data by data acquistion system were saved automatically by computer unit on the hard disk.
6. The power on rear wheel axis was determined by the following formula:

$$Pa = \frac{2 \pi nT}{1000}$$

where :

Pa = power on rear wheel axes, kW,

n = rotating speed of rear wheels, revs/s., and

T = torque on rear wheels axis, N.m.

2.5.7. Pull force measurement:

The strain-gage dynamometer was connected between the two tractors by chain to measure the pull force. The front one had the instrumentation and the plow was mounted with the rear one. The data acquisition system channel of pull force was cleared from any data, and the calibrated constants were fixed on channel by computer unit and the same procedure was followed to record the data of pull force. The formula bellow was taken to determine the pull power:

$$Pp = \frac{P \times S}{1000}$$

where :

Pp = pull power kW.,

P = pull force, N, and

S = forward speed of plowing, m/s.

2.5.8. Yield:

Three samples were taken randomly from each treatment to determine the cotton yield at picking times. The sample area was 42 m^2 (21 m x 2 m).

These data were analyzed statistically as vectorial analysis to test the interactions between treatments.

RESULTS AND DISCUSSION

3.1. Power requirements:

The results show that the most part of power consumption occurred with rear wheels axis in all plowing treatments. The rear wheels axis power exceeded the drawbar power by 127.3%, 115.3%, 105.8%, 119.9% and 138.8% at forward speeds 2.5, 3.0, 4.0, 5.0 and 6.0 km/h respectively with local chisel plow, and by 252.3%, 239.9, 220.7% and 212.9% at forward speeds 2.5, 3.0, 4.0, 5.0 and 6.0 km/h respectively with local moldboard plow with three bottoms. The rear wheels axis had the most power of plowing operation, which equaled more than two times and four times of drawbar power with chisel and mold-board plows respectively. The ratio of rear wheels axis power to draw-bar power was 2 and 4 with chisel and moldboard plows, i.e., the power ratio of moldboard was two times of chisel plow approximately as shown in Fig. 5. The discussion of power indicated that the pull power of plowing operation was more affected by rear wheels axis power than the draw-bar power specially in moldboard plow. Also, the power requirement for moldboard plow was higher than chisel plow by 30.4%, 21.0%, 9.5%, 13.1% and 9.2% at forward speeds of 2.5, 3.0, 4.0, 5.0 and 6.0 km/h respectively. Also, the torque and power results showed that the rear wheels axis torque was approximately equal on the two sides (left and right) with chisel plow, but, with the moldboard plow case the torque on the axis at unplowing side was approximately eight times of torque on the axis at plowing side.

3.2. Field capacity:

Fig. 6 shows the field capacity (plow productivity) of tested plows. It was found that the chisel plow has the highest field cappacities, which were 1.04, 1.25, 1.67, 2.08, and 2.55 fed/h at forward speeds of 2.5, 3.0, 4.0, 5.0, and 6.0 km/h respectively. This result is attributed to the increase of plowing width for chisel plow which was 175 cm.

3.3. Penetration force:

The soil penetration resistance after plowing was less than before plowing in all treatments as shown in Fig. 7 a and b. The results indicated that the chisel plow affected penetration resistance of soil more than moldboard plow. Also, the lower speed affected soil penetration resistance more than the higher speeds. This can be referred to the performance of plows, where, the chisel plow penetrates and cuts the soil layers and results in more prosity in lower layers. This affected layers of more than 30 cm depth. Meanwhile, the moldboard plow cuts and inverts the soil layers upside down. This movement of soil layers affected layers down to more than 30 cm depth. Both plows compacted the soil layers to a depth of more than 35 cm with a forward speed of 5 km/h. Also, lower speed affected soil penetration resistance more than higher speed.

3.4. Soil clods:

Table 1 presents the effect of tillage systems on percentage of clod-size distribution. The results show that the clods bigger than 100 mm had the biggest percent in all treatment, which were over 50%, 45% and 31% for speeds of 3, 4 and 5 km/h respectively. High speed had the smallest percentage of clods bigger than 100 mm. The high speed had better distribution of clods on sieves. Where, the clods less than 50 mm had the best percentage with the highest speed. Consequently high speeds broke soil better with the two types of plows. Also, the clods mean diameter was smaller at 5 km/h speed than 4 and 3 km/h speeds. The chisel plow had bigger clods than moldboard plow at 3 km/h while, at 4 and 5 km/h forward high speeds. The clod diameter was bigger with moldboard plow than chisel plow.

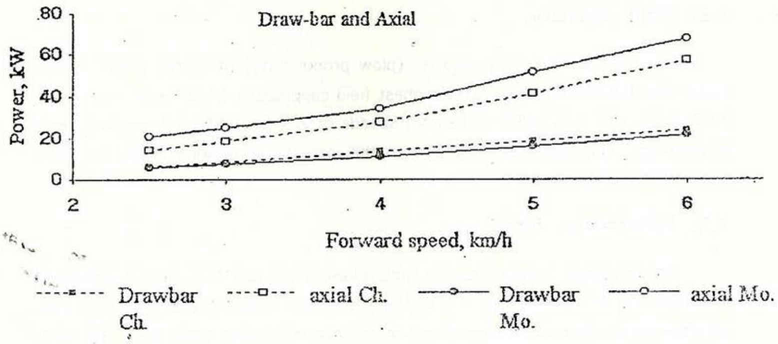

Fig. 5. The axial, and draw-bar power reqirement of plowing (kw) using tested plows at different forward speeds (km/h).

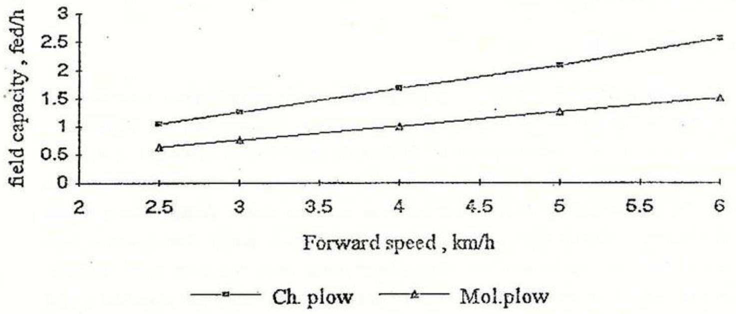

Fig. 6 Field capacity for tested plows , fed/h at different forward speeds, km/h.

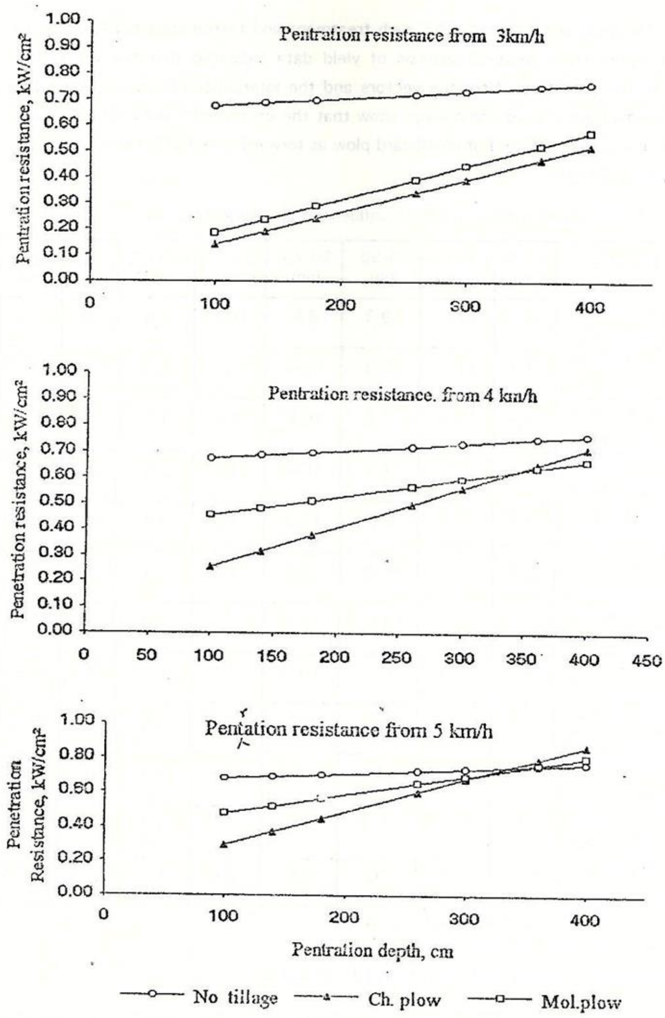

Fig. 7. Relationship between depth, cm; and pentration resistance kW/cm^2 for tested plows.

3.5. Yield:

The yield was calculated for each treatment and tested statistically as vectorial analysis. The statistical analysis of yield data indicated that the treatments were highly significant. Also, the vectors and the interactions between them were highly significant. Means comparison show that the best combination (of soil proparеties and yield) consisted of moldboard plow at forward speed of 5 km/h and manual planting on rows.

Table 1. Clod-size distribution (%) as influenced by tillage systems.

Systems	>100 mm	100-75 mm	75-50 mm	50-25 mm	25-19 mm	19-12.5 mm	<12.5 mm	Dsc** mm
*Mb by 5km/h+ manual plant.	38.6	14.0	19.3	8.8	10.5	3.5	5.3	63.40
*Ch by 5km/h+ manual plant.	31.1	11.9	16.3	10.4	4.4	5.9	20.0	52.33
Ch by 4 km/h+ mechanic. plant.	48.4	11.3	11.8	10.8	3.2	4.3	10.2	66.10
Ch. by 5 km/h+ mechanic. plant.	31.1	11.9	16.3	10.4	4.4	5.9	20.0	52.33
Mb by 3 km/h+ manual plant.	50.8	11.5	9.8	12.3	3.3	4.9	7.4	68.66
Ch by 4 km/h + manual plant.	48.4	11.3	11.8	10.8	3.2	4.3	10.2	66.61
Mb by 3 km/h+ mechanic. plant.	50.8	11.5	9.8	12.3	3.3	4.9	7.4	68.66
Mb by 4 km/h+ mechanic. plant.	45.3	12.0	12.0	10.3	5.1	5.1	10.3	64.44
Mb by 5 km/h+ mechanic. plant.	38.6	14.0	19.3	8.8	10.5	3.5	5.3	63.40
Mb by 4 km/h+ manual plant	45.3	12.0	12.0	10.3	5.1	5.1	10.3	64.44
Ch. by 3 km/h+ manual plant.	58.3	12.1	7.3	8.5	2.4	4.1	7.3	74.15
Ch. by 3 km/h+ mechanic. plant.	58.3	12.1	7.3	8.5	2.4	4.1	7.3	74.15

* Ch = Chisel plow, and Mb = Moldboard plow.
** Dsc = The main soil clod diameter.

Comparative study for the tested systems:

Table 2 presents the energy requited and cotton yield as affected by different tillage systems. The chisel plow saved the energy requirement by 50.37%, 45.32% and 37.67% at 3, 4 and 5 km/h forward speed comperd with moldboard plow.

Table 2 shows also that the yield when using chisel plow at 4 and 5 km/h forward speed treatments was highest than the same treatments of moldboard plow except moldboard plow at 5 km/h forward speed with manual planting where it had the highest yield of all tested treatments.

Table 2. Energy required and cotton yield as affected by different tillage systems.

Systems	Energy required, kWh/fed	Yield, kg/fed
*Mb by 5km/h+ manual plant.	46.19	425.5
*Ch by 5km/h+ manual plant.	28.79	384.1
Ch by 4 km/h+ mechanic. plant.	24.79	364.4
Ch. by 5 km/h+ mechanic. plant.	28.79	359.2
Mb by 3 km/h+ manual plant.	43.52	311.7
Ch by 4 km/h + manual plant.	24.79	304.6
Mb by 3 km/h+ mechanic. plant.	43.52	300.5
Mb by 4 km/h+ mechanic. plant.	45.34	295.0
Mb by 5 km/h+ mechanic. plant.	46.19	287.0
Mb by 4 km/h+ manual plant	45.34	239.2
Ch. by 3 km/h+ manual plant.	21.60	180.8
Ch. by 3 km/h+ mechanic. plant.	21.60	155.8

* Ch = Chisel plow, and Mb = Moldboard plow.

IV. CONCLUSIONS

The most power of tillage was consumed at rear-wheels axis, where its ratio to drawbar power was 2 and 4 with chisel and moldboard plows respectively. Also, the ratio of torques at rear wheels left and right equaled 1 and 8 with chisel and moldboard plows respectively, where, at the chisel plow case the right and left wheels run on unplowed soil and in the moldboard plow case the left wheel run on unplowed soil and the right wheel run on plowed soil. The power requirement increased as the forward speed increased. The power of tillage operations was less with the chisel plow than moldboard plow. The penetration resistance was less with the chisel plow at low forward speed where it's effect reached more than 35 cm depth. For the soil clods, the chisel plow had the biggest clods with the forward speed of 3 km/h and smallest clods with the forward speeds of 4 and 5 km/h compared with the moldboard plow. The planting methods affected cotton yield. The manual method gave the highest yield compared with the mechanical method of planting at the same seed rate. Finally, the system composed of moldboard plow at 5 km/h forward speed and manual planting gave the highest cotton yield but consumed 1.5 times more energy than the second plowing system with chisel plow at 5 km/h forward speed and manual planting, and the third plowing system with chisel plow at 4 km/h and manual planting.

RECOMMENDATION

Although, the mechanization system of "moldboard plow at forward speed 5 km/h with manual planting gave the highest yield, the author recommends the system consisting of chisel plow at forward speed 4 km/h or 5 km/h with manual or mechanical planting, where the chisel plow saves power and had the best distribution of soil clods compared with moldboard. The power ratio between rear wheels axis and draw bar powers and the torque ratio between left and right rear wheels of tractor were best with chisel plow than moldboard plow. Also, the chisel plow gave the best characrteristics of soil (pulverization and penetration) than moldboard plow at forward speeds of 4 and 5 km/h. This will save the tractor wheels life and tractor power. Also, the chisel plow width is bigger than moldboard plow width, which will save in tillage time.

REFERENCES

1. Abd El-Wahab, M.K. 1994. Minimum tillage by a simple combination, Misr J. Ag. Eng., 11 (3) : 711-724.
2. El-Sayed A.S. and Ismail, E.S. E.S. 1994. Effect of Different Tillage Techniques on some soil properties and cotton yield, Misr, J. Ag. Eng., 11 (4): 929-941.
3. ElAshry, E.R., A.M. Bassuni, A.A. Sayed-Ahmed, and K.A. Ahmed. 1994. An instrumentation system for measuring the tractor performance-1: System development and calibration, Misr J. Ag. Eng., 11 (4): 968-987 .
4. Hendrick, J. C. and R.G. William. 1971. Rotary tillage design, Trans. ASAE, 14 (4): 669-683.
5. Hamad, S.A., E.B. El Banna, A.E. Abou El Maged, and A.R. Obaia. 1994. Tillage tools operation affecting tractor wheels dynamic weight, soil pulverization and porosity, Misr J. Ag. Eng., 11 (3): 19-35.
6. Metwally E-S. M., 1987. The effect of seed-bed preparation on corn yield and irrigation water consumption, M.Sc. Thesis, Fac. of Ag., El-Monofia Univ, : 25-26, 40-43.
7. Morad, M.M. and M.A. El-Shazly. 1994. Effect of some operating parameters on rotaryplow performance, Misr J. Ag. Eng., 11 (4) : 1009-1020.
8. RNAM, (Economic and Social Commission for Asia and the Pacific Regional Network for Agricultural Machinery), 1983, Test codes and procedures for farm machinery, Ch. on Soil pulverization, : 10-11.

احتياجات القدرة فى النظم المميكنة لإعداد مرقد البذرة والزراعة لمحصول القطن

متولى السيد محمد متولى

معهد بحوث الهندسه الزراعية – مركز البحوث الزراعية – الدقى – جيزة .

أجرى هذا البحث فى المزرعة البحثية لمحطة البحوث الزراعية بزرزورة – إيتاى البارود – محافظة البحيرة فى مساحة ستة أفدنة تقريبا. وقد كانت معاملات البحث تحت الدراسة هى نوع المحراث (حفار سبعة أسلحة – قلاب ثلاثة أبدان) والمحراثين محلية الصنع، سرعة الحرث الأمامية للجرار كان لها ثلاثة مستويات داخل المعاملات (٣ . ٤ و ٥ كم /س) بالأضافة إلى سرعتـ ـن خارج المعاملات هما (٢,٥ و ٦ كم /س). أما العامل الثالث فهو طريقة الزراعة شملت مـ ـستويين هما زراعة يدوية وزراعة آلية بأستخدام آلة الزراعة المتخصصة فى زراعة ـقطن بالزغب البرازيلية الصنع، وتضمنت معايير الدراسة مقاومة التربة للأختراق قبل وبعد الحرث، درجة تفتيت التربة بعد الحرث، درجة تفتيت التربة ومتوسط قطر الحبيبات وذلك بواسطة ستة غرابيل مختلفة الأقطار. وقد سجلت قراءات العزم على العجل الخلفى للجرار يميناً ويساراً كلاً على حده وقوة الشد على قضيب الشد الخلفى للجرار أثناء الحرث بأستخدام أجهزة قياس ذو مقاييس أنفعال ووحدة الحاسب الآلى المثبتة بالجرار لتسجيل وحفظ البيانات وذلك لتقدير القدرات المطلوبة للحرث. أما عينات المحصول فقد أخذت وقت الجنى على جنيتين لتقدير أنتاجية المحصول للفدان.

وقد أوضحت النتائج أن أفضل النظم على الترتيب هى " المحراث القلاب بسرعة آماميه ٥ كم/س + الزراعة اليدوية يليه "المحراث الحفار بسرعة ٥ كم/س + الزراعة اليدوية " المحراث الحفار بسرعة ٤ كم / س + الزراعة الآلية " المحراث الحفار بسرعة ٥ كم / س + الزراعة الآلية. كما أظهرت النتائج أن نسبة القدرة على محور العجل الخلفى للجرار إلى القدرة على قضيب الشد الخلفى للجرار كانت تساوى أثنين فى حالة المحراث الحفار وأربعة فى حالة المحراث القلاب المطرحى، كذلك فإن نسبة العزم على العجله الخلفية اليسرى إلى العزم على العجلة الخلفية اليمنى كانت تساوى واحد فى حالة المحراث الحفار وتساوى ثمانية فى حالة المحراث القلاب المطرحى. كذلك القدرة تتزايد مع زيادة السرعة الأمامية للجرار أثناء الحرث، وأن القدرة اللازمة للمحراث الحفار أقل من القدره اللازمة للمحراث القلاب المطرحى لنفس السرعة وعمق الحرث. أما بالنسبة لمقاومة التربة للأختراق فقد كانت النتائج أفضل بأستخدام المحراث الحفار عن أستخدام المحراث القلاب.

وبالرغم من آن النظام المكون من المحراث القلاب بسرعة ٥ كم/س مع الزراعة اليدوية قد أعطى أعلى أنتاجية، إلا أن الكاتب يوصى بأحد النظم من المحراث الحفار بسرعة أمامية ٤ أو ٥ كم /س مع الزراعة الألية أو اليدوية، حيث أن المحراث الحفار يوفر القدرة وكذلك أعطى أفضل توزيع لحبيبات التربة مقارناً بالمحراث القلاب المطرحى، كما أعطى نسبة القدرة بين محور العجل الخلفى والقدرة على قضيب الشد ونسبة العزم بين العجلة اليمنى والعجلة اليسرى الخلفيتين للجرار نتائج أفضل للمحراث الحفار عن المحراث القلاب المطرحى. كما أعطى المحراث االحفار أيضا نتائج أفضل لخصائص التربة (نسبة التحبب ومقاومة أخترق التربة) عنه فى حالة المحراث القلاب المطرحى وذلك عند سرعة أمامية ٤ و ٥ كم /س ، مما يؤدى إلى إطالة عمر عجل الجرار ويقلل من أستهلاكه كما يوفر فى القدرة. وكذلك عرض التشغيل للمحراث الحفار أكبر منه فى المحراث القلاب المطرحى وهذا يقلل من زمن التشغيل اللازم لأتمام عملية الحرث وتجهيز التربة للزراعة.