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"A STUDY ON MECHANIZATION OF OIL SEED CROP"

Performance Evaluation of Some Planting Machines for Rapeseed Crop (Canola)

BY

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Dedication

To
My parents

To
My brothers

To
My sisters

To
My husband , my daughter and my son

To
My friends

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Abstract

canola brassica napus,l.)is one of the newly intodue crops in egepy. oilseed rape is one of important oil crops over the world. it has the third positon on the world oil prodution crops, sceond position in total wrold area for oil crops and the fifth in the wold international teade for crops.

the main purpose of the present study is evaluate the pneumatic planter and seed drill planting machinne to suitable to suitable for sowing rapeseed crop compared with traditional method as a suggestion soluion for incrasing the production of rapeseed crop in egypt.

the resudlts of the persent study led to the folloing points:-

- the gerinaion ratio of the pneumatic plantr was better thhan the seed drill machine under all planting speeds and planting spacing .
- the according to platting speed the pneumatic planter had higher uniformity comparing with the seed drill machine .
- under all planting speeds and peeds and planting the ettective field capactity and field efficiennсy of pneumatic planter was better than the actual field capacity and field efficency of drill machine.
- thefuel consumption (ralekw.) geadlly decreased as planting speed increased for all planting spacing.
- for all planting speeds the power requirement (kW) with pneumatic planter with higher then power requirement with seed drill machine.
- the wheel slip ratio gra dually mcreased as plantingspeedinvread for all plantng space.
- the total seed yield/plant was gradduall increased as plating speed increased for all planting spaing .

the total costs (L.E./h) was gradually increased as planting speed inceasd for all planting spacing.

1. INTRODUCTION

Canola (Brassica Napus,L.) is one of the newly introduced crops in Egypt. Canola introduced recently to contribute in reduction of salinity. Rape oilseed is one of the most important oil crops over the world. It has the third position on the world oil production crops, second position in total world area for oil crops and the fifth in the world international trade for crops. Rapeseed has a bright future in Egypt because of ability to grow in the new reclaimed lands under wide soil variation drought and salinity as revealed by ***Kandil et al. (1995)***. Canola cultivation is recommended for increasing total oil production to compensate the gap between consumption and production for edible oil. The majority of local edible production, in Egypt, which comes from cotton seed, did not cover the total needs of oil consumption. Canola has gained much attention in order to meet the increasing demand for oil.

The total planting area of rapeseed crop in Egypt reached about 444 fed. while the total seeds production of rapeseed reaches to about 332.4 Mg of seeds according to the Arab Agricultural Statistics ***(Yearbook of Agric., FAO, 2004).***

The annual consumption of oil in Egypt of bout 1.129 Tg while itproduce of about 13.55% (153 Gg.) from the total need and import of about 86.45% (976 Gg), according to Oilseeds situation and Outlook, 2002. So, Egypt costs of about 3.220 milliard Egyptian pound (LE.) to cover this deficiency.

To cover the shortage of oil requirement in Egypt, it must be increase the planting area of canola crops especially in the newly lands which can be grown individually and increasing cultivated area of oil crops as soyabeen, sunflower, maize, sesame and cotton.

INTRODUCTION

The problem of the planting process of rapeseed in lands includes the shortage of agricultural labors and lower productivity and accuracy of manual planting. Meanwhile using mechanical planting will increase the planting accuracy (planting density and depth), consequently will increase the canola production in addition to decrease the planting cost as recommended by previous researchers (***Uiger et al., 1993***) which indicated that the total requirement of human power was of about 32 man.hour/fed. Compared with 0.823 man.hour/fed* in mechanical planting. Therefore, using mechanical planting technique for planting canola in the newly lands is consider the first important factor to solve the manual planting problems and helps to increase the canola production in Egypt.

The main purpose of the present study is to evaluate the performance of pneumatic planter and seed drill planting machines to suit sowing of rapeseed crop comparing with traditional method as a suggestion solution to increase the production of rapeseed crop and area devoded to rapeseed crop in Egypt.

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* fed is an Egyptian unit of area and equal to 4200 m^2

2- Review of literature

2.1 Methods and equipment for planting seeds:

Mechael and Ojha (1966) and Klenine et al. (1985), indicated that the common methods used for sowing crops are as follows: broadcasting , dibbling seed dropping behind the plough, drilling , hill dropping , check-rowing and transplanting (Fig. 2-1).

They showed that **broadcasing** is scattering seeds on field surface, soon after broadcasting; they are covered by manipulating the soil and planking it over. Such crops are given inter culturing operations only by hand tools. A slightly higher rate of seeding is obtained by this method (Fig. 2-1_a)

Dibbling method means placing two or more seeds in holes made in the soil either by tools or by some implement. Dibbling of seed is only done for small plots and it is generally used for vegetable crops. Wheat crop gives a quite encouraging yield by dibbling; the seed rate is reduced by one-fifth or more (Fig. 2-1_b)

Seeding behind the plough in the furrow (Fig. 2-1_c) is used for large seeds like maize and peas. This method is also successfully used for wheat and barley since the depth of seeding is comparatively small. It is generally observed that seed rate is increased and the moisture content of the soil is kept slightly high.

The same authers pointed that **drilling** means dropping the seeds in the furrow through seed tubes. Some of the mechanically operated seed drills give a very high accuracy in metering the number of rows planted at a time, proper depth, spacing and the amount of sown seeds, and the covered area per day are higher than the other methods. For seed drilling, the disadvantage is only that mechanical seed drill may damage the seed and is likely to get clogged during operation (Fig. 2-1 $_d$)

In the hill dropping method, the seeds are dropped at a fixed height and spacing, not in a continuous stream. The distance between the plants in a row is constant, while the distance between rows is not necessarily the same as that between the plants in a rows (Fig. 2-1$_e$).

Check-rowing is the method in which the spacing between the rows is the same as that between the plants.

Transplanting of seedling is commonly done for paddy vegetable crops and flower plants.

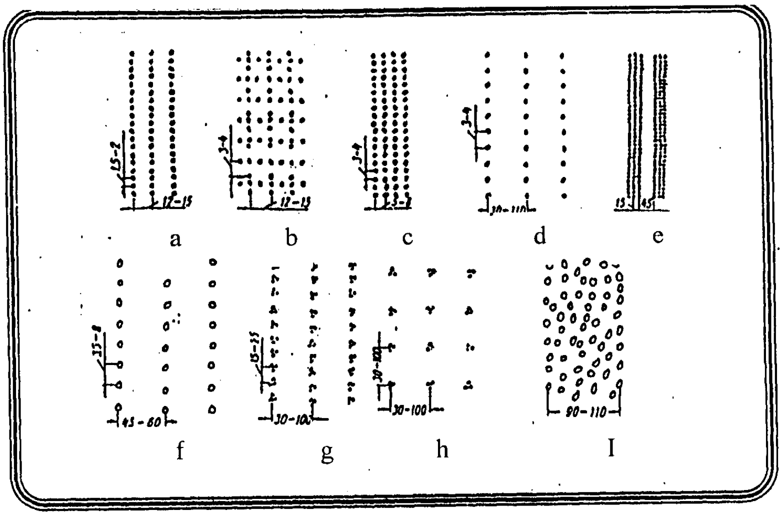


Fig. 2-1: Methods of sowing and planting (all dimensions in cm).

a-row sowing ; b- dibbling ; c-narrow row sowing ; d- wide row sowing ; e-strip sowing ; f-single grain sowing ; g – hill – drop sowing; h-square hill –drop sowing ; I-random sowing .
(klenin et al ., 1985)

Allen et al. (1983) conducted an experiment to compare air disk plate and placeless planter for metering sunflower. They studied seeding accuracy at varying forward speeds and with different size of graded seed plus pelted seeds. They showed that when planter speed with metering plates increased from 6.4 to 8.0 km/h, the seeding rate decreased by 15 and 35 %, respectively, for pelted and graded seeds. They added that, there was no speed effect with air - disk metering placeless metering was more accurate with large seeds than were other systems. They also showed that pelting of small seed increased seeding accuracy up to the level of medium - sized seeds in a growth chamber study. They concluded that, seedlings from pelted seed emerged sooner with medium soil water content. They also indicated that the clay seed coating can increase water imbibitions and speed germination under some soil water conditions.

El Shal (1987) tested a pneumatic planter to plant different kinds of seeds such as soybean, maize and sunflower under different plate speeds and different air suction pressure to investigate the uniformity distribution. He concluded that the pneumatic planter is too effective for all seeds and grains of different sizes and shapes under special suction pressure and feed plate speed to produce high uniformity of seeds distribution and high filling percentage.

Srivastava et al.(1993) showed that planting mechanisms and machine have been developed to permit and carry out any planting method. He mentioned that in the drill seeder where the seeds are metered from a hopper by a different types metering mechanisms past an adjustable gate. The seeds then enter a tube and fall by gravity to furrow which has been opened by a disk. The weight of the machine is carried on transport wheels. For all the seed drills the rotor element can be moved endwise to control the volumetric flow rate of seeds. Maximum flow rate occurs when the rotor element open entire width of the gate, while zero flow rate occurs when the non - rotating cut of covers the full gate width. The flow rate also varies with the rotational speed of the rotor element.

He decided that most precision planters included seed plates for metering seeds, pockets along the periphery of the plates were sized to match the seed dimensions, so that only one seed could sit in each pocket. As each pocket passed the seed tube, a spring - loaded knockout device would push the seed into the tube, plates were easily replaceable, and farmers kept set of plates to match each size of seed to be planted.

He added that in the pressure - disk planters the positive pressure in the seed reservoir is used to hold seeds in the pockets of the rotating seed plate. The pressure- disk planter has a separate seed reservoir and plate for each row. Gravity moves the seeds from the hopper to the metering unit, where differential pressure holds a seed in each cell. While each cell is close to the drop tube, a soft brush cuts off the air supply to the cell and the seed falls into the tube by gravity.

He also concluded that vacuum-disk planters are similar to pressure - disk metering, except that the pressure differential is supplied by creating a vacuum on the side of the seed disk opposite the seeds. Seeds from the hopper enter the seed reservoir, where vacuum created by a pump holds the seeds in the seed cells on the rotating seed disk. The vacuum is blocked as the cells reach a point above the seed tube and the seeds fall into the tube by gravity.

Imbabi (1996) studied the performance and productivity of mechanical planting equipment when planting sunflower seeds in flat and furrow soil under various field dimensions. He also studied the germination ratio, productivity and concluded that the planting by machine in flat soil surpassed the planting in furrow soil in all the mechanical criteria evaluation.

2.2 The function of seed planting machines:

FMO (1981) reported that the purpose of most planters and grain drills excluding the broadcast planter is to plant seeds evenly in rows or on beds. To do this in the desired manner, the planter must perform a number of important functions;

1- Open a furrow in the soil.
2- Meter the seed.
3- Place the seed.
4- Cover the seed.
5- Firm the seed bed around the seed.

Kepner et al. (1986) reviewed the function of a seed planter in depositing of seed in furrow in an acceptable pattern. They recommended that, the planter should not damage the seeds. Hence, the seeds should also have the proper size and shape for a given size of cell. They added that smooth seeds approaching spherical shape are best adapted to precision planting.

John (1989) reported that planting machine can be characterized by its components which actively engage the soil. Those components are used to perform seven machine functions as follows:

1- Soil and residue cutting.
2- Row preparation.
3- Soil opening for seed placement.
4- Firming uncovered seed.
5- Seed furrow closure and firming

6- Seed covering
7- Depth control.

2.3 Parameters affecting the seed flow:

Lovegrove (1968) reviewed that the function of the seed dispensing mechanism is to transfer seed from the hopper into the counter tubes at a pre-set rate synchronized with the ground wheel speed of the drill. The mechanism is driven by the land wheels of the drill through a train of drive employing cither gears or chains or both. The sowing rate must be accurately adjusted in spite of the widely differing sizes of the seeds commonly sown. This problem presents accounts for the many different types of seed - dispensing mechanisms available, four of which are cup feed , external force feed , internal force feed and centrifugal feed.

Shibon (1971) stated that the seed discharge increased as the gate opening increased. He showed that generally there was no significant effect for seed shaft speed on the seed damage for all values of the length of fluted wheel exposed. He added that, the seed discharge decreased as the speed of feeding shaft increased for a!' types of seeds. This reduction is linear for both the normal and reversed direction of operation of the feeding shaft

Chinnan et al. (1975) pointed out that smaller seed size resulted in more multiple drops, fewer skips, higher seed placement errors and lower average spacing. They added that as the level of seed in the hopper decreased the number of skips increased and average spacing increased. They showed also that manufacturing variations in seed plates resulted in highly significant differences in metering and seed placement accuracy's.

Hamad and Banna (1980) and Amin (1983) showed that the length of feeding - wheel mechanism , its speed , and transmission rotor have positive effect on the amount of sowing rate.

Wilson (1980) studied the errors in seed released from seed delivery mechanism to seed spacing distribution in the furrow. The factor with the most outstanding effect is the ratio between forward speed of drill and the speed of release points on the metering mechanism. When this ratio is unity, the release errors will have a minimal effect upon spacing distribution.

Culpin (l986) divided the metering mechanism types according to their location related to the seed box. The mechanism of the external force-feed drill (Fig. 2-2) consists essentially of a roller which rotates just below the seed box and drills seed from the bottom of the box, into hopper at the tops of the seed tubes. The seed box is a single compartment, and the rollers rotate in feed runs attached to the bottom of it.

He added that, in a simple type the mechanism provides a simple regulation of the seed rate for which no seed is delivered by the smooth part of the roller. In some machines the rollers are connected to the drive shaft by individual dog clutches, and coulters may be shut off as required by disengaging these clutches. He also cleared that, the internal force feed is especially efficient for sowing cereals. The feed mechanism consists of a shaft carrying a series of Hanged discs, the insides of the flanges being slightly corrugated. Each feed disc is housed in a casting which fits in the bottom of the seed box.

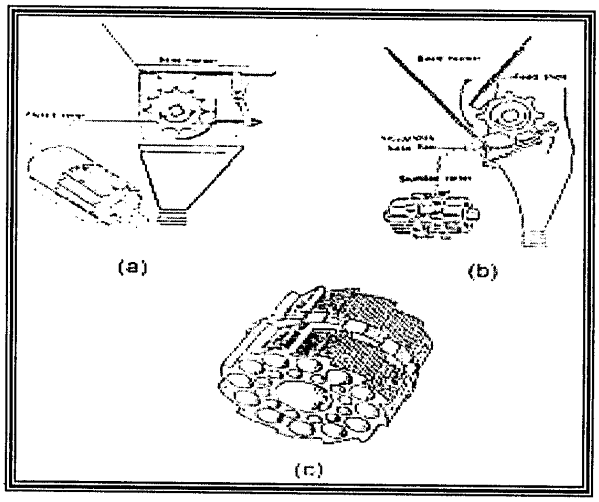


Fig. 2-2 : Drill feed mechanisms..

a) Studded roller feed; b) External (fluted roller) force feed
c) Flexible tinted roller force feed, used in conjunction with movable gear cassettes for seed regulation (Histair Bcltinson)

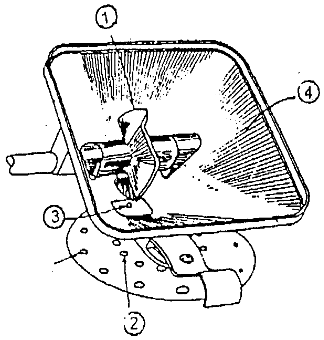
As the wheels rotate, the seed is drawn by the corrugations past baffles to a point outside the box, where it falls into the seed tube. One side of the flanges lies both the serration's and the clearance between them and the baffles are smaller than the other side. Either side may be used by adjusting the position of a hinged flap in the hopper, which covers either the course or the fine side of the feed run. It has been concluded that, this type of mechanism has the advantages of the force - feed drills and gives a more continuous flow of seed than the external -feed type. Its main disadvantage is that it is less adaptable than the external force feed type, being really suitable for sowing few crops apart from cereals.

Therefore; on a typical drill the baffle plates or feed gates can be set in any of three positions namely quarter open for small seeds , half- open for medium seeds , e.g. cereals, and three - quarters - open for large seeds.

Kepner et al. (1982) reported that metering the seed flow has two aspects. The first, metering rate refers to the number of seeds that are released from the hopper per unit time. Metering rate is important in any planter to ensure that the desired final plant population will be achieved. The second is that, seeds must be scintillated in precision planters to allow placement of seeds at uniform spacing in each row.

Mohsenin (1986) and Sitkei (1986) showed that seeds have different shapes and their flow may be affected by length of major axis. Other factors which may be considered in determining seed size are the weight of a seed, volume, specific gravity, moisture content, and number of seed per gram weight.

Srivastava (1990) showed that the oldest principle for metering seed is the variable orifice and this simple principle is still in use. The volumetric flow rate of seeds is regulated by changing the orifice size. An agitator is used above the orifice to prevent bridging of the seeds Fig (2-3).



1- Agitator.	2- Variable orifice.
3- Orifice.	4- Seed box.

Fig 2-3: Agitator to prevent seed bridging (Srivastava 1990).

He added that, the most popular system for seed metering in a drill is the fluted wheel (Fig-2-4). The fluted - wheel assemblies are positioned at the bottom of the seed hopper so that seeds can flow into the openings by gravity. The tinted wheel provides quasi-positive displacement metering, i.c, seeds in the flute openings are carried towards an adjustable gate as the tinted wheel rotates.

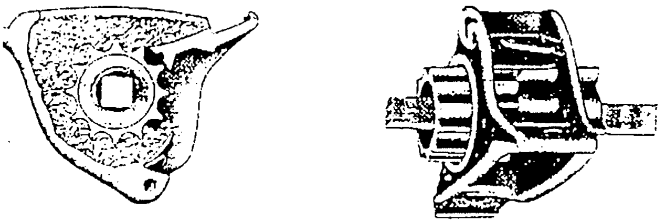


Fig 2-4: Thcjluid wheel metering mechanism (Srivastava ,1990)·

2.4 Effect of planting methods on crop yields related to canola crop:

Smith (1964) stated that there are number of factors that affect the germination of seeds and emergrence of seeding plants namely:

- Planting depth.
- Type and temperature of soil.
- Moisture content of seeds.
- Uniformity of distribution of the seeds.
- Type of seeds for dropping mechanism.
- Type of furrow opener.
- Prevention of loose soil getting under seeds.
- Uniformity of coverage.
- Type of covering device.
- Degree of pressing the soil around the seeds.
- Clean lines of the seed bed.
- Time of planting in relation to season.
- The good adjustment and skill attention of the operator.

El - Beheidi and Salem (1971) found that the highest yield of seeds (1.45 Mg /fed) and straw (1.38 Mg /fed) of Vicia Faba were obtained by sowing in double rows with plant 15cm apart. Number of pods and number of branches / plant were the highest in plots sown with single rows for plants 35cm apart.

Ishag (1971) reported that mean seed yield of Faba Bean was decreased from 1.19 to 0.98 Mg / fed with increased spacing between holes and increased from 1.0 to 1.18 Mg /fed with increasing number of seeds / hole .

El - Khunany (1972) planted Faba bean variety (Giza 2) and found that widening the distance between hills decreased both seeds and straw yields per fed. On the other hand, reducing the distance between hills as well as increasing the number of plants per hill more than one plant was associated with increasing the seed and straw yields per fed.

Hakam and Ibrahim (1973) found that the highest seed yield of Faba Bean resulted from sowing 2 seeds in each hill with 20 cm between hills and 30 cm between rows.

Christenson (1974) reported that the best seed yield of Held beans was obtained from 40 seeds in rows 12 or 24 cm apart. While, row - spacing of 45 cm reduced the yield by 46 %.

Wahby (1976) found that the area per seed affects the yield. To increase the yield it is required to have uniformity in seed horizontal distribution and a constant depth of planting. The suitable shape of area for each seed was found to be an equilateral triangle, because it resulted in unequal distance between seed or plants and equal area per plant.

El-Sheikh (1981) found that differences between the two seeding rates either 26 or 52 kg/fed were not significant for number or pods/ plant of Faba Bean. On the other hand the highest seed rate (52 kg seed / fed) increased seed and straw yields / fed and seed index (1000 seed mass) as compared with the lowest one (26 kg seed / fed).

Samir (1982) showed that the number of pods per plant of faba bean decreased as the plant density increased from 10 to 40 plants/m^2. He added that the highest yield / ha was obtained with the highest plant densities of 40 plants / m^2, which was sown at 20 cm apart on both sides of the ridge and two seeds in each hill.

Tebrugge (1983) conducted a laboratory experiment to study the effect of planting methods on the area covered by seeds. He treated the seed drill machine in three ways; the conventional way, without the furrow opener (i.e. band sowing method) and with small unit for distribution over area (i. e. band width sowing method). He found that the conventional method of drilling seed achieved 16 % covered area where dismounting the furrow opener gave covered area in the range of 24 - 64 %. However, using the seed distribution unit covered an area of 80-100%. In addition, he found that the percentage increase in crop yield was 16.1% for the band sowing and 22.3% for the hand width sowing compared with the conventional seed drilling.

Heege (1986) reported that the average percentage increase in crop yield were 4 and 7% for the band sowing and band width sowing method in crop yield compared with the conventional seed drilling.

Abd El- Wahab et al. (1987) studied the effect of mechanical planting and seeding rates on the yield and characteristics of lentil plants. The results revealed that the plant characteristic such as branches, pods, seeds yield and straw were highly affected by planting methods and rate of seeding. Under mechanical methods the yield of seed and straw increased by 30% and 16%, respectively as compared with manual method at a seeding rate of 35 kg/feddan. They gave the highest value in comparson with other different planting methods.

Ghonemo (1988) found that number of pods per plant in Faba bean decreased gradually as plant population increased. On the contrary seed and straw yields / fed, were increased significantly as the population increased.

Abo-Habaga (1992) reported that band width sowing method increased the seeding emergence 24.1% and also increased the percentage of the utilized area for root distribution per plant by 32% and consequently the crop yield by 17.3% as compared with drill sowing method.

Abo - Habaga (1994) found that when using the drill machine without furrow opener increased the percentage of utilized area for sowing with 33.75% (at conventional method was 19.55%). On the other hand, he indicated that the band sowing and the bandwidth sowing method decreased the number of grass weeds and also, the weed dry weight.

El - Hanafy (1997) found that band sowing method increased the utilized area for seeds, actual mean sowing area for each seed and root mass, while decreased weeds numbers and consequently increased the crop yield as compared with drill sowing method. Furthermore, the band sowing method eliminated the need of excess pulverization of seedbed which was necessary for the drill machine. This means saving energy and time for seedbed preparation.

2.5 Importance of mechanical planting:

Free (1970) reported that the grain yield of corn was greatly affected by the planting methods. However, the success or the failure of crop production system often depends on seed-bed condition, previous tillage operations, planting methods and tillage. This fact was corporations by ***Cannel and Ellis (1978)*** where reported that the different cultivation methods have an effect on soil conditions and plant root growth.

Hamad and Banna (1980) and Amin (1983) showed that the length of feeding- wheel mechanism, its speed , and transmission ratio have positive effect on the amount of sowing rate.

Erbach (1981) described the major planter requirements for conservation planting as: a) more seeds contact with soil, b) consistently cut plant residue, c) uniformly penetrate the soil, d) uniform of seed depth, and e) adequately seed cover.

Sharma et al. (1983) stated that using seed drill gives an increase of 12.5% in wheat yield and it reduces the time required for sowing by 40%, and the uniform placement of seed saves about 50% of its quantity.

Abo El- Ees (1985) showed that, the method of seed drilling is very effective due to its effect on uniformity of depth and spacing . It is well known that mechanical seed drilling leads to more uniform spacing and sowing depth resulting in higher yield. However , the statistical analysis for the mechanical seed drilling gave a significantly higher yield than the traditional hand method of sowing.

Kepner et al. (1986) reviewed the function of a seed planter in depositing of seed in furrow in an acceptable pattern. They recommended that, the planter should not damage the seeds. Hence, the seeds should also have the proper size and shape for a given size of cell. They added that , smooth seeds approaching spherical shape are best adapted to precision planting.

Abd Alla (1999) reported that, the sowing process is considered one of the most important agricultural operations. The art of placing seeds in the soil to obtain high germination ratio and healthy plants is most important objective to achieve highest yield. However, applying mechanization in planting crops by Egyptian farmers still limited because of the little number of available planters.

2.6 Planting accuracy.

Nave and Paulsen (1979) compared five seeder meters to determine the amount of soybean seed damage and accuracy of seed spacing. A fluted roller meter, an air disc meter, a single run feed computer, an air drum meter and a horizontal plate meter were used. Seed-quality comparisons were made, based on germination tests, tetrazolium tests, percentage of splits and percentage of seed coat cracks. Results showed that fluted roller meter provided the largest variation. However, there was no significant difference between the seed spacing accuracy of any meter tested.

Kepner et al.(1982) stated that the percent of cell fill for a planter is influenced by such factors as, the maximum of seed size in relation to cell size, the seed shape, the cell shape, the exposure times of a cell to seed in the hopper and the peripheral speed of the cell. They also, mentioned that the diameter or length of the cell should be about 10% greater than the maximum seed dimension, and the cell depth should be about equal to the average seed diameter or thickness. They also, added that most of seed damage was caused by the cut of device. The percentage of seed damage increases as the cell speed is increased.

Allen et al. (1983) investigated an experiment to compare air disk plate and less plate planter for metering sunflower. They studied seeding accuracy at varying forward speeds and with different size of graded seed plus pelted seeds. They showed that, when planter speed with metering plates was increased from 6.4 to 8.0 km/h, the seeding rate decreased by 15 and 35 % for pelted and graded seeds, respectively. They added that there was no speed effect with air - disk metering plate less metering was more accurate with large seeds than were other systems. They also showed that, pelting of small seed increased seeding accuracy up to the level of medium - sized seeds in a growth chamber study. They concluded that seedlings from pelted seed emerged sooner with medium soil water content; they also indicated that the clay seed coating can increase water imbibitions and speed germination under some soil water conditions.

Abo El-Ees (1986) stated that the emergence and stand pattern for cotton is more uniform at higher forward speeds. In other words, the seed drill should be operated at the highest practical forward speed in order to cut the costs and increase the yield.

Korayem et al. (1986) studied the effect of corn seed size in relation to cell size, cell speed and tractor forward speed on the accuracy and performance of mounted (CKHK-6) corn planter. Cell fill, seed damage, seed spacing and scattering were also studied. They found that seed size to cell size had an important effect. The accuracy of seed spacing, seed rate and damage, and increasing cell speed, generally, reduced cell fill while increased seed damage and seed spacing along the row.

Harb and Abdel-Mawla (1997) showed that the machine plants garlic cloves more uniformly at low forward speeds. At high forward speed above 3.0 km/h the percentage of unsuccessful fed increased to more than 20% and accordingly the mean number of seeds dropped per meter along the furrow decreased.

2.6.1 Germination percentage.

Nakra (1990) mentioned that there are many factors, which affect germination of seed such as:

1. Quantity of seed to be planted.
2. Depth at which seed has to be planted.
3. Type of soil
4. Uniformity distribution of seed in bed.
5. Type of furrow.
6. Type of covering device.
7. Type of seed dropping mechanism.
8. Distance between rows.

He also mentioned that there are other factors which also affect seed germination such as seedbed preparation, time of sowing or planting, watering of seed bed, temperature of soil, etc. which attained farmer ought to know.

Imbabi (1996) study the performance and productivity of mechanical planting equipment when planting sunflower seeds in flat and furrow soil under various field dimensions. He also studied the germination ratio, productivity and concluded that the planting by machine in flat soil surpassed the planting in furrow soil in all the mechanical criteria evaluation.

2-6-2 Seed scattering:

Erol (1971) and Bernacki et al. (1972) reported that the seed distribution in horizontal plan depends on lateral and longitudinal distribution patterns generated by the delivery mechanism.

Chinnan et al. (1975) studied the effect of planting speed on metering and seed accuracy. Their results indicated that the higher planting speed resulted in more skips, higher grains placement errors and higher average spacing. Meanwhile, the uniformity of grains in row depends on the performance of metering device of sowing machine.

Wilson (1980) mentioned that the accuracy of seed spacing requirements vary from crop to crop depending on the growth pattern of the crop, the harvesting requirements, the husbandry techniques used and the targeted mean spacing. The total variation or error in the seed spacing distribution produced by a spacing drill may be considered as the sum of a number of error components which occur at each stage of seed delivery.

Kupresanin (1984) showed that pneumatic seed drill gave better distribution of seeds within the row than mechanical drill. Also, sunflower seed yield significantly increased.

El-Awady and El-Said (1985) found that agitation improved uniformity of feed rates and increased them by the order of 10%. Agitation essentially reduced the ratio of missing iced.

El-Shal (1987) tested a pneumatic planter to plant different kinds of seeds such as soybean, maize and sunflower under different plate speeds and different air suction pressure to investigate the uniformity distribution. He concluded that the pneumatic planter is too effective for all seeds and grains of different sizes and shapes under special suction pressure and feed plate speed to produce high uniformity of seeds distribution and high filling percentage.

Adigboh and Akubuo (1991) concluded that increasing forward speed for two rows automatic Minister Yam planter increased effective field capacity, while decreased field efficiency. Also, they pointed out thar within-row plant spacing uniformity was influenced by planter forward speed. Generally, uniformity of planting spaces leads to good growth and increasing the yield.

Bahnasawy (1992) indicated that an increase in forward speed causes disturbance in seed-depth and seed spacing, slip percentage increase with speed and affects plant population and grain yield.

Metwalli et al. (1998) showed that by increasing planting forward speed both longitudinal and transverse scattering increased.

Moussa (1999) found that the percentage of seeds dropped per meter along the furrow decreased about 20% for the different crops by increasing operating speed. He also indicated that lateral and longitudinal deviation of seeds along the row increased by increasing operating speed and decreasing seed size.

Helmy et al.(2000) reported that for all planting machines and hill spacing values, increasing the forward speed tends to increase both longitudinal and transverse scattering values.

Imbabi and Omran (2002) developed a feeding device of single-row push type seeder to be used in sesame seeds planting. Their results indicated that the seed distribution in both sides of the drilled centerline was mainly affected by the ground wheel speed and increased as the speed increased, 100% of seeds were scattered in 9 cm on both sides of drilled center line.

Gomaa (2003) found that the longitudinal and transverse scattering increased by increasing planting forward speed for the two types of planters (pneumatic and mechanical). He also indicated that the mean values of longitudinal and transverse scattering in case of pneumatic planter were less than mean values of longitudinal scattering in case of mechanical planter.

Kamel et al. (2003) indicated that longitudinal and lateral scattering increased as the forward speed increased. They also indicated that the lower values of longitudinal and lateral scattering of sown wheat grains were obtained with the pneumatic seed drill compared with the mechanical seed drill under different levels of land preparation and sowing forward speeds.

2-7 Machine performance:

El- Awudy (1978) derived the service time per hectare in the form of a second order polynomial including the effects of operation, turnings and transportation between fields. Cost was consequently derived and found to decrease with the increase of holding size. Small machinery at any rate, were found to suit large holdings as much as large ones , but were superior in the case of small holdings

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 concluded a new relationship for predicting the effective field capacity for row- crop machines.

Kepner et aL. (1982) defined field capacity and efficiency of an implement as:

Theoretical field capacity of an implement is the area of field coverage that would be obtained if the machine were performed its function 100 percent of the time at the rated forward speed and always covered 100 percent of its rated width.

Effective field capacity is the actual average rate of field coverage by the machine, based upon the total field time.

Field efficiency is the ratio of effective field capacity to theoretical field capacity, expressed as percent. It includes the effects of time lost in the field and of failure to utilize the full width of the machine.

They reported that the effective field capacity of a machine is a function of the rated width of the machine, the percentage of the rated width actually utilized the speed of travel, and the amount of held time lost, and the skill of the operator.

Kaul and Egbo (1985) stated that the field capacity of a farm machinery is influenced by many factors, some of which arc within the control of the farm manager to obtain maximum field capacity. However in practice this is not possible because:

- It is generally impossible to utilize the full width of a machine without any overlap.

- It is not always possible to work at the recommended speed due to the condition of the field, the judgment and skill of the operator, and the amount of power available. Considerable time is lost during turning at the ends of rows, in minor breakdown and the lubrication of the machine, thus it is impossible for the machine to work effectively all the time.

Abdel - Mageed (1986) reported that the width of machine has a significant effect on the field efficiency and that effect increased with decresing machine width.

Zhengping et al. (1986) used modeling relationship for machinery performance which was based upon machinery management standards published by ASAE. The model examined the effect of variable machine width on time and fuel use when given a machine type, tractor power and set of field conditions. They found that, the matching of machine width and tractor powers have an important effect on the work time and fuel requirements per unit of agricultural area.

ASAE (1989) standards showed that the field efficiency decreased by increasing forward speed and would consider that the field efficiency is the ratio of the productivity of a machine under field condition to the theoretical maximum productivity.

Abdel- Mawgood (1990) studied the performance of different planting machines (seed drill and planter) in sunflower planting when working under various conditions of speed and size of holding .

He showed that comparing field capacity data per one meter width of the planting machines (fed/h.m) , the maximum value of it during planting by using the seed drill was :

2.6 (fed / h) ÷3 (m) = 0.867 (fed / h.m)

He added that the maximum field capacity per one meter width of the planter was :

2.07 (fed /h) ÷ 2.4 (m) = 0.863 (fed /h.m)

This clarifies that the seed drill field capacity is higher than that of a four row planting machine. This may be due to the excess planter's ridgers which caused excess weight, also the high soil resistance on these ridgers during operation . This caused less speed and consequently less field capacity than that of the seed drill

Helmy et al. (2000) studied the performance evaluation of some sugar beet planting machine. They indicated that, hill spacing had no effect on the effective field capacity and field efficiency. However, field efficiency increased by decreasing machine forward speed.

Emara et al.(2002) indicated that increasing planting forward speed of pneumatic planter during corn planting operation lead to decrease planter efficiency, fuel consumption (l/fed.), and energy requirement, while field capacity and power consumed are increased.

Gomaa (2003) compared the performances of two types of planters (pneumatic and mechanical planter) in cowpea planting. He found that, the values of field efficiency of mechanical planter were higher than those of pneumatic planter at all planting forward speeds. The highest values of field efficiency were 90.55 and 87.78%, respectively, for mechanical and pneumatic planters. Also, the values of field capacity increased by increasing operating forward speed.

Kamel et al. (2003) studied the effect of some operating factors on the uniformity of seeds distribution and planting accuracy of wheat crop using pneumatic seed drill comparing with mechanical seed drill. They found that the effective field capacity increased and the field efficiency decreased as the sowing speed was increased for both types of seed drill under all land preparation levels.

2-8 Wheel sleep ratio:

Lando (1990) studied the interaction of soil moisture content (m.c) and ploughing depth. The moisture content values were 10.15, 20.25 and 30 % at ploughing depth of 10, 15 and 20 cm using a 4 wheel drive and 45 hp tractor. Slip was lowest at 15 % and highest at 25 and 30 % soil moisture content cores pending to 20 cm depth. Slip did not differ significantly at 10 , 15 and 20 % moisture content while it was less at 15 than at 10 % moisture content due to lower draught resistance .

Verma and Guruswamy (1995) studied the effect of different levels of inflation pressures (83 and 110 k P_a), soil moisture (13,15 and 17 %) and drawbar loads (1.96 to 9.79 kN) on tractive performance of 2 wheel drive tractor in silty clay loam soil under 3 surface conditions (unploughed with paddy stubble, ploughed and prepared seedbed conditions). The study indicated that the slip and tractive efficiency were significantly influenced by all the above variables. The slip increased with the increase of pull, increased marginally with the increase in inflation pressure and decreased with reduced soil moisture content. High tractive efficiency was obtained at lower levels of slip in the range of 10 to 20 %. Higher tractive efficiency occurred at a gross traction ratio of 0.4 to 0.5. Tractive efficiency increased marginally with an increase in inflation pressure and decreased with increasing moisture content.

Poje (1997) studied the measurement of pulling force, torque on drive wheels, tractor speed and passage with and without wheel slip. The use of energy for soil tillage was expressed by specific work. A greater part of the power consumed (42.3 - 57.7 %) was required for the control of rolling resistance and slip of drive wheels. The plough used 41 % more power per meter of working width than the disc harrow and 60 % more than seedbed preparation equipment. Energy consumption per unit volume of tilled soil was approximately the same while considerable more energy per unit surface area was needed by the plough.

2.9 Canola yield and quality:

Kolsarici and Er (1988) evaluated four canola cultivars at three densities. They found that seed yield (2.53 Mg/ha) was obtained with grant cultivar. Plant height ranged from 170.2 cm grant to 119.3 cm for Err cultivar. They also found that seed index (1000 seed mass) ranged from 4.5 g in Err to 5.59 in grant cultivar.

Singh and patra (1989) in canola found that PT30 cultivar gave the highest seed yield /ha (660.7 kg/ha) and T9 cultivar showed the greatest stability, but had an average seed yield of only 576.18 kg/ha. M27 cultvar was the earliest flowering.

Kandil et al. (1995) found that plant height, number of branches/plant; seed index (1000-seed mass) and seed oil content were significantly affected by cultivars.

Said and Keshta (1999) reported that canola cultvars markedly differed in number of days to 50% flowering, plant height, number of branches/plant, seed yield/plant , seed yield/fed, straw yield/fed, seed oil content and seed oil yield/fed. Serw4 and Pactol cultivars in number of days to 50% flowreing.

2-10 Planting cost:

Bowers (1975) mentioned that, total cost of performing a field operation includes charges for the implement, the tractor power utilized and labors. Implement and tractor costs are divided into two categories. Fixed costs and variable costs. Fixed costs are related to machine ownership and occur regardless of whether or not the machine is used, and include depreciation, interest, taxes, insurance, and hand shelter. Operating costs are directly related to the amount of use and include repairs and maintenance, fuel and lubricants and labor.

Culpin (1986) estimated depreciation for established machines with many moving parts, e. g. tractor, combines, balers and forage harvesters, based on average annual fall in value as percent of new price. He also estimated annual cost of spares and repairs as a percentage of new purchase price at various levels of use . He stated a tendency for repair costs to increase with age as the depreciation falls , but up to the end of the fourth harvest.

Roth et al. (1982) classified the machinery costs into two groups:

a) Fixed costs are independent of machine use and occur whether the machine is used or not. Fixed costs are also referred to as the cost of owning the machine. Each of the fixed costs is estimated on a calendar year or annual basis. The fixed costs are described as follows

1- Depreciation. 2- Interest on investment.

3- Taxes. 4- Shelter. 5- Insurance.

b) Variable costs are frequently used to describe the operating costs. Each of the variable costs will be figured on an hourly basis. The variable or operating costs are listed as follows:

1 - Repair and maintenance. 2- Fuel.

3- Labor. 4-Lubrication.

Kaul and Egbo (1985) stated that machine costs can be worked out on the basis of two items:

1- Fixed costs. 2- Operating costs.

There are three different ways to calculate depreciation as follows:

a) Straight-line depreciation.

b) Sum of the digits depreciation.

C) declining balance depreciation.

Anon (1986) concluded that in terms of Egyptian bulb production from sets, the cost of manual planting is very high, it is 6.88 times as much as that of mechanical planting by "Joen" planter and 30.19 times as much that of "Hassia" planter.

3. MATERIALS AND METHODS

Experiments were carried out at Gemmiza Agricultural Research Station, Agricultural Research Center (ARC) during the canola growing season of 2005/2006 , with Canola Serw 4 variety. The experiments were conducted to study the factors affecting on the planting accuracy and uniformity of pneumatic planter and seed drill machine to select the optimum mechanical planting condition for Canola crop. The experimental area 1.5 feddan.

The soil of the experimental area was clay in texture. The mechanical analysis for the experimental sites is given in Table 3-1:

Table 3-1: Mechanical analysis of the experimental soil.

Clay, %	Silt, %	Sand, %	Texture	CaCO3	Organic matter, %
53.32	17.63	29.05	Clay	1.3	1.71

The experimental design was split split plot design with three replication. The main plots were designated to the two types of planting machine while four different levels of planting speed and plant spacing were randomely distributed in the sub-sub plots.

A- Main plots:

Two types of planting machine:

A_1- Pneumatic planter and

A_2- Seed drill.

B- Sub- plots:

Four different levels of planting speed.

B_1- 3.21 km/h,

B_2- 4.25 km/h,

B3- 5.50 km/h and

B4- 6.50 km/h.

C- Sub sub- plots:

Three different levels of plant spacing.

C_1- 5 cm. between hills,

C_2-10 cm. between hills and

C_3-15 cm. between hills.

All plots were prepared by using chisel plow (twice)+disk barrow (twice)+ mechanical scraper Phosphours fesitilizer was applied in the from of calcium super phosphate (15.5% P_2O_5) ate rate of 200 kg/fed. During land preparation, Nitrogen fertilizer in the from of Urea (46.5%) was applied as recommend dose. Irrigation, weed control and hoeing were the same for all treatments as usually recommended for Canola crop.

3. 1: Planting machine:

Two different sowing machines were used in the present study: Pneumatic planter and seed drill as shown in Figs. 3.1 and 3.2, respectively. Their specification are summarized in Table 3-2.

Table 3-2: The specification of the sowing machines.

Specification	Pneumatic planter	Seed drill
Model.	Mono air 80	Tye
Type.	Mounted	Mounted
Source.	Germany	U.S.A
No. of rows.	4	20
Working width, m.	2.4	3
Row spacing in planting, cm	50	50 (Three adjacent rows were locked)
Seed hopper capacity, kg.	12 per unit	
Sours of metering.	Air	Ground wheel
Control	Hydraulic	Hydraulic
Mass, kg	500	700

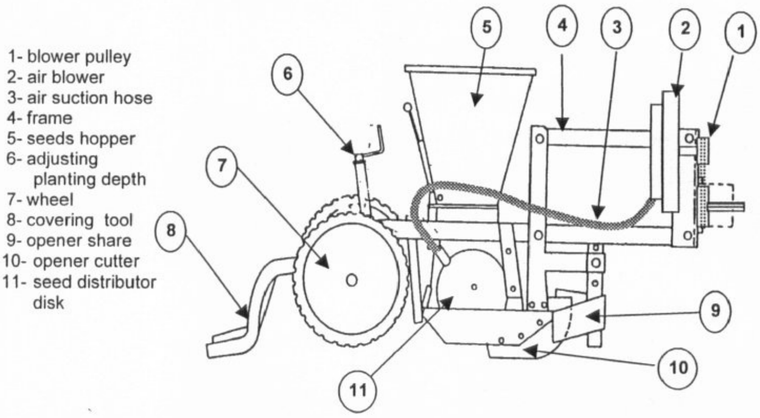


Fig. 3.1: Schematic diagram for pneumatic planter machine (mono air).

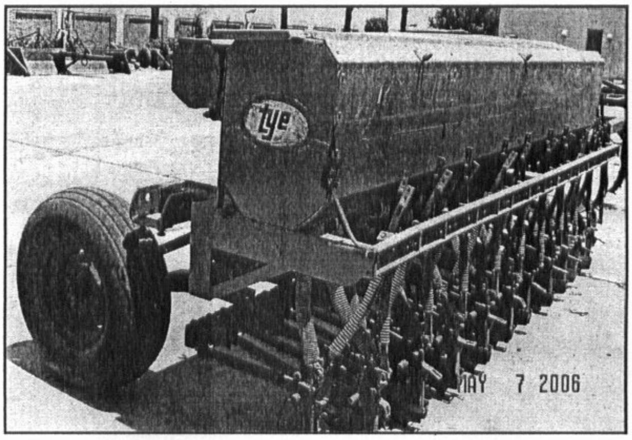


Fig. 3.2 : Seed drill planting machine.

3.2: Tractor:

A Nasr 65 hp (48.5 kw) tractor was used to pull the two machines during carrying out the experiments. The technical specification of the tractor are shown in Table 3-3.

Table 3-3:Technical specification of Nasr tractor.

Type	**Nasr**
Engine model	DM34
Number of cylinder	4
Fuel type	Diesel
Mass, kg	2255
Length, cm	332
Width, cm	190
Horse power at 2300 rpm, kW (hp)	48.5 (65)
Maximum engine speed, rpm	2400.
Gears No.	6 forward, 2 reverse
Diameter of P.T.O., cm	3.49

3.3: Measurements:

3.3.1:Germination ratio:

The germination ratio (G_r) was determined according to ***Imbabi (2001)*** by using the following formula:

$$G_r = \frac{N_p}{N_s} \times 100 \quad ,\% \qquad \text{3.1}$$

where :

N_p = Number of Canola plants within a length of 10 m. and

N_s = Number of Canola seeds delivered within the same length.

3.3. 2: Planting uniformity and accuracy:

The sowing accuracy includes longitudinal and lateral scattering, and distribution uniformity were determined and measured in 10 m long with three replicates as follow:

3.3.2.1- Seed scattering:

Longitudinal and lateral seed scattering (distribution) were determined by measuring the plants spacing in each treatment. The seed longitudinal and lateral scatterings were calculated from the following formula ***(Steel and Torrie, 1980)***

$$\text{Scattering}=\sqrt{\frac{\text{Sum of saquare of variance of seed scattering from its mean}}{\text{Number of hills}}} \quad \ldots\ldots\ldots\ldots\ldots 3.2$$

3.3.2.2- Uniformity of plant distribution (Coefficient of uniformity)

The plant distribution was analyzed to determine the coefficient of variation (CV) of plants space according to the following formula:

$$\text{CV}=\frac{\text{SD of plant spacing}}{\textit{Average}\text{ plant spacing}}\times 100 \ ,\% \quad \ldots\ldots\ldots\ldots\ldots\ldots 3.3$$

where:

SD = is the standard deviation $=\sqrt{\frac{(S-S^{-})^2}{n}}$,

S = on-row spacing, cm;

S^{-} = average on-row spacing, cm and

n = number of sample.

Logically laws of CV values represent more uniformity (UH)

UH = 100 ± CV%

3.3.3: Field capacity and efficiency.

Theoretical field capacity (T.F.C.) was calculated as fallows:

$$T.F.C. = \frac{W \times S}{C} \text{ ,fed/h} \quad \ldots\ldots 3.4$$

Where:

W = the working width of implement, m;

S = average working forward speed, km/h and

C = constant.

However the effective field capacity (E.F.C.) was calculated as follows:

$$\text{E.F.C.} = \frac{1}{\text{Effective planting time, h/fed.}} \text{ ,fed/h} \quad \ldots\ldots 3.5$$

While the field efficiency (η_f) was calculated by using the following formula:

$$\eta_f = \frac{\text{E.F.C.}}{\text{T.F.C.}} \times 100 \quad \ldots\ldots 3.6$$

3.3.4: Fuel requirement, l/kW.fed.

Fuel requirement was determined by measuring the volume of the fuel consumed during planting operation. It was measured as follows:

The fuel tank is filled to full capacity before and after the test, the amount of fuel required to refueling the tank with respect to time and power after the test is the specific fuel consumption.

This amount was measured by using a graduated cylinder.

$$S \cdot F \cdot C = \frac{F}{t \times kW} \times C \text{ , l/kW.h} \quad \ldots\ldots 3.7$$

Where:

S.F.C = specific fuel consumption, ,l/kW.h;

F = volume of fuel consumed during the test, cm^3;

t = test time, sec and

C = constant= 3.6

While the Fuel requirements per feddan (F.R.) will be as follows :

$$F.R = \frac{S.F.C}{EFC}, \text{ l/kW.fed.} \quad \ldots\ldots 3.8$$

3.3.5: Power requirements.

The power consumed by the planters was calculated by measuring fuel consumption during planting operations for different treatments under study. The following formula was used to estimate power consumption (*EP*) by the planters according to ***Embaby (1985).***

$$EP = \left(F_c \times \frac{1}{60 \times 60}\right)\rho_f \times L.C.V. \times 427 \times \eta_{th} \times \eta_m \times \frac{1}{75} \times \frac{1}{1.36}, \quad kW \ldots\ldots 3.9$$

where:

F_c = fuel consumption, *l/h;*

ρ_f = density of diesel fuel *(0.85 kg/l),*

$L.C.V.$ = lower calorific value of diesel fuel *(10000 kcal/kg),*

427 = thermo-mechanical equivalent, *kg.m/k cal;*

η_{th} = thermal efficiency of diesel engine, (40%)*and*

η_m = mechanical efficiency of diesel engine, (80%).

3.3.6: Wheel slip:

Wheel slip percentage was calculated according to the following formula ***(Srivastava, 1990)***

$$S = \frac{L_1 - L_2}{L_1} \times 100 \quad \ldots\ldots 3.10$$

Where:

L_1 = distance of 10 revolutions for machine wheel on farm road, m and

L_2 = distance of 10 revolutions for machine wheel on the field, m

3.3.7: The total yield (Mg/fed):

The yield of each plot was measured to study the effect of above mentioned factors on rapeseed crop. A frame of 1 m^2 for measuring the yield was used. The frame was placed randomly one time in each of the plots. The yield of the crop located within the frame border lines was measured. The average number of branches, grain yield and straw yield were calculated in all treatments in kg/fed.

3.3.8: Planting cost:

The cost of planting operation was estimated and calculated according to the equation given by ***El-Awady (1978)*** as follows:-

$$C = \frac{P}{h}\left(\frac{1}{L} + \frac{i}{2} + a + r\right) + (0.9W \times F \times U) + b \quad \text{.........................3.9}$$

Where:

C = cost per hour of operation, (LE/h),
P = estimated price of the machine, (LE),

h = estimated yearly hour operation,

L = life expectancy of the machine,

i = annual interest rate,% ;

a = annual taxes and overheads,% ;

r = annual repair and maintenance rate, %;

0.9 = a correction factor for rated load ratio and lubrication,

W = engine power, (hp),

F = specific fuel consumption, (l/hp.h),

U = fuel price, (0.6 LE/l) and

b = hourly labor wage, (3 LE/h).

Table 3-4: Cost assumption.

Items	p	h	i	L	a	r
Tractor	80000	1000	0.1	10	0.02	0.18
Pneumatic planter	15000	500	0.1	5	0.02	0.1
Seed drill	10000	500	0.1	5	0.02	0.1

P = estimated price of the machine, (LE),
h = estimated yearly hour operation,
i = annual interest rate,% ,
L = life expectancy of the machine,
a = annual taxes and overheads,% ,
r = annual repair and maintenance rate, %,

3.3. 9: Statistical analysis

The experimental treatments were arranged in split-split plot experimental design, with three replicates. The main plots were machine types and the sub plots were planting speed, while the sub-sub plots were plant spacing. The obtained experimental data were statistically analyzed using the split-split-plot design program in computer division.

4-RESULTS AND DISCUSSION

4.1: Effect of planting speed on the germination ratio, %.

The obtained results recorded in Table A-1 in Appendix A and illustrated in Fig. 4-1 show the effect of planting speed on the germination ratio (%) for both types of planting machines at different plant spacing.

In general, the germination ratio was gradually decreased as planting speed increased for all planting space. Also, the results indicated that when the planting speed increased from 3.21 to 6.5 km/h, the germination ratio decreased for the pneumatic planter from 99.20 to 86.70%, from 94.65 to 85.00% and from 90.31 to 80.34% at planting spacing 5, 10 and 15 cm, respectively Also, for seed drill planting machine it decreased from 97.30 to 84.76 %, from 92.42 to 81.52% and from 89.10 to 79.03% at planting spaces 5, 10 and 15 cm, respectively. This can be attributed to the fact that at high speeds some of the seeds were left uncovered. Also, with high speeds, plate cell of feeders filling percent decreased, and high losses percentage may be referred to the insufficient depth and recovery of seeds or seed damage.

Also, the data show that when the planting space increased the germination ratio decreased, increasing planting space from 5 to 15 cm the germination ratio decreased from 99.2 to 90.31%, from 95.76 to 86.5%, from 91.51 to 85.10% and from 86.70 to 80.34% for the pneumatic planter at planting speed of about 3.21, 4.25, 5.50 and 6.50 km/h, respectively. Also, it was decreased from 97.30 to 89.10%, from 92.75 to 85.43%, from 89.67 to 82.53% and from 84.76 to 79.03% for seed drill machine at the same planting speeds, respectively.

RESULTS AND DISCUSSION

Table 4.1 : Different characters as affected by machines, speeds and plant spacing.

Main effects and interactions	Germination ratio	uniformly	Field efficiency	Field capacity	fuel requirement.	Slip ratio	,Yield/plant	Seed yield
Machine (A):								
A_1	89.71 a	90.207 a	71.51 a	2.089 a	7.43 a	8.667 a	32.242 a	1.117 a
A_2	87.72 b	87.72 b	65.53 b	1.879 b	6.88 b	8.21 b	31.359 b	1.095 b
F. test	*	*	**	**	*	*	**	N.S
Speed (B) :								
B_1	93.83 a	90.422 a	76.66 a	1.563 c	6.373 c	6.83 d	28.63 c	1.192 a
B_2	90.68 a	89.937 a	69.65 b	1.858 b	7.028 b	7.97 c	30.81 b	1.109 a
B_3	87.48 b	88.370 b	66.00 c	2.105 b	7.305 b	8.877b	32.77 b	1.046 b
B_4	82.89 c	86.860 b	61.90 d	2.446 a	7.920 a	10.08 a	34.99 a	1.078 b
F. test	**	**	**	**	**	*	**	*
Plant space (c):								
C_1	92.21 a	93.391	67.18	1.954 b	7.23	8.969 a	30.05 c	1.218 a
C_2	89.16 b	89.009	68.61	1.992 ab	7.112	8.519 a	31.91 b	1.103 b
C_3	84.79 c	84.292	69.86	2.033	7.128	7.835 b	33.44 a	0.997 c
F. test	**	**	**	**	N.S	**	**	**
Interaction								
A × B	N.S	N.S	**	**	N.S	N.S	N.S	N.S
A × C	N.S	*	**	N.S	N.S	N.S	N.S	N.S
B × c	*	N.S	**	N.S	N.S	N.S	**	N.S
A × B × C	N.S	N.S	**	N.S	N.S	N.S	**	N.S

A_1 = Pneumatic planter A_2 = Seed drill
B_1 = 3.21 km/h B_2 = 4.25 km/h B_3= 5.50 km/h B_4 = 6.50 km/h
C_1 = 5 cm C_2= 10 cm C_3= 15 cm
* =significant at 5% level *= significant at 1% level N.S. = not significant

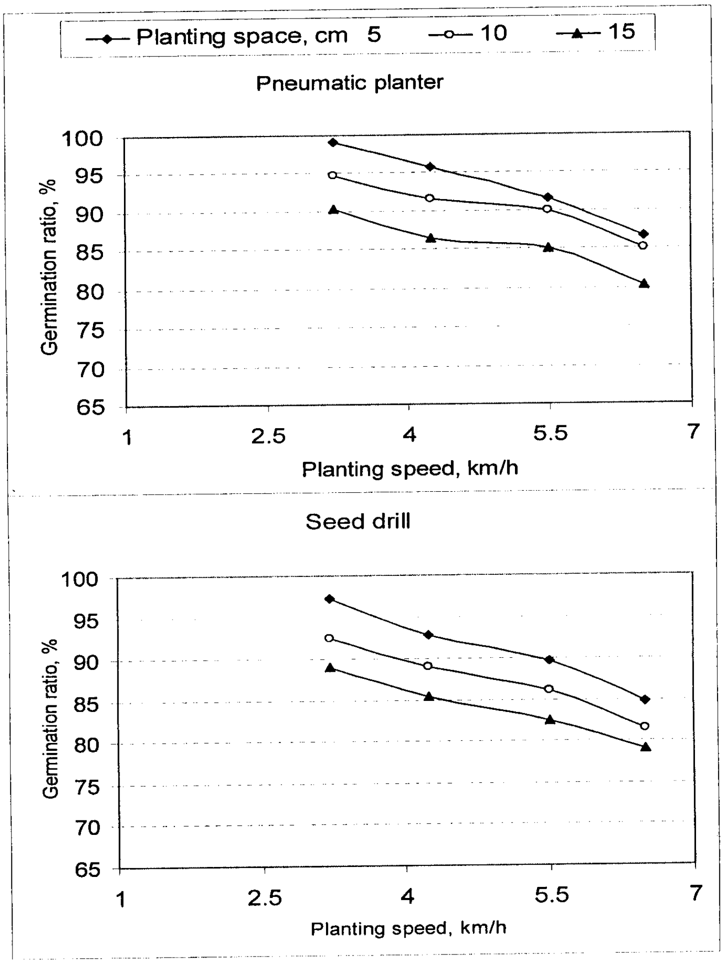


Fig.4-1: Effect of planting speed and machine type on germination ratio at different planting space for pneumatic planter and seed drill.

The results indicated that the germination ratio of the pneumatic planter was better than the seed drill machine under all planting speeds and planting spaces.

The interaction between speeds and plant spacing on germination ratio character recorded in Table 4-2.

Table 4-2: Effect of the interaction between speeds and plant spacing on germination ratio character.

Speed treatment	Plant spacing		
	C_1(5 cm)	C_2 (10 cm)	C_3 (15 cm)
S_1 (3.21 km/h)	98.25 a	93.53 bc	89.71 c-e
S_2 (4.25 km/h)	94.26 ab	91.81 b-d	85.96 e-g
S_3 (5.50 km/h)	90.59 b-d	88.03 d-f	83.82 f-h
S_4 (6.50 km/h)	85.73 e-g	83.26 gh	79.68 h

S_1 = (3.21 km/h) S_2 = (4.25 km/h) S_3 = (5.50 km/h) S_4= (6.50 km/h)

4.2: Effect of planting speed on the uniformity of seeding:

The obtained results recorded in Table A-2 and illustrated in Fig. 4.2 show the effect of planting speed on the uniformity of seeding for both type of planting machines at different plant spacing.

In general, the uniformity of seeding was gradually decreased as planting speed increased for all plant spacing. Also, the results indicated that when the planting speed increased from 3.21 to 6.5 km/h, the uniformity of seeding decreased for the pneumatic planter from 96.12 to 93.02, from 92.13 to 88.52% and from 86.50 to 83.40% at plant spacing 5, 10 and 15 cm, respectively. And it was decreased from 93.91 to 89.69%, from 89.62 to 85.51% and from 84.25 to 81.02% at planting space 5, 10 and 15 cm, respectively, for seed drill planting

The data indicated that when plant spacing increased from 5 to 15cm the uniformity of seeding decreased from 96.12 to 86.50%, from 96.00 to 85.67%, from 95.06 to 84.63% and from 93.02 to 83.40% for the pneumatic planter at planting speeds 3.21, 4.25, 5.50 and 6.50 km/h, respectively. While it was decreased from 93.91 to 84.25%, from 92.32 to 83.21%, from 91.01 to 82.32% and from 89.69 to 81.02% for seed drill at the same planting speeds, respectively.

The results indicated that according to planting speed the pneumatic planter had higher uniformity comparing with the seed drill.

The interaction between machines and plant spacing on uniformity character recorded in Table 4-3.

Table 4.3: Effect of the interaction between machines and plant spacing on uniformity character.

Plant spacing	Machine	
	M1	M2
C_1	95.05 a	91.73 b
C_2	90.52 b	87.50 c
C_3	85.05 d	83.53 d

C_1= 5 cm C_2= 10 cm C_3= 15cm

M_1= pneumatic planter M_2= seed drill

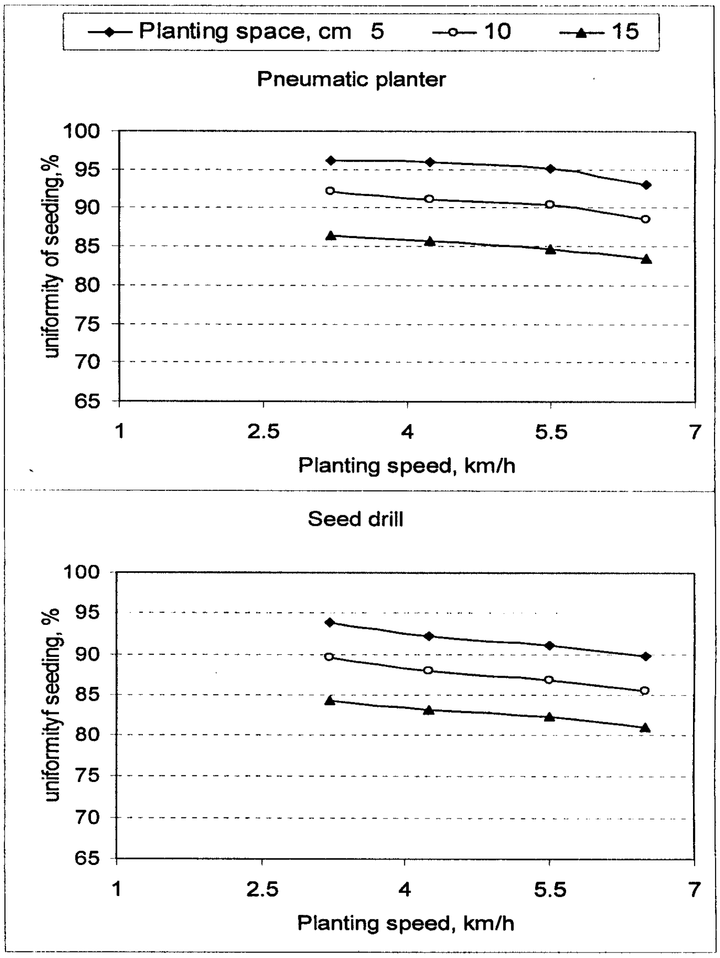


Fig.4-2: Effect of planting speed and machine type on uniformity (%) of seeding at different planting spaces for pneumatic planter and seed drill.

4.3: Effect of planting speed on the actual field capacity and field efficiency.

The obtained results recorded in Tables A-3 and A-4 and illustrated in Figs. 4-3 and 4-4 show the effect of planting speed on the actual field capacity and field efficiency for both type of planting machines at different plant spacing.

In general, the actual field capacity was gradually increased and the field efficiency decreased as planting speed increased for all plant spacing. This may be due to the increasing rate of the actual field capacity was smaller than the increasing rate of the theoretical field capacity.

Also, the results indicated that when the planting speed increased from 3.21 to 6.5 km/h, the actual field capacity (fed./h) increased for the pneumatic planter from 1.56 to 2.59, from 1.58 to 2.62 and from 1.61 to 2.69 at plant spacing 5, 10 and 15 cm, respectively. And it increased from 1.5 to 2.24, from 1.54 to 2.26 and from 1.56 to 2.29 at planting space 5, 10 and 15cm , respectively for seed drill planting machine. Also, the results indicated that when the planting speed increased from 3.21 to 6.5 km/h, the field efficiency decreased for the pneumatic planter from 76.74 to 65.15, from 77.72 to 66.42 and from 79.17 to 67.69 at planting space of 5, 10 and 15 cm, respectively. Also, it decreased from 73.83 to 56.79, from 75.77 to 57.29 and from 76.74 to 58.05% at planting spaces of 5, 10 and 15 cm , respectively, for seed drill and planting machine.

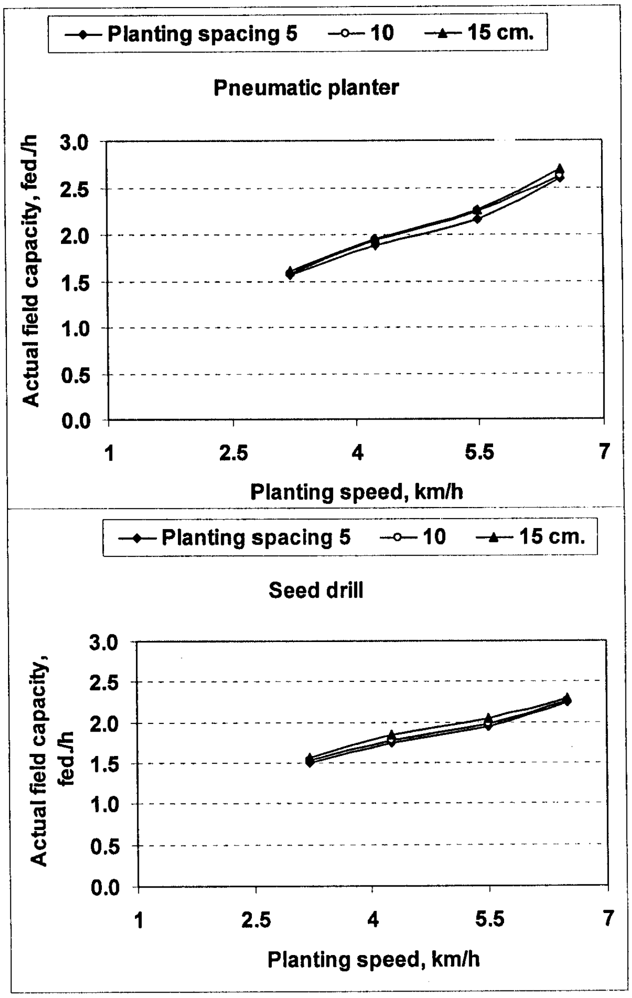


Fig.4-3: Effect of planting speed and machine type on actual field capacity at different planting space for pneumatic planter and seed drill.

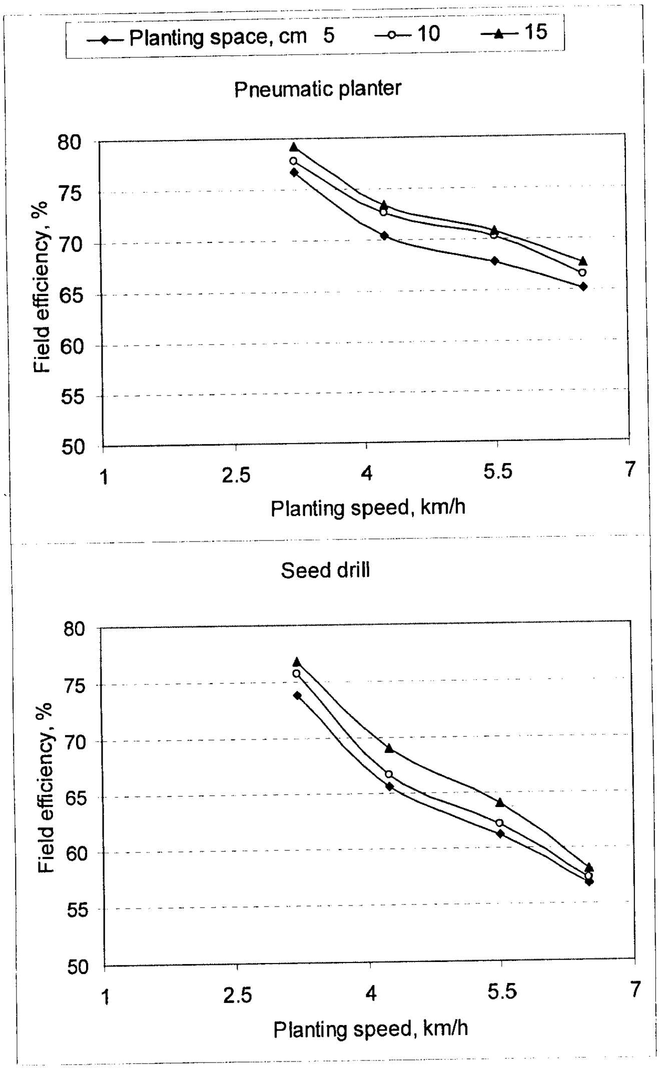


Fig.4-4: Effect of planting speed and machine type on the field efficiency at different planting space for pneumatic planter and seed drill.

The interaction between machines and speeds on field capacity and field efficiency character recorded in Tables 4-4 and 4-5.

Table 4.4: Effect of the interaction between machines and speeds on field capacity character.

Speed treatment	Machine	
	M1	M2
S_1	1.583 de	1.543 e
S_2	1.927 b-d	1.790 c-e
S_3	2.220 b	1.990 bc
S_4	2.628 a	2.263 b

S_1 = (3.21 km/h) S_2 = (4.25 km/h) S_3 = (5.50 km/h) S_4= (6.50 km/h)

M_1= pneumatic planter M_2= seed drill

Table 4.5: Effect of the interaction between machines and speeds on field efficiency character.

Speed treatment	Machine	
	M1	M2
S_1	77.88 a	75.45 a
S_2	72.19 b	67.11 cd
S_3	69.59 bc	62.41 e
S_4	66.42 d	57.38 f

S_1 = (3.21 km/h) S_2 = (4.25 km/h) S_3 = (5.50 km/h) S_4= (6.50 km/h)

Also, data indicated that when plant spacing increased from 5 to 15cm the effective field capacity increased, for the pneumatic planter from 1.56 to 1.61, from 1.88 to 1.96, from 2.16 to 2.26 and from 2.59 to 2.69fed/h at planting speed 3.21, 4.25, 5.50 and 6.50 km/h, respectively. While it increased from 1.5 to 1.56, from 1.75 to 1.84, from 1.95 to 2.04 and from 2.24 to 2.29fed/h for seed drill planting machine at the same of planting speeds, respectively. Also, for the pneumatic planter the field efficiency increased from 76.74 to 79.17, from 70.45to 73.43, from 67.71 to 70.21 and from 65.15 to 67.69 % at all planting speeds, respectively. While it increased from 73.83 to 76.74, from 65.61 to 69.00, from 61.15 to 64.00 and from 56.79 to 58.05% for seed drill planting machine at all planting speeds, respectively.

The interaction between machines and plant spacing on field efficiency character recorded in Table 4-6.

Table 4.6: Effect of the interaction between machines and plant spacing on field efficiency character.

Speed treatment	Machine	
	M1	M2
C_1	70.01 b	64.35 d
C_2	71.76 ab	65.47 cd
C_3	72.78 a	66.95 c

The interaction between speeds and plant spacing on field efficiency character recorded in Table 4-7.

Table 4.7: Effect of the interaction between machines and plant spacing on field efficiency character.

Speed treatment	Plant spacing		
	C_1	C_2	C_3
S_1	75.89 a	76.75 a	77.96 a
S_2	68.03 cd	69.70 bc	71.21 b
S_3	64.43 ef	66.15 de	67.42 cd
S_4	60.97 g	61.85 fg	62.87 fg

The results indicated that according to planting speeds and planting space the pneumatic planter was better than seed drill. Under all planting speeds and planting space the actual field capacity and field efficiency of pneumatic planter was better than the actual field capacity and field efficiency of seed drill machine.

The interaction between machines, speeds and plant spacing on field efficiency character recorded in Table 4-8.

Table 4.8: Effect of the interaction between machines, speeds and plant spacing on field efficiency character.

Speed treatment		Plant spacing		
		C_1	C_2	C_3
M_1	S_1	76.74 a-c	77.72 ab	79.17 a
	S_2	70.45 d-g	72.68 c-e	73.43 cd
	S_3	67.71 f-i	70.21 d-g	70.84 d-f
	S_4	65.15 h-k	66.42 g-i	67.69 f-i
M_2	S_1	73.83 b-d	75.77 a-c	76.74 a-c
	S_2	65.61 h-j	66.72 f-i	69.00 e-h
	S_3	61.15 kl	62.09 jk	64.00 i-k
	S_4	56.79 m	57.29 lm	58.05 lm

4.4: Effect of planting speed on the specific fuel requirement (l/kW.fed).

The obtained results recorded in Table A-6 and illustrated in Fig. 4-5 showed the effect of planting speed on the Fuel requirement (l/kW.fed) for both type of planting machines at different planting spaces.

In general, the Fuel requirement (l/kW.fed) was gradually decreased as planting speed increased for all planting spaces. Also, the results indicated that when the planting speed increased from 3.21 to 6.5 km/h, The fuel requirement (l/kW.fed) decreased for the pneumatic planter from 0.202 to 0.122, from 0.200 to 0.120 and from 0.196 to 0.117 (l/kW.fed) at planting space 5,10 and 15 cm, respectively, and from 0.210 to 0.141, from 0.205 to 0.140 and from 0.203 to 0.138

(l/kW.fed) at planting space 5, 10 and 15 cm for seed drill planting machine, respectively.

4.5: Effect of planting speed on the power requirement.

The obtained results recorded in Table A-7 in Appendix A and illustrated in Fig. 4-6 showed the effect of planting speed on the power requirement (kW) for both type of planting machines at different planting spaces.

In general, the power requirement was gradually increased as planting speed increased for all planting spaces. Also, the results indicated that when the planting speed increased from 3.21 to 6.5 km/h, the power requirement increased for the pneumatic planter from 21.29 to 26.03, from 20.94 to 25.68 and from 20.56 to 25.30 (kW) at planting space 5, 10 and 15 cm, respectively. While it was increased from 19.77 to 24.83, from 19.42 to 24.42 and from 18.98 to 24.04 (kW) at planting space 5, 10 and 15 cm for seed drill planting machine, respectively. This trend may be due to increasing the fuel consumption by increasing the planting speed. The power requirement by pneumatic planter is more than the power required by seed drill planting machine.

Data in Table A-7 indicated that for all planting speeds the power requirement (kw) with pneumatic planter was higher than power requirement with seed drill machine. This may be due to the fuel consumption by pneumatic planter was higher than the fuel consumption by seed drill machine.

4.6: Effect of planting speed on the slip ratio (%).

The obtained results recorded in Table A-8 and illustrated in Fig. 4-7 showed the effect of planting speed on the wheel slip ratio for both type of planting machines at different planting spaces. In general, the wheel slip ratio was gradually increased as planting speed increased for all planting spaces. Also, the results indicated that when the planting

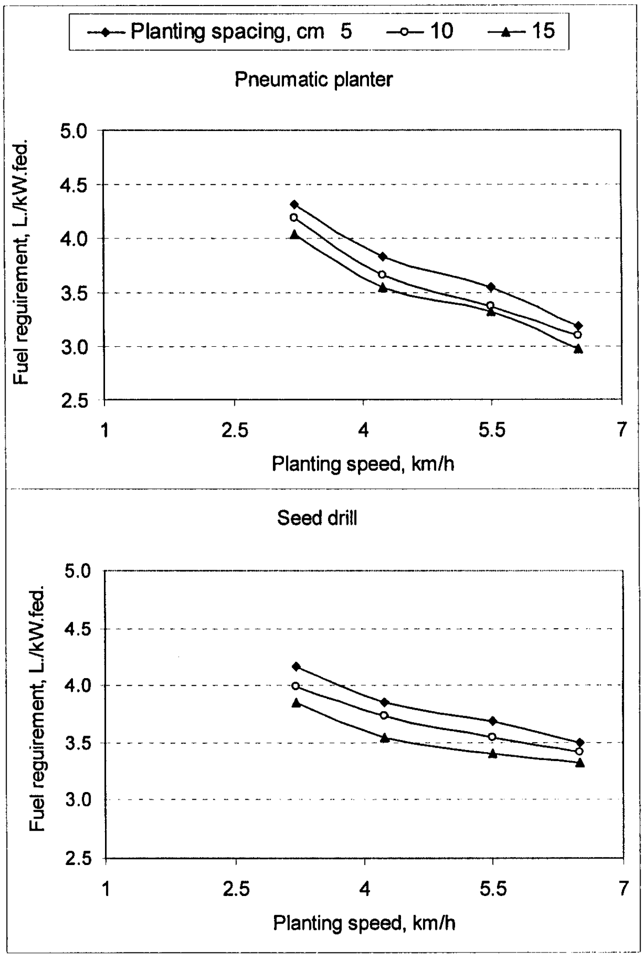


Fig.4-5: Effect of planting speed and machine type on specific fuel consumption at different planting space for pneumatic planter and seed drill.

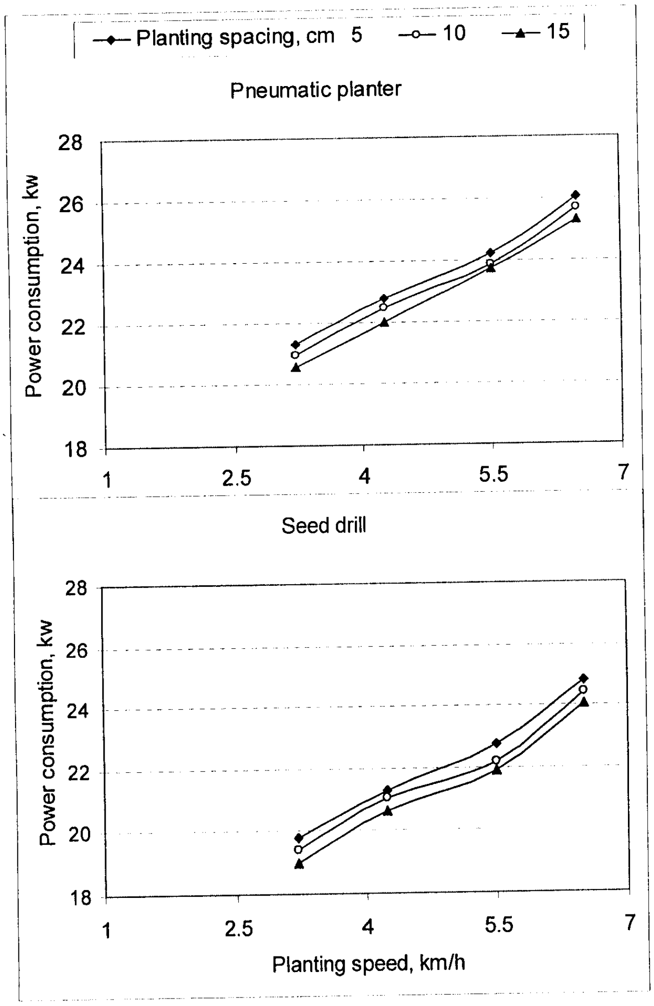


Fig.4-6: Effect of planting speed and machine type on power consumption, (kW) at different planting space for pneumatic planter and seed drill machines .

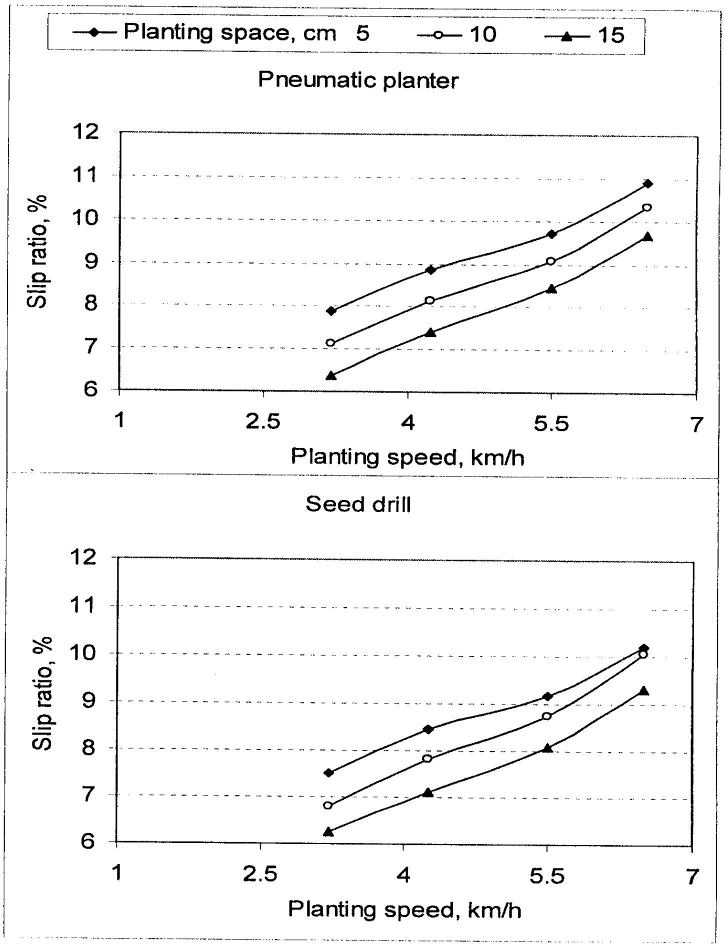


Fig.4-7: Effect of planting speed and machine type on slip ratio, % at different planting space for pneumatic planter and seed drill.

speed increased from 3.21 to 6.5 km/h, the wheel slip ratio increased for the pneumatic planter from 7.88 to 10.91, from 7.13 to 10.34 and from 6.39 to 9.67 % at planting space 5, 10 and 15 cm, respectively. While it increased from 7.52 to 10.21, from 6.81 to 10.05 and from 6.25 to 9.31% , respectively at planting space 5, 10 and 15 cm for seed drill planting machine.

Data in Table A-8 indicated that for all planting speeds the wheel slip ratio for pneumatic planter was higher than that of with seed drill machine. This may be due to heavy mass of seed drill machine, however it is obvious that the difference between the slip for the machines was small.

4.7: Effect of planting speed on the total seed yield g/plant:

The recorded data in Table A-9 and illustrated in Fig. 4-8 show the effect of planting speed on the total seed yield/plant for both type of planting machines at different planting spaces.

In general, the total seed yield/plant gradually increased as planting speed increased for all planting spaces. Also, the results indicated that when the planting speed increased from 3.21 to 6.5 km/h, seed yield/plant increased for the pneumatic planter from 27.20 to 33.54, from 29.24 to 35.62 and from 30.76 to 37.14 g/plant at planting spaces of 5, 10 and 15 cm, respectively. While it increased from 26.32 to 32.66, from 28.36 to 34.74 and from 29.88 to 36.26 (g) at planting spaces of 5, 10 and 15 cm, respectively for seed drill planting machine.

Data in Table A-9 indicated that for all planting speeds seed yield/plant with pneumatic planter was higher than that of seed drill machine.

The interaction between speeds and plant spacing on seed yield per plant character recorded in Table 4-9.

Table 4.9: Effect of the interaction between speeds and plant spacing on seed yield per plant character.

Speed treatment	Plant spacing		
	C_1 (5 cm)	C_2 (10 cm)	C_3 (15 cm)
S_1	26.76 h	28.80 gh	30.32 e-g
S_2	28.91 f-h	31.00 d-g	32.52 c-E
S_3	31.44 d-f	32.68 b-e	34.20 bc
S_4	33.10 b-d	35.18 ab	36.70 a

Also, increasing planting space causes an increase in the seed yield/plant for pneumatic planter, where increasing planting space from 5 to 15 cm cause a increase in the total seed yield from 27.20 to 30.76, from 29.35 to 33.96, from 31.90 to 34.64 and from 33.54 to 37.14 g/plant at planting speeds of 3.21, 4.25, 5.50 and 6.5 km/h, respectively. While, for seed drill machine the total seed yield/plant increased from 26.32 to 29.88, from 28.47 to 32.08, from 30.98 to 33.76 and from 32.66 to 36.26 g/plant at planting speeds of 3.21, 4.25, 5.50 and 6.5 km/h, respectively.

The interaction between machines, speeds and plant spacing on seed yield per plant character recorded in Table 4-10.

Table 4.10: Effect of the interaction between machines, speeds and plant spacing on seed yield per plant character.

Speed treatment		Plant spacing		
		C_1 (5 cm)	C_2 (10 cm)	C_3 (15 cm)
M_1	S_1	27.20 u	29.24 g-j	30.76 e-i
	S_2	29.35 g-j	31.44 d-h	32.96 b-g
	S_3	31.90 c-h	33.12 b-g	34.64 a-e
	S_4	33.54 a-f	35.62 a-c	37.14 a
M_2	S_1	26.32 j	28.36 h-j	29.88 f-j
	S_2	28.47 h-j	30.56 f-i	32.08 c-h
	S_3	30.98 d-i	32.24 c-h	33.76 a-f
	S_4	32.66 b-g	34.74 a-d	36.26 ab

4.8: Effect of planting method on the total yield (Mg/fed.):

The obtained results recorded in Table A-10 and illustrated in Fig. 4-9 show the effect of planting speed on the total yield (Mg/fed.) for both type of planting machines at different planting spaces.

In general, the total yield (Mg/fed.) gradually decreased as planting speed increased for all planting spaces. Also, the results indicated that when the planting speed increased from 3.21 to 6.5 km/h, the total yield (Mg/fed.) decreased for the pneumatic planter from 1.42 to 1.13, from 1.21 to 0.997 and from 1.08 to 0.950 Mg/fed. at planting spacing values of 5, 10 and 15 cm, respectively. While it decreased from 1.33 to 1.06, from 1.19 to 0.970 and from 1.03 to 0.930 at planting spaces of 5,10 and 15 cm , respectively, for seed drill planting machine. These results cane be attributed to that when the planting speed increased the germination ratio decreased as mentioned before, or in another word it will increase the seedlings losses per feddan which certainly will cause a decrease in the total yield.

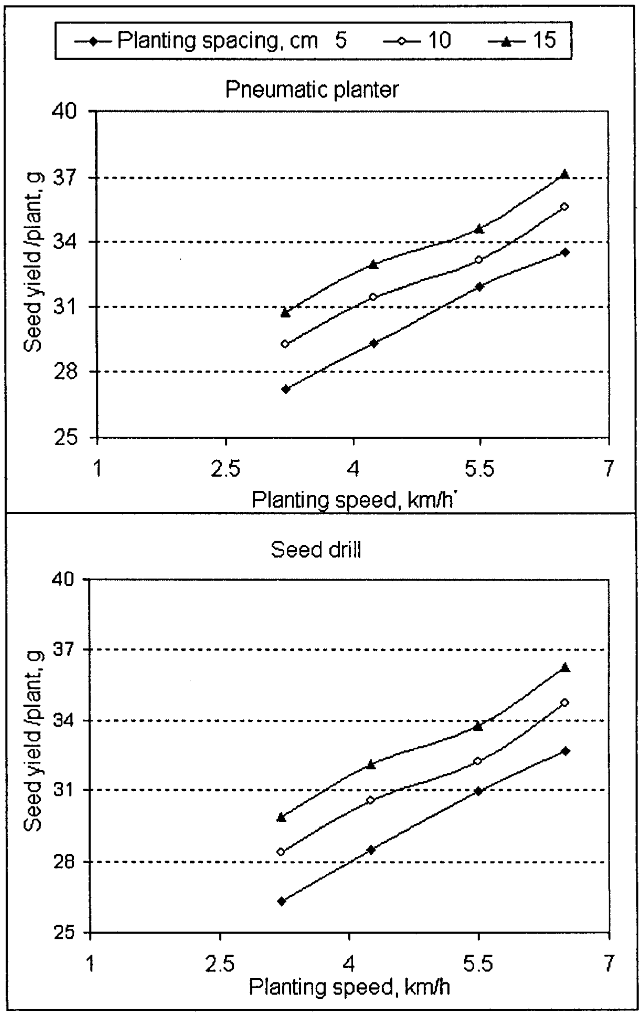


Fig.4-8: Effect of planting speed and machine type on the seed yield (g /plant), at different planting space for pneumatic planter and seed drill.

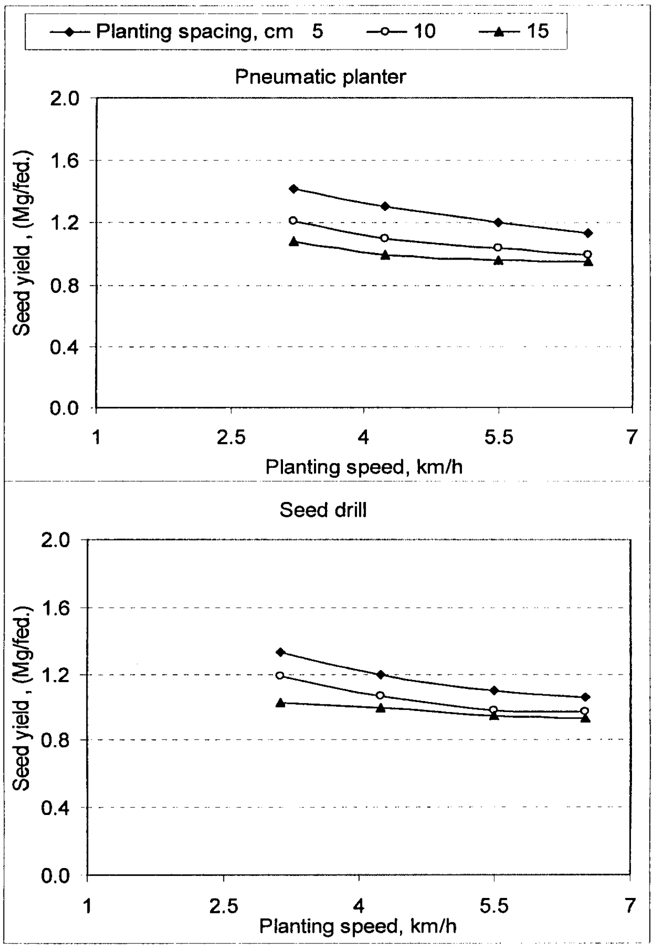


Fig.4-8: Effect of planting speed and machine type on the seed yield (Mg/fed.) at different planting space for pneumatic planter and seed drill.

Also, increasing planting space caused decrease in the total yield for pneumatic planter, where increasing planting space from 5 to 15 cm causes a decreased in the total yield from 1.42 to 1.08, from 1.31 to 0.999, from 1.20 to 0.960 and from 1.13 to 0.950 Mg/fed at planting speeds of 3.21, 4.25, 5.50 and 6.5 km/h, respectively. And for seed drill machine the total yield decreased from 1.33 to 1.03, from 1.20 to 0.997, from 1.10 to 0.950 and from 1.06 to 0.930 ton/fed. at planting speeds of 3.21, 4.25, 5.50 and 6.5 km/h, respectively.

4.9: Effect of planting speed on the costs:

The obtained results were recorded in Tables 4-11 and 4-12 which show the effect of planting speed on the total costs for both type of planting machines at different planting spaces.

In general, the total costs (L.E./h) was gradually increased as planting speed increased for all planting spaces. This trend due to the increase of both fuel consumption and actual field capacity by increasing the planting speeds.

The results showed that the total costs for the pneumatic planter increased from 35.04 to 36.14, from 34.96 to 36.06 and from 34.87 to 35.98 L.E./h when the planting speeds increased from 3.21 to 6.50 km/h and the total costs for seed drill machine increased from 34.89 to 36.07, from 34.81 to 35.97 and from 34.71 to 35.88 L.E./h when the planting speeds increased from 3.21 to 6.50 km/h for planting space 5, 10 and 15 cm, respectively.

Also, the results showed that for the pneumatic planter when the planting speeds increased from 3.21 to 6.5 km/h the total costs decreased from 22.46 to 13.96, from 22.13 to 13.77 and from 21.66 to 13.37 L.E./fed. for planting space 5, 10 and 15 cm, respectively. While for seed drill machine for the same change in planting speeds the total costs decreased from 23.26 to 16.10, from 22.60 to 15.92

and from 22.25 to 15.67 L.E./fed. for planting space 5, 10 and 15 cm, respectively. The manual planting operation had the highest total cost 100 L.E./fed.

Table 4-11: Effect of planting speeds and planting space on the hourly costs (L.E./h) for pneumatic planter and seed drill machine.

Machine type	Planting space, cm	Planting speeds, km/h			
		3.21	4.25	5.50	6.50
Pneumatic planter	5	35.04	35.39	35.73	36.14
	10	34.96	35.31	35.64	36.06
	15	34.87	35.21	35.61	35.98
Seed drill	5	34.89	35.24	35.58	36.07
	10	34.81	35.18	35.45	35.97
	15	34.71	35.09	35.39	35.88

Table 4-12: Effect of planting speeds and planting space on total costs per fed. (L.E./fed.) for pneumatic planter and seed drill machine.

Machine type	Planting space , cm	Planting speeds, km/h			
		3.21	4.25	5.50	6.50
Pneumatic planter	5	22.46	18.82	16.54	13.96
	10	22.13	18.20	15.91	13.77
	15	21.66	17.96	15.76	13.37
Seed drill	5	23.26	20.14	18.25	16.10
	10	22.60	19.77	17.90	15.92
	15	22.25	19.07	17.35	15.67

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* *One American dollar ≃ 5.68 Egyptian pound (L.E) according to prices of 2005*

5- SUMMARY AND CONCLUSION

Canola (Brassica napus,L.) is one of the newly introduce crops in Egypt. Oilseed rape is one of the important oil crops over the world. It has the third position on the world oil production crops, second position in total world area for oil crops and the fifth in the world international trade for crops.

The annual consumption of oil in Egypt is bout 1.129 Tg while it produce of about 13.55% (153 Gg.) from the total need and import of about 86.45% (976 Gg). according to Oilseed situation and outlook 2002). So, Egypt costs about 3.22 milliard Egyptian pound (LE.) to cover this deficiency.

The main purpose of this study is to evaluate the pneumatic planter and seed drill planting machines to suit sowing rapeseed crop compared with traditional method as a suggestion solution for increasing the production of rapeseed crop in Egypt.

3.1: Planting variables:

To achieve the study goal the experimental treatments were carried as follows:

1- Two types of planting machine (pneumatic planter and seed drill) for planting rapeseed.

2- Four different levels of planting speed namely 3.21, 4.25, 5.50 and 6.50 km/h

3- Three different levels of plant spacing of 5, 10 and 15 cm.

3.4: Measurements:

3.4.1: Germination ratio.

3.4.2: Planting uniformity and accuracy.

a- Seed scattering

b- Uniformity of plant distribution (Coefficient of uniformity)

3.4.3: Field capacity and efficiency.

3.4.4: Fuel requirement (l/kW.fed).

3.4.5: Power requirements.

4.6: Wheel slip ratio.

4.7: Seed yield(g /plant.)

3.4.8: The total yield (Mg/fed)

3.4.9: Planting cost. (L.E/h)

The obtained results could be summarized as follows:-

4.1: Germination ratio %:

The germination ratio gradually decreased as planting speed increased for all planting spaces. Also, the results indicated that the germination ratio of the pneumatic planter was better than the seed drill machine under all planting speeds and planting spaces.

4.2: Uniformity of seeding:

The uniformity of seeding gradually decreased as planting speed increased for all planting spaces. Also, the results indicated that, according to planting speed the pneumatic planter had higher uniformity comparing with the seed drill machine.

4.3: Effective field capacity and field efficiency:

The effective field capacity gradually increased while, the field efficiency decreased as planting speed increased for all planting spacing.

The results indicated that according to planting speeds and planting spacing the pneumatic planter was better than seed drill . Under all planting speeds and planting spacing the effective field capacity and field efficiency of pneumatic planter was better than the effective field capacity and field efficiency of seed drill machine.

4.4: Fuel consumption rate (l/kW.fed):

The fuel consumption rate (l/kW.fed) gradually decreased as planting speed increased for all planting space. Also, the analysis of variance indicated the planting speed km/h had a highly significant effect on the fuel consumption rate (l/kW.fed)

4.5: Power requirement (kW):

The power requirement gradually increased as planting speed increased for all planting spacing. Also, for all planting speeds the power requirement (kW) with pneumatic planter was higher than that with seed drill machine.

4.6: Wheel slip ratio:

The wheel slip ratio gradually increased as planting speed increased for all planting space. Also, for all planting speeds the wheel slip with pneumatic planter was higher than that with seed drill machine.

4.7: Total seed yield (g /plant).

The total seed yield/plant gradually increased as planting speed increased for all planting space.

The analysis of variance indicated that the planting speed and planting space had a highly significant effect on total seed yield/plant.

4.8: The total yield (Mg/fed.):

The total yield (Mg/fed.) gradually decreased as planting speed increased for all planting space.

The analysis of variance indicated that the planting speed and planting space had a highly significant effect on total yield (Mg/fed.)

4.9: Costs of planting methods:

The total costs (L.E./h) gradually increased as planting speed increased for all planting space.

The results showed that the total costs (L.E./h) for the pneumatic planter increased from 35.04 to 36.14, from 34.96 to 36.06 and from 34.87 to 35.98 L.E./h when the planting speeds increased from 3.21 to 6.50 km/h. And the total costs for seed drill machine increased from 34.89 to 36.07, from 34.81 to 35.97 and from 34.71 to 35.88 L.E./h when the planting speeds increased from 3.21 to 6.50 km/h for planting space 5, 10 and 15 cm, respectively.

Recommendations

1- The optimum operating condition for pneumatic planter is at planting speed of 3.21 km/h and plant spacing of 5cm.
2- The optimum operating condition for seed drill is at planting speed of 3.21 km/h and plant spacing of 5cm.

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المراجع العربية:

١- التقرير الصادر عن قطاع الشئون الاقتصادية بوزارة الزراعة واستصلاح الأراضى عن موقف البذور الزيتية ومستقبلها (Oilseed situation and outlook) (٢٠٠٤).

Table A-1: Effect of planting speeds and plant spacing on germination ratio% for pneumatic planter and seed drill machine.

Machine type	Planting spaces, cm	Planting speeds, km/h			
		3.21	4.25	5.50	6.50
Pneumatic planter	5	99.2	95.76	91.51	86.70
	10	94.65	91.52	89.95	85.00
	15	90.31	86.50	85.10	80.34
Seed drill	5	97.30	92.75	89.67	84.76
	10	92.42	89.10	86.10	81.52
	15	89.10	85.43	82.53	79.03

Table A-2:Effect of planting speeds and plant spacing on uniformity for pneumatic planter and seed drill machine.

Machine type	Planting spaces, cm	Planting speeds, km/h			
		3.21	4.25	5.50	6.50
Pneumatic planter	5	96.12	96.00	95.06	93.02
	10	92.13	91.09	90.34	88.52
	15	86.5	85.67	84.63	83.4
Seed drill	5	93.91	92.32	91.01	89.69
	10	89.62	88.00	86.86	85.51
	15	84.25	83.21	82.32	81.02

Table A-3:Effect of planting speeds and plant spacing on actual field capacity (fed./h) for pneumatic planter and seed drill machine.

Machine type	Planting spaces, cm	Planting speeds, km/h			
		3.21	4.25	5.50	6.50
Pneumatic planter	5	1.56	1.88	2.16	2.59
	10	1.58	1.94	2.24	2.62
	15	1.61	1.96	2.26	2.69
Seed drill	5	1.5	1.75	1.95	2.24
	10	1.54	1.78	1.98	2.26
	15	1.56	1.84	2.04	2.29

Table A-4:Effect of planting speeds and plant spacing on field efficiency for pneumatic planter and seed drill machine.

Machine type	Planting spaces, cm	Planting speeds, km/h			
		3.21	4.25	5.50	6.50
Pneumatic planter	5	76.74	70.45	67.71	65.15
	10	77.72	72.68	70.21	66.42
	15	79.17	73.43	70.84	67.69
Seed drill	5	73.83	65.61	61.15	56.79
	10	75.77	66.72	62.09	57.29
	15	76.74	69.00	64.00	58.05

Table A-5:Effect of planting speeds and plant spacing on fuel consumption (l/h) for pneumatic planter and seed drill machine.

Machine type	Planting spaces, cm	Planting speeds, km/h			
		3.21	4.25	5.50	6.50
Pneumatic planter	5	6.73	7.20	7.66	8.23
	10	6.62	7.10	7.54	8.12
	15	6.50	6.96	7.50	8.00
Seed drill	5	6.25	6.73	7.19	7.85
	10	6.14	6.65	7.01	7.72
	15	6.00	6.53	6.93	7.60

Table A-6:Effect of planting speeds and plant spacing on fuel requirement (l/kW.fed.) for pneumatic planter and seed drill machine.

Machine type	Planting spaces, cm	Planting speeds, km/h			
		3.21	4.25	5.50	6.50
Pneumatic planter	5	0.202	0.168	0.146	0.122
	10	0.200	0.162	0.141	0.120
	15	0.196	0.161	0.139	0.117
Seed drill	5	0.210	0.180	0.162	0.141
	10	0.205	0.177	0.159	0.140
	15	0.203	0.171	0.155	0.138

Table A-7:Effect of planting speeds and plant spacing on power requirements (kW) for pneumatic planter and seed drill machine.

Machine type	Planting spaces, cm	Planting speeds, km/h			
		3.21	4.25	5.50	6.50
Pneumatic planter	5	21.29	22.77	24.23	26.03
	10	20.94	22.46	23.85	25.68
	15	20.56	22.01	23.72	25.30
Seed drill	5	19.77	21.29	22.74	24.83
	10	19.42	21.03	22.17	24.42
	15	18.98	20.65	21.92	24.04

Table A-8: Effect of planting speeds and plant spacing on wheel slip percentage (%) for pneumatic planter and seed drill machine.

Machine type	Planting spaces, cm	Planting speeds, km/h			
		3.21	4.25	5.50	6.50
Pneumatic planter	5	7.88	7.87	9.72	10.91
	10	7.13	8.15	9.09	10.34
	15	6.39	7.42	8.44	9.67
Seed drill	5	7.52	8.46	9.18	10.21
	10	6.81	7.83	8.75	10.05
	15	6.25	7.12	8.08	9.31

Table A-9:Effect of planting speeds and plant spacing on total yield (g /plant) for pneumatic planter and seed drill machine.

Machine type	Planting spaces, cm	Planting speeds, km/h			
		3.21	4.25	5.50	6.50
Pneumatic planter	5	27.20	29.35	31.90	33.54
	10	29.24	31.44	33.12	35.62
	15	30.76	32.96	34.64	37.14
Seed drill	5	26.32	28.47	30.98	32.66
	10	28.36	30.56	32.24	34.74
	15	29.88	32.08	33.76	36.26

Table A-10 :Effect of planting speeds and planting space on total seed yield (Mg/fed.) for pneumatic planter and seed drill machine.

Machine type	Planting spaces, cm	Planting speeds, km/h			
		3.21	4.25	5.50	6.50
Pneumatic planter	5	1.42	1.31	1.20	1.13
	10	1.21	1.10	1.04	0.997
	15	1.08	0.999	0.960	0.950
Seed drill	5	1.33	1.20	1.10	1.06
	10	1.19	1.07	0.980	0.970
	15	1.03	0.997	0.950	0.930

الملخص العربي

مقدمة :

يعتبر محصول الكانولا من المحاصيل التى أدخلت الى مصر حديثا حيث يعتبر محصول الكانولا من أهم محاصيل الزيوت على مستوى العالم حيث يقع فى المرتبة الثالثة من حيث إنتاج الزيت على مستوى العالم وفى المرتبة الثانية من حيث المساحة المنزرعة من محاصيل الزيوت وفى المرتبة الخامسة فى التجارة الدولية للمحاصيل.

فى مصر يستهلك سنويا ١١٢٩ ألف طن (١,١٢٩ تيرا جرام) من الزيوت وحتى الآن ننتج ١٥٣ ألف طن (١٥٣ جيجا جرام) فقط هذا يعنى أن إنتاجنا من الزيوت يعادل ١٣,٥٥% فقط من الاستهلاك ونستورد حوالى ٨٦,٤٥% (٩٧٦ جيجا جرام)، لذلك تحتاج مصر إلى حوالى ٣,٢٢ مليار جنيه مصرى لكى نغطى هذا النقص. ولكى نغطى ذلك العجز فى احتياج الزيت فى مصر لابد من زيادة المساحة المنزرعة من محصول الكانولا خاصة فى الأراضى الجديدة ولكن من المعوقات الأساسية التى تحد من تكثيف زراعة محصول الكانولا فى الأراضى الجديدة هى مشكلة الزراعة.

الهدف من الدراسة:

من هذا المنطلق كان الهدف الرئيسى لهذه الدراسة هو إيجاد بعض الحلول التى قد تساعد على زيادة إنتاج محصول الكانولا للتغلب على مشكلة الفجوة بين الإنتاج والاستهلاك للزيوت فى مصر ولهذا اشتملت الدراسة على:-

* تقييم أداء آلة زراعة فى جور تعمل بضغط الهواء (بنيوماتيك) وكذلك آلة الزراعة فى صفوف (السطارة) فى زراعة محصول الكانولا ومقارنتهما بطريقة الزراعة التقليدية (اليدوية) مع إجراء حسابات التكاليف.

لكى نحقق هذه الأهداف اشتملت الخطة البحثية لهذه الدراسة على المتغيرات التالية:-

١- نوعان من آلات الزراعة (آلة زراعة الجور بضغط الهواء ، السطارة).

٢- أربعة مستويات من سرعات الزراعة(٣,٢١، ٤,٢٥ ، ٥,٥٠ ، ٦,٥٠ كم/س).

٣- ثلاثة مستويات مختلفة من مسافات الزراعة بين الجور فى الصف الواحد٥، ١٠،١٥ سم.

لدراسة أداء هذه الآلات تم تحديد المؤشرات التالية:-

١- نسبة الإنبات.

٢- انتظامية الزراعة (التشتت الطولى- التشتت العرضى)

٣- السعة الحقلية والكفاءة الحقلية.

٤- معدل استهلاك الوقود.

٥- الطاقة المطلوبة.

٦- نسبة الانزلاق

٧- إنتاجية البذور(جرام/نبات)

٨- إنتاجية البذور الكلية (ميجاجرام/فدان)

٩- تكاليف الزراعة.

أهم النتائج

يمكن تلخيص النتائج المتحصل عليها كما يلى:-

١- نسبة الإنبات (٪):

- أوضحت النتائج أن نسبة الإنبات تقل بزيادة سرعات الزراعة عند كل مسافات الزراعة المستخدمة فى الدراسة.
- تبين من الدراسة أيضا أن آلة الزراعة فى جور بشفط الهواء أعطت نتائج أفضل من السطارة الميكانيكية عند كل سرعات ومسافات الزراعة قيد الدراسة.

٢- انتظامية الزراعة.

- دقة وانتظامية الزراعة تقل بزيادة سرعات الزراعة عند كل مسافات الزراعة قيد الدراسة.
- تبين من الدراسة أيضا أن دقة وانتظامية الزراعة لآلة الزراعة فى جور بشفط الهواء تكون أعلى بالمقارنة بالسطارة الميكانيكة عند كل سرعات ومسافات الزراعة تحت الدراسة.

٣- السعة الحقلية (فدان/ساعة)والكفاءة الحقلية (٪).

- السعة الحقلية تزيد والكفاءة الحقلية تقل بزيادة سرعات الزراعة عند كل مسافات الزراعة قيد الدراسة.
- أكدت النتائج أن السعة الحقلية والكفاءة الحقلية لآلة الزراعة فى جور بشفط الهواء أفضل من السعة والكفاءة الحقلية للسطارة عند كل سرعات الزراعة ومسافات الزراعة.

٤- متطلبات الوقود (لتر/ك وات.فدان)

- متطلبات الوقود يقل بزيادة سرعة الزراعة عند كل مسافات الزراعة قيد الدراسة.
- بالتحليل الاحصائى وجد أن سرعات الزراعة كم/ساعة كانت عالية المعنوية وتؤثر على معدل استهلاك الوقود

٥- القدرة المطلوبة (ك وات).

- القدرة المطلوبة تزيد بزيادة سرعة الزراعة عند كل مسافات الزراعة قيد الدراسة
- عند كل سرعات الزراعة القدرة المطلوبة لآلة زراعة الجور أكبر بالمقارنة بالقدرة المطلوب للسطارة.

٦- نسبة الانزلاق (٪).

- نسبة الانزلاق تزيد بزيادة سرعة الزراعة عند كل مسافات الزراعة قيد الدراسة.
- عند كل سرعات الزراعة نسبة انزلاق عجل آلة زراعة الجور أكبر من نسبة انزلاق عجل السطارة الميكانيكية.

٧- إنتاجية البذور (جرام / نبات)

- إنتاجية البذور /نبات تقل بزيادة سرعة الزراعة عند كل مسافات الزراعة قيد الدراسة.
- بالتحليل الاحصائى وجد أن سرعات الزراعة ومسافات الزراعة عالية المعنوية وتؤثر على إنتاجية البذور/نبات . كما أن نوعية الآلة لها نفس التأثير على محصول النبات.

٨- إنتاجية البذور الكلية (ميجاجرام/فدان)

- انتاجية الحبوب (ميجاجرام/فدان) تقل بزيادة سرعات الزراعة عند كل مسافات الزراعة قيد الدراسة.

- بالتحليل الاحصائى وجد أن سرعات الزراعة ومسافات الزراعة عالية المعنوية وتؤثر على إنتاجية البذور الكلية (ميجاجرام/فدان). أما نوعية الآلة فلم تظهر أى تأثير معنوى على محصول الفدان.

٩- تكاليف الزراعة (جنيها/ساعة).

- التكاليف الكلية تزيد بزيادة سرعات الزراعة عند كل مسافات الزراعة قيد الدراسة.
- أوضحت النتائج أن التكاليف الكلية لآلة الزراعة فى جور بشفط الهواء تزيد من ٣٥,٠٤ الى ٣٦,٩٦ ، من ٣٤,٩٦ الى ٣٦,٠٦ ، ٣٤,٨٧ الى ٣٥,٩٨ جنيها/ساعة عند زيادة سرعة الزراعة من ٣,٢١ الى ٤,٢٥ ن ومن ٤,٢٥ الى ٥,٥٠، ومن ٥,٥٠ الى ٦,٥٠ كم/ ساعة على التوالى. والتكاليف الكلية للسطارة تزيد من ٣٤,٨٩ الى ٣٦,٠٧ ، من ٣٤,٨١ الى ٣٥,٩٧ ، من ٣٤,٧١ الى ٣٥,٨٨ جنيه/ساعة مستويات السرعة سالفة الذكر على التتابع عند كل من مسافات الزراعة الثلاث قيد الدراسة.

التوصيات:

من خلال النتائج السابقة يمكن التوصل الى التوصيات التالية:

١- أنسب ظروف تشغيل للزراعة بآلة الزراعة في جور بشفط الهواء هي عند سرعة أمامية ٣,٢١ كم/ساعة ومسافة زراعة ٥سم بين الجور فى الصف الواحد.

٢- أنسب ظروف تشغيل للزراعة بالسطارة هي عند سرعة أمامية ٣,٢١ كم/ساعة ومسافة زراعة ٥سم بين الجور فى الصف الواحد.

٣- استخدام آلة زراعة الجور فى زراعة محصول الكانولا أفضل من استخدام السطارة.

المستخلص العربي

يعتبر محصول الكانولا من المحاصيل التى أدخلت الى مصر حديثا حيث يعتبر محصول الكانولا من أهم محاصيل الزيوت على مستوى العالم حيث يقع فى المرتبة الثالثة من حيث إنتاج الزيت على مستوى العالم وفى المرتبة الثانية من حيث المساحة المنزرعة من محاصيل الزيوت على مستوى العالم وفى المرتبة الخامسة على مستوى العالم فى التجارة الدولية للمحاصيل .

من هذا المنطلق كان الهدف الرئيس لهذه الدراسة هو إيجاد بعض الحلول التى قد تساعد على زيادة إنتاج محصول الكانولا للتغلب على مشكلة الفجوة بين الإنتاج والاستهلاك للزيوت فى مصر

وكان أهم النتائج المتحصل عليها مايلى :

- تبين من الدراسة أن نسبة الإنبات لآلة زراعة الجور بضغط الهواء هو أفضل من الستارة عند كل سرعات مسافات الزراعة قيد الدراسة
- تبين من الدراسة ان انتظامية الزراعة لآلة زراعة الجور بضغط الهواء تكون أعلى بالمقارنة بالسطارة عند كل سرعات ومسافات الزراعة قيد الدراسة
- أكدت النتائج أنه عند كل سرعات الزراعة ومسافات الزراعة قيد الدراسة أن آله زراعة الجور بضغط الهواء أفضل من السطارة لكل من السعة والكفاءة الحقلية
- استهلاك الوقود (لتر / فدان) يقل بزيادة سرعة الزراعة عند كل مسافات الزراعة قيد الدراسة
- عند كل سرعات الزراعة ومسافات الزراعة الطاقة المطلوبة لآلة زراعة الجور بضغط الهواء تكون أعلى بالمقارنة بالطاقة المطلوبة للسطارة
- عند كل سرعات ومسافات الزراعة انزلاق عجل الجرار لآلة الزراعة الجور بضغط الهواء أعلى بالمقارنة بالسطارة
- إنتاجية البذور / نبات تقل بزيادة سرعة الزراعة عند كل مسافات الزراعة قيد الدراسة
- إنتاجية البذور الكلية(ميجا جرام / فدان) تقل بزيادة السرعة عند كل مسافات الزراعة قيد الدراسة
- التكاليف الكلية (جنيها / ساعة) تزيد بزيادة سرعات الزراعة عند كل مسافات الزراعة قيد الدراسة

لجنة الإشراف

الدكتور/ السعيد محمد خليفة

أستاذ الهندسة الزراعية المساعد - قسم الهندسة الزراعية
كلية الزراعة- جامعة كفرالشيخ

الدكتورة/ نبيهة حسن أبوالهنا

مدرس الهندسة الزراعية - قسم الهندسة الزراعية
كلية الزراعة - جامعة كفرالشيخ

الدكتور/ محمد السيد أبوغزالة

رئيس بحوث — معهد بحوث المحاصيل الحقلية
مركز البحوث الزراعية- الدقى — الجيزة.

بسم الله الرحمن الرحيم

قالوا سبحانك لا علم لنا إلا ما
علمتنا إنك أنت العليم الحكيم

صدق الله العظيم

الآية (٣٢) سورة البقرة

"دراسة على ميكنة محصول زيتى"

تقييم أداء بعض آلات زراعة محصول الكانولا

رسالة مقدمة من

فاطمة عبدالغنى عبدالنبى الرشيدى

للحصول على درجة الماجستير فى العلوم الزراعية
(الميكنة الزراعية)

٢٠٠٦م

لجنة المناقشة والحكم على الرسالة **موافقون**

الأستاذ الدكتور/ مبارك محمد مصطفى ....

أستاذ الهندسة الزراعية المتفرغ – كلية الزراعة– جامعة عين شمس

الأستاذ الدكتور/ ممدوح عباس حلمى ....

أستاذ ورئيس قسم الهندسة الزراعية – كلية الزراعة– جامعة كفرالشيخ

الدكتور/ محمد السيد أبو غزالة ....

رئيس بحوث– معهد بحوث المحاصيل الحقلية– مركز البحوث الزراعية بالجيزة

أودعت مكتبة الكلية بتاريخ / /٢٠٠٦م

أمين المكتبة

١١٨٦

جامعة كفرالشيخ
كلية الزراعة
قسم الهندسة الزراعية

"دراسة على ميكنة محصول زيتى "
تقييم أداء بعض آلات زراعة محصول الكانولا

رسالة مقدمة من

فاطمة عبد الغنى عبد النبى الرشيدى

بكالوريوس العلوم الزراعية (الميكنة الزراعية)
كلية الزراعة- كفر الشيخ -جامعة طنطا ١٩٩١

كجزء من المتطلبات للحصول على درجة ماجستير العلوم الزراعية
(الميكنة الزراعية)

من

قسم الهندسة الزراعية

كلية الزراعة

جامعة كفرالشيخ

٢٠٠٦