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EFFECT OF TILLAGE AND PLANTING PRACTICES ON RICE YIELD AND ENGINEERING CHARACTERISTICS OF MILLING QUALITY

A. M. Zein EL- Din* T. K. Zein EI-Abedin* A.A. EL- Hesawy**
R.G. Abd EI-Hameed***

ABSTRACT

*The present work was carried out to determine the effect of different land preparation methods, conventional tillage (CT) and reduced tillage (RT) combined with different planting systems, random manual transplanting, row transplanting (20*20) and mechanical drilling of two rice variety, long and short grain represented by Giza 182 and Sakha 101, respectively, on yield and milling quality to recommend the most suitable combination of land preparation methods and planting systems. The field experiments were conducted at the Agriculture Research Experimental Station, Faculty of Agriculture, Alexandria University, and the milling process were conducted in Rice Training and Research Center, repeated during the 2005 and 2006 summer seasons. The results indicated that the maximum total grain yield with respect to planting systems was achieved with mechanical drilling system combined with conventional tillage treatment (3.045 t/f_d). However, reduced tillage treatment (RT) with transplanting in rows (20*20) cm gave higher grain yield (2.73 t/f_d) than CT treatment. In addition, mechanical drilling with conventional tillage (CT) gave higher values of yield components (number of tillers per sq.m - number of filled grain per panicle and 1000 grain weight) compared to the same planting system under reduced tillage. Moreover, the measured physical and mechanical properties such as length (L), width (W), grain shape factor (L/W) and grain rigidity indicated that: as the length to*

* Prof., Agric., Eng., Alex., Univ., Egypt.

** Prof., of field crops. Res., Inst., Egypt.

*** Graduate student. Agric., Eng., Alex. Univ., Egypt.

*width ratio (grain shape) decreased, the rigidity increased. In addition, milling process resulted higher head rice percentage (HRP) in conventional tillage treatment (CT) with mechanical drilling than other treatment. However reduced tillage treatment (RT) combined with row transplanting (20*20) gave higher head rice than CT treatment.*
Keywords: (Tillage, Planting systems, Rice yield, Milling quality).

INTRODUCTION

Rice is considered as one of the most important crops in Egypt and in the world today. The possibility of improving productivity is depended upon many important factors. In order of importance *first:* land preparation method, (seedbed preparation) is one of the most important factors controlling the suitability of the physical conditions of the soil. Some tillage techniques of land preparation have been evaluated as a way to reduce land preparation cost without sacrificing grain yields, *Second:* planting method which is still one of the main limiting factors in rice productions, because of its marked influence on the vigor of the growing plants and it is very important to apply the most economical method to obtain maximum grain yield, *Third:* improved drainage and irrigation which are efficient water control results in direct improvement in yield; in addition, it aids in the control of bests, diseases, and weeds, and *Fourth:* harvesting time, immaturity of the grains, over-ripening of grain, variety characteristics, and fungus diseases of the grains are also affecting in rice yield (Grist D.H 1976). Rice grain yield and quality are actually affected by numerous factors. Milling quality is a final production index as a result of all combined processes involved in rice production. Therefore the general objective of the present work is: Studying the effect of land preparation and planting systems and their interactions on the yield and yield component, agronomic characteristics and milling quality under two different varieties, short and long grains. The specific objectives could be represented by:

- Design and conduct a complete experiment combining different levels of tillage and methods of planting using two different varieties.
- Measuring some engineering characteristics of rice related to

milling quality.

- Estimating the milling quality, expressed in (brown rice %, hull %, total milling quality%, head rice %, broken rice % and bran & germ %).
- Analyzing the data obtained statistically in order to recommend the most suitable land preparation, planting method for each variety.

Chang and Lindwall (1990) indicated from a literature review, soil property changes due to tillage are related to several parameters include, soil type, type of tillage equipment, tillage depth, soil conditions such as moisture content at the time of tillage and climatic conditions. EI-Gohary (1978) pointed that bulk density decreased by increasing the plowing depth and the plowing process caused a pronounced increase in values of total porosity than the corresponding depth of zero tillage. He also indicated that deep plowing decreased soil penetrability through its effect on soil loosening at different depths. EI-Nakib and Fouad (1990) mentioned that the penetration force almost linearly increased with depth. The same trend appeared before and after operation, such increase in soil penetration resistance may be due to compaction of soil particles. They found that the soil bulk density decreased after tillage operations, the decrease in bulk density value was much more in the upper layer (0-10cm) .Also, the plowing increases pore spaces. Ebada (1992) found that soil resistance to penetration is directly dependent upon the soil compaction, moisture content and soil texture. He also showed that compaction increased with depth. On the other hand, compaction values of all layers after harvesting are in general higher than those before planting rice crop. Donald et al (1987) mentioned that the aggregate size has been related to the germination and early growth of seedlings since' the distribution of aggregate sizes influences the pore characteristics of the seedbed, seed-soil contact and the supply of water to the developing seedling. Aggregate size distribution also influences seedling growth when water is not limiting, presumably as a consequence of limitations related to soil strength. Lillard et al (1964) studied comparisons between no tillage and conventional tillage proved that the average yield from the no tillage plots were the highest on the early planting and lowest on the late planting cited by Zein EI- Din(1985). Basiliob (1967) studied the effect of three methods of land preparation (plowing), (plowing+ rotovator), and (plowing+ harrowing) on grain yield of rice. He found that (plowing+ harrowing) treatments gave the maximum yield than the other methods. Daff and Orcino (1974) demonstrated the effect of five land preparation systems of rice on grain yield. They found that grain yield of rice did not vary significantly among land preparation systems. Abo EI-Ees (1985) studied that the effect of seedbed preparation and method of planting in rice yield. The plow type, depth of plowing on rice yield was the specific factors considered. Rice gave high yield with moldboard plow due its greater ability in soil Inversion and, as a result, weed killing. In general, rice yield increased with depth of plowing in all treatments. Shad and DeDatta (1986) showed that two experiments on land preparation practices, consisting of zero, minimum and conventional tillage treatments, revealed that conventional tillage was the best practice in terms of grain yield, and tiller number. It was followed by minimum and zero tillage, respectively. Sharma et al (1988) studied seedbed preparation affects on root characters such as root volume. He found that, in general the root volume increased by increasing intensity of tillage. Better aeration in tilled treatments might be one reason. An increase in root volume means an increase in nutrient uptake by the root, which may explain the higher grain yield in tilled than in untilled treatments. Zein El-Din (2000) studied the effect of different plowing and planting methods on rice crop yield. (Chisel plowing twice and moldboard plowing followed by harrowing. He found that increasing tillage practices did not increase both 1000-grain weight, and total yield (ton/fd) for manual transplanting and broadcasting systems significantly. However, there is a significant increase with using mechanical drilling systems for both varieties (Giza171 & Giza 181). Wade and Johanston (1975), Main and Latif(1969) found that the plant height, number of spikelets per panicle and number of filled grains per panicle increased more in transplanting than in broadcasting method. Therefore, the transplanted crop tended to increase the yield of grain which was in consistency with the number of ear-bearing tiller per panicle. Moreover, the difference was small between the two methods of planting with respect to straw yield, although transplanted operation always tends to increase the grain of straw ratio.

Anonymous (1972) studied the effect of two methods of establishments (row and random transplanting) on growth, yield and yield components of IR-8 rice cultivar. Random transplanting increases grain yield, total number of plants per square meter, panicle number per square meter and 1000-grain weight, but it decreases the number of tiller per plant when compared with row transplanting. Moreover, they indicated that the increase in panicle number per unit area was a reflection of the higher

plant density from random transplanting. EI-Kerdy (1982) and Metwalli et at (1980) reported' that mechanical transplanting gave higher brown rice yield than manual transplanting. He also mentioned that, the high yield with mechanical transplanting could be explained by the number of panicle per unit area and by larger heavy panicles and vigorous growth. Vigorous young seeding, a larger number of hills per unit area, and easily machine transplanting caused the high yield. Lee et al (1974) sowed seven rice cultivars with two planting methods direct sowing and transplanting. They found that yield and panicle number were higher in direct sowing than transplanting where as the inverse were true for spikelet's number. Also, a negative correlation between time to heading and yield was found. Purushothaman and Morachan (1974) found that rice maturity was complete at 137 and 144 days after sowing in drilling and transplanting methods, respectively. On the other hand, no significant differences were observed between the two methods for the plant height. India cultivar, IR-8, recorded higher number of total and productive tillers per square meter under direct seeding than under transplanting method. Panicle length, number of spikelet's and filled grain per panicle were slightly higher transplanting than under direct seeding. Rice yield was 7.44 and 7.02 tons per hectare in drilling and transplanting methods, respectively. Badawi (1982) studied the effect of three, planting methods; transplanting, drilling and broadcasting, on the yield of Giza 170 and Giza 181 rice cultivars. He found that broadcasting encourages heading date than other methods with about 5%. It gave higher tiller number/m^2, 1000-grain weight and number of tiller/m^2.1000 grain weight and number of panicles/m^2 as compared with the other. He also found that transplanting gave higher milling %, unfilled and filled grains per panicle than broadcasting, while drilling method resulted in the shortest plants. He recorded 23% and 12% increase in grain number/panicle for transplanting and drilling than broadcasting, respectively. From quality Point of view, transplanting gave the highest milling output for Giza 171 and Giza 181 followed by drilling whereas broadcasting method gave the lowest values. Shaalan et al (1983) studied four treatments of planting method (broadcasting, mechanical drilling, manual transplanting and mechanical transplanting). They reported that the grain yield was highly significant affected by the planting methods. The highest significant mean values were those of mechanical drilling, manual transplanting and mechanical transplanting (7.84, 7.80 and 7.72 ton/ha respectively), while broadcasting gave 6.26 ton/ ha). Milling is the process of whitening the rice by removing the silver skin and the bran layer of the brown rice. Theoretically, the best condition for rice whitening is to remove that, without causing breakage to the grains (Shokr 1993).

Rice kernel breakage during the milling process is affected by different parameters such as paddy harvesting conditions, paddy drying, storage and handling, physical properties of the paddy kernels, the environmental conditions, and the type and quality of the milling system components.
Harry (1982) stated that losses associated with rice milling are attributed to several factors grouped these factors under two broad categories namely (a) factors associated with rice and (b) factors associated with machine. He added that factors associated with paddy include (1) varietal characteristics, (2) production factors, and (3) postproduction operations prior to milling. The miller may have no control of these factors and factors associated with the machine can be more less controlled and include machine type, machine adjustment systems and their operation.

Geng et al (2001) reported that resistance to breakage is a desirable trait of the rice kernel. Many factors, such as the genetics of the cultivar, the plant growth environment and the conditions of the milling process will affect kernel breakage. The objective of this study was to characterize the interrelationships amongst grain filling and grain structural characteristics and to determine whether the grain-filling process and grain characteristics affect head rice, and to suggest a pathway through which grain characteristics can influence head rice recovery. An analysis of the interrelationships amongst all grain characteristics suggested that variables of grain structure (size, volume and percent hull) have a decisive influence on the grain- filling process (rate and duration of grain filling). The grain-filling process will affect final grain traits such as weight and density, which in turn will have a direct impact on head rice. In addition, non- uniformity, whether expressed in terms of variable grain size and shape or grain filling and maturity, has a detrimental effect on rice milling quality. The implication of these findings is that rice breeders need to pay more attention to selecting plant types that have a high degree of uniformity of grain characteristics on the panicle, and to those traits (such as greater grain size, weight and density) that have a positive impact on yield and milling quality. Sorenson et al (1973) confirmed that importance of grain type in the relationship between cracked rough rice and broken milled rice. They reported that long grain stress-cracked rice kernels are very fragile and break easily during milling. The medium grain stress cracked kernel very often with stand milling without breakage is only partially related to the quantity of cracked kernels in the rough rice

MATERIAL AND METHODS

1. Soil collection and analysis:

Soil samples were taken from experimental site before and after seedbed preparation for each sub-sub plot to determine physical, chemical analysis and soil properties.

a- Soil mechanical analysis:

Three samples were taken from each area for mechanical analysis. The samples were taken to represent the soil for each experiment. The depth of samples ranged from (0-30). Mechanical analysis of the soil showed that the soil was sandy clay loam as shown in Table (1).

Depth	Sand	Silt	Clay	Texture
0-30	54.00	16.10	29.90	Sandy clay loam

b- Soil chemical analysis:

Chemical analysis of the soil was stated based on information collected by soil and water department, Faculty of Alex. As shown in Table (2).

Soil characters	PH	EC (ds/m)	Mg^{+} (meq/l)	Na^{+} (meq/l)	Ca^{++} (meq/l)	Hco^{-}_{3} (meq/l)	Cl^{-} (meq/l)	Available N (ppm)	Available P (ppm)
Site 4-2	8.04	1.65	3.40	2.65	4.40	3.50	1.50	16.50	18.31

c- Soil moisture content:

Soil samples were taken at three depths 10, 20 and 30cm. Three steel soil cores of 5cm internal diameter and 4cm height were inserted into the soil profile. Soil samples were taken at three locations for each plot. Soil moisture content was determined using the oven method at 105 c for 24 hours.

d- Soil density:

A set of similar soil cores were used to take soil samples before plowing. Three soil cores were inserted into the soil profile at three depths 10, 20 and 30 cm before and after tillage. A special apparatus was constructed and used to determined the soil density in three layers (0-10), (10-20) and (20-30cm) after tillage. The apparatus consists of a box with two sliders to separate the three soil layers. The box had a dimension of 25*25*30 cm. the whole box was inserted into the soil without the two sliders. The bulk density was determined as a function of weight and volume of soil. sample.

2. Tillage quality measurements:

Tillage quality parameters, the reduction in the soil penetration resistance (ΔP %), the reduction of bulk density and mean weight diameter (M.W.D) were evaluated for each treatment in the field test.

a- Soil resistance to penetration:

Penetration resistance is composite parameters that involves several independent parameters of soil but is generally considered to reflect the soil strength. A simple probe known as a pentameter was used to measure the soil resistance with respect to its depth. Penetrometer force reading per unit of base cross sectional area provides indication of relative strength and uniformity versus depth in a particular soil condition. It follows the American society of agricultural engineer's standards for small cone penetrometers. The penetration resistance was measured before and after seedbed preparation to calculate the percentage reduction of soil resistance due to tillage.

b- Aggregate -size distribution:

Set of sieves having square holes were used to determine the clod size. An area of about (50cm*50cm) was chosen at random from the tilled area to determine the size of clods. The tilled sample was put on the upper sieve, and then the set of sieve were shaken. The soil retained on each sieve surface was weighed. The soil mean weight diameter (M.W.D) was determined according **Rnan test code (1983)** a follow:

$$M.W.D = \sum_{n}^{i=1} X_i * W_1 / W_T$$

$$X_i = \frac{\varepsilon_{i-1} + \varepsilon_i}{2}$$

Where: X i = the mean weight diameter of each fraction.

WI = the weight of the soil retained on each sieve.

W T = the total weight of the soil retained on the sieves.

ξ = sieve mech.

3. Tillage treatments:

Two methods of seedbed preparations were used as follows:

C.T: Conventional tillage (the soil was prepared using chisel plow in two perpendicular passes (at depth 15 cm), followed by disc harrow and the soil was leveled by scraper. The power source was a Belarous tractor 90hp.

R.T: Reduced tillage (the soil was prepared using chisel plow in one pass at a depth of 15 cm), The power source was a Belarous tractor 90 hp.

4. Planting systems:

Three planting methods were used as follows:

PL_1: Mechanical drilling.

PL_2: Random manual transplanting

PL_3: Transplanting in rows (20*20).

4. 1. Mechanical drilling system:

Mechanical drilling system was done using mounted plain seed drill of 17 rows with 3m width. The seed is pre- germinated (dry seed).It was drilled in to non- puddled soil at 2-3cm depth and then covered by soil for proper germination to avoid bird damage. This method of planting needs less number of labours (IRRI 2006). In this system, super phosphate 15% (100 kg/f_d) and urea 46% (50 kg/f_d) were added to the soil before and after plowing respectively. The second and third quantity of urea 46% were added after 21 and 45 days from drilling. Saturn 50% (3 lit/f_d + 100 liters of water) was used for weed control after 3-4 days from planting. The drilled plots were irrigated at 5 days interval after drilling for a period of 25-30 days and then continuously flooded. Seeding rate was adjusted for this system to 45 kg/ f_d

4. 2. Random Manual transplanting system:

In this planting system the seed was soaked in water for 24 hours and spreaded them in floor. Then incubate by covering with polyethylene bags for 48 hours until getting sprout and then spread the sprouted seeds uniformly on a puddled nursery field. Drain excess water from the field for a week, after that transferring seedling from nursery and transplant it by 2-3 seedlings per hill randomized. The manual transplanting was done by a team of labour. Seeds were sown by hand in the nursery at a rate of 50 kg/f_d The same fertilizer lied in mechanical drilling was used for the manual transplanting system (main land), but only the second quantity of urea 46% (50 kg/f_d)was added after 30-40 days from transplanting. Saturn 50% (3 lit + 100liters of waters) was used as a weed control after 8-9 days from transplanting. After transplanting by 3 days, the main land was irrigated to a height of 3cm. This level was increased gradually until crop gets mature.

4. 3. Transplanting in rows (20*20):

In this system, the seeds were treated as the same in random transplanting system, but in row transplanting the space be 20cm between rows and 20 cm between plants. Seeds were sown by hand in the nursery at a rate of 50 kg/fd The same fertilizer methods applied in mechanical drilling was used for the manual transplanting system (main land), but only the second quantity of urea 46% (50 kg/f_d) was added after 30-40 days from transplanting. Saturn 50% (3 lit + 100 liters of waters) was used as a weed control after 8-9 days from transplanting. After transplanting by 3 days, the main land was irrigated to a height of 3cm. This level was increased gradually until crop gets mature Sowing systems were done according to the technical recommendations of agriculture research center, ministry of agriculture, 2005.

The two varieties used in this experimental were: (Giza 182) as a long grain and (Sakha 101) as a short grain.

5. Harvesting method:

After approximately 124 days from planting, the crop was harvested when the field completely drained, the panicles became yellow, and the grain moisture content was approximately 18 % in each sub- plot. The harvesting was done manually using sickle. Harvested area was 1 m^2 and repeated three times for each sub-plot. The harvested plants were left for about three days to be air-dried in the field. Then the crop was moved to the threshing location for separating the paddy grain from the panicle using laboratories experimental threshing unit.

6. Agronomic Characteristics:

6.1. Plant height (in centimeters):

Ten random plant heights were measured in each sub- plot. Each plant height was determined from the soil surface up to the apex of the plant and the average of the ten plant heights were calculated and recorded.

6.2. Panicle length (in centimeters):

Ten panicles were chosen at random from the harvested plants of each sub-plot. The length of each panicle was measured from the node to the uppermost panicle. The average of the ten lengths were calculated and recorded.

6.3. Panicle Weight (in grams):

Panicle Weight is determined by weighing each of the previous ten panicles (6.2) and their average was determined.

6.4. Filled grains weight per panicle (in grams):

The filled grains weight in each of the previous ten panicle (6.2) was weighed and their average was recorded.

7. Grain yield and its components characteristics:

7.1. Grain yield (ton / f_d):

Harvesting was done when grain moisture content was approximately 18%. In each subplots. The yield of rice crop was obtained by measuring the weights of grain obtained from harvesting of three different areas of 1m^2 each. The harvested plants were left for about three days to be air-dried in the field, after which they were threshed by a laboratory experimental threshing unit at grain moisture content of about 16%. The obtained grain yield was weighted in kilograms/plot and, then converted into tons/fed. The grain moisture percentage was estimated by using the Satake grain moisture Meter.

7.2. Number of spike- bearing tillers per m^2:

Number of spike - bearing tillers/m2 was determined by counting the panicles in three random areas of 1m^2 in each sub- plot and their average was calculated. It was determined two days before harvesting. .

7.3. Number of filled grains per panicle:

Ten panicle were chosen at random from the harvested plants of each sub-plot. The number of filled grains on each of this panicle was counted and their average was recorded.

7.4. Seed Index (1000- grains weight) in grams:

Ten random samples, each of 1000 grains, were drawn from the total number of filled grains from the pervious panicles and each was weighed. Their average represented the 1000- grain weight sub-plot.

8. Engineering characteristics:

8.1. Grain length and width (mm):

Each dimension was determined (in mm) by the micrometer as an average of 500 random rough grains/ sub-plot.

8.2. Grain shape:

Expressed as the grain length (in mm)/ grain width (in mm) ratio. It was recorded as an average of the above-mentioned (8.1) ten random rough rice grains/sub- plot.

8.3. Rigidity (kg.m/m^2):

Rigidity of the grain has close relationship with the quality. The grain with higher moisture content or chalky grain shows less rigidity and consequently, milling recovery will be less.

9. Milling recovery characteristics:

1- Precleaning:

The paddy was mechanically cleaned to remove foreign materials such as straw, soil particles, mud ball, seeds and impurities. According to the different shapes, sizes and specific weight. A precleaning electric apparatus model (TRG). The apparatus consists of four oscillating and replicable sieves. To ensure high degree of cleaning recycling in the apparatus is done.

2- Grading:

The paddy which was obtained from the precleaning apparatus was sorted by the Testing Thickness Grader model (TWS). Immature grains of less thickness were separated out through the solts, while regular or thicker grains were discharged through the out let to the receptacle. For long grains of paddy, we used hexagonal screen supplied with mesh 1.7mm and to the short gains of paddy 1.8mm with an input capacity 600grams for each operation, this apparatus is supplied with motor 100 watt and revolution of main shaft 70 rpm. When the immature grains in the paddy have almost separated from the grains discharge the paddy into the receptacle.

3- Husking:

The first step in the milling operation of rice is removal of hulls. Laboratory rubber roll Sheller model (THU-35A) with a capacity of 40 kg/hr.The husker consists of two rubber rolls, each of 100 mm diameter and 35 mm wide. The rolls are driven mechanically with

Motor 400 watt, and rotate in opposite inward directions. A weight sample (100g) of paddy of each variety was dehusked by adjusting to grain size so as to minimize the breakage of rice. The shelled rice and husk were weight separately for determining the yield of brown rice.

4- Milling:

For milling test, Testing Mill Model (TM- 05) with an input capacity of200 grams/ one time was used .This whitening equipment consists of abrasive roll # 36 is of 36cm diameter and rotate at a speed of 450 rpm by motor 400 watt. The roll rotate inside a fixed cylinder is of 38 cm diameter made of perforated steel. The bran layer is removed from the brown rice as a result of the friction between rice kernels and both cylinders. The milling components (brown rice, hull, total milled rice, head rice, broken rice, bran and germ) were then weighted and recorded. All milling components were balanced with the incoming paddy before milling

RESUL TS AND DISCUSSION

1- Effect of different land preparation methods on soil physical and mechanical properties:

1.1. Soil moisture content:

Soil moisture content was measured before and after tillage for each treatment at depths of (0-10), (10-20) and (20-30) cm. The average moisture content of the three depths was 13% before tillage, and 11%, 10.2 % after tillage for RT and CT respectively. It is clear that the moisture content after tillage using chisel plow two passes (CT) higher than chisel plow one pass (RT).This result agrees with Lindwall and Erback (1983) who indicated that tillage and planting systems had significant effects on soil moisture content.

1.2. Soil density:

Soil bulk density was measured before and after tillage for each treatment at three depths (0-10), (10-20) and (20-30) cm. The average value was 1.39 g/cm3 before tillage and 1.22, 1.13 g/cm3 after tillage for RT and CT respectively. It is apparent that the bulk density decreases after land preparation using chisel plow two perpendicular passes (CT) than that of chisel plow one pass (RT). This gives a clear indication that bulk density is significantly affected by the tillage system. Since the soil, porosity is higher in complete tillage than reduced tillage, which leads by turn, to an increase in root aeration, water permeability and an increase in nutrient movement. All of which create a suitable environment for plant growth.

1.3. Aggregate -size distribution:

The mean weight diameter of the soil clods was determined after tillage treatments. The average mean weight diameter was 34.3mm in reduced tillage (RT) while was 23.1mm in complete tillage. Based on this result, the use of chisel plow in two passes then harrowing using disk harrow gave the best degree of soil clod size than that of reduced tillage using chisel plow one pass. This result agrees with obtained by Samir (1995) who mentioned that mean weight diameter for soil aggregate is affected by plow type and soil land preparation. It means that decreases of soil clod size decreased the plant deviation percentage and increase crop productivity as also indicated by Abo- Habaga (1992).

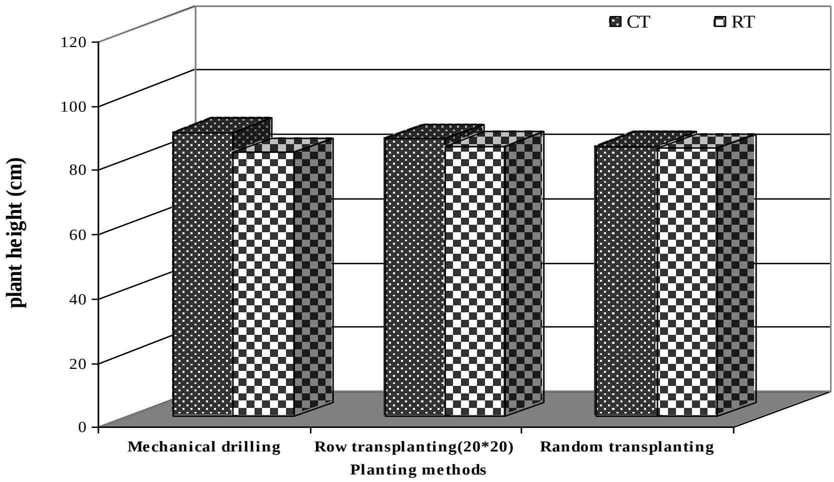
1.4. Soil resistance to penetration:

Soil penetration resistance was measured by using a soil penetrometer before and after tillage treatments. The average value was 906 kPa before tillage and after tillage, it becomes 407.7 kPa using chisel plow in two passes (CT). The reduction in soil penetration resistance was 55%. In case of reduced tillage using chisel plow one pass, the soil penetration resistance was 543.6 kPa with reduction percentage 40%. In conclusion, soil penetration resistance decreased with soil bulk density decreased. In addition, it depends upon soil moisture content, soil type and specific weight according to El- Banna (1987). Hence, decreasing of soil penetration resistance increased plant ability to penetrate the soil surface and therefore increase the seedling emergence that by turn, affect in crop yield.

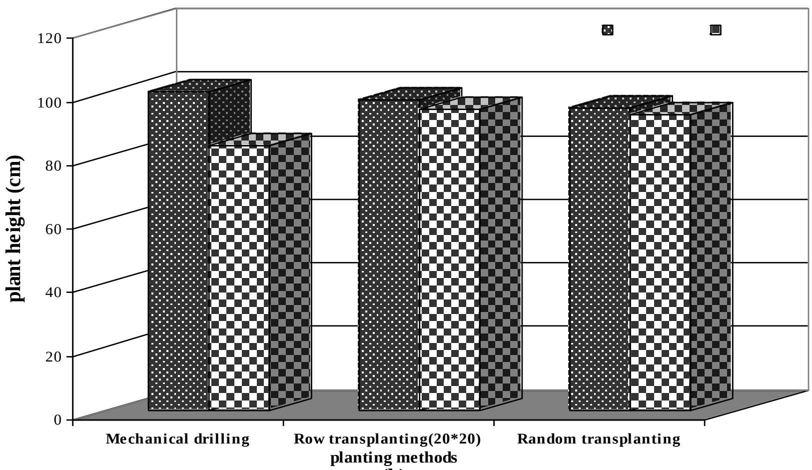
2- Effect of different land preparation and planting systems on the agronomic characteristics of rice:

2.1. Plant height (cm):

The average values of the plant height for different land preparation methods and planting systems for the two seasons were estimated. It is clear that the highest plants were obtained with conventional tillage (CT) method rather than that of reduced tillage method (RT) for both varieties "Giza 182 and Sakhal0l" as shown in Figure (1). Moreover, there were differences in plant height between planting systems. Generally, mechanical drilling system gave higher plants with conventional tillage treatment (CT) followed by transplanting in rows (20*20) then random man\1al transplanting. This result agrees with that obtained by Aref 1990 who mentioned that in case of drilling method, the highest plants were affected by plant intensity. Low number of seeds per unit area permitted plants to grow freely without competition. So seeds gave higher number of tillers and consequently taller plants. This result agrees also with Bahnas (2003) who concluded that behavior may be due to the maximum .root volume in mechanical drilling. Land leveling scraper creates more suitable soil conditions of root distribution, consequently, the root volume increases. The increased root volume provides more water and more nutrients to plants causing more plant anchorages. So mechanical drilling achieved the earlier flowering time, the higher plant height and the maximum yield. On the other hand, reduced tillage method (RT) resulted in lowest plant height with mechanical drilling, while the higher plants was recorded in transplanting in rows (20*20) followed by random manual transplanting.



(a)



(b)

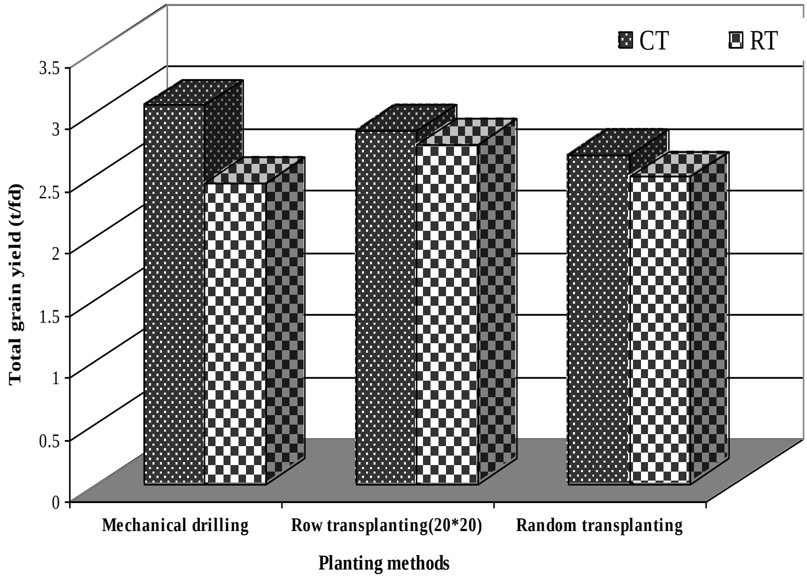
Figure (1) Effect of land preparation and planting system on average plant height for the two rice varieties a- Giza 182 b- Sakha 101

The statistical analysis data showed a significant difference between tillage treatments. Also, there was a significant difference between the two varieties, where Sakha 101 exceeded Giza 182 in plant height. There were a highly significant difference in plant height between planting systems (PL), and between tillage treatments and planting systems (PLO*PL) due to interaction. However, there were no significant interaction between the three treatments (PLO*PL *V AR) in two seasons.

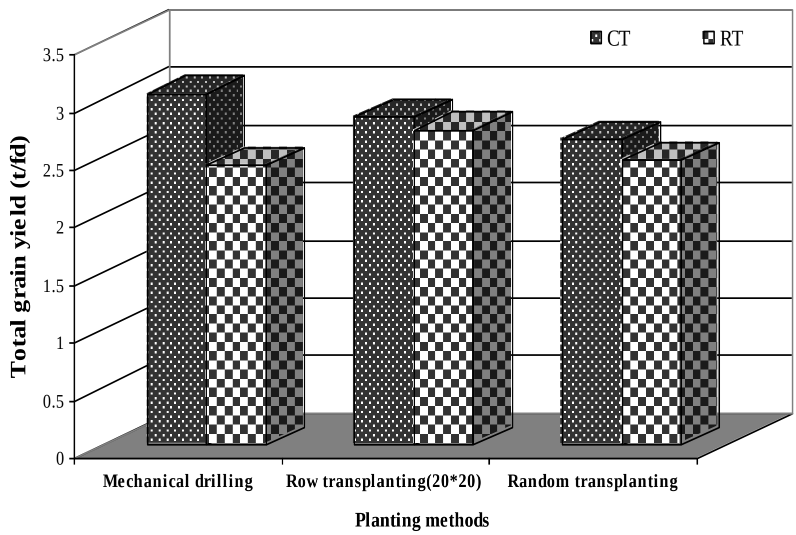
3. Effect of different land preparation methods and planting systems on grain yield and its components:

3.1. Total yield (ton/f_d):

Yield in ton per feddan is graphically illustrated in figure (2) for the two rice varieties. The chisel plowing in two passes (CT) is remarkably superior to the chisel plowing in one pass (RT) for both seasons. The maximum total grain yield with respect to planting systems was achieved by mechanical drilling system with conventional tillage (CT). This may be ascribed to the greater ability of chisel plowing in two passes in weed killing and break- up of soil (Samir 1995). The physical properties of the seedbed therefore have a considerable effect on seedling emergence, plant stand establishment and subsequent plant growth and yield. Seedling emergence is sensitive to the physical conditions of the soil in the seedbed concerning bulk density, penetration resistance, aggregate mean weight diameter and these factor combinations. All of which result in better nutrients movement causing an increased root volume and consequently, more plant anchorage. Also, they enhance the vegetative growth leading to stronger stem, increase number of tillers, panicle weight and number of filled grain, but if the vegetative growth exceeded the accepted limit for this variety, it will lead to negative results since the plant becomes longer, more branched and more panicle but with fewer filled grains. That illustrates the importance of a planting system and its. Convenience with tillage method for each variety. In contrast, the minimum yield of about (2.42 ton/f_d) obtained by the chisel plow one pass with mechanical drilling. Moreover, the same trend of this result was recorded with the other variety Sakha 101 (short grain). Analysis of variance proved that the yield of the chisel plowing in two passes (CT) was significantly higher than the other treatment



(a) -



(b)-

Figure (2) Effect of land preparation and planting system on average total grain yield for the two rice varieties a- Giza 182 b- Sakha 101

4 - Effect of different land preparation methods and planting systems on some physical and mechanical properties of rice:

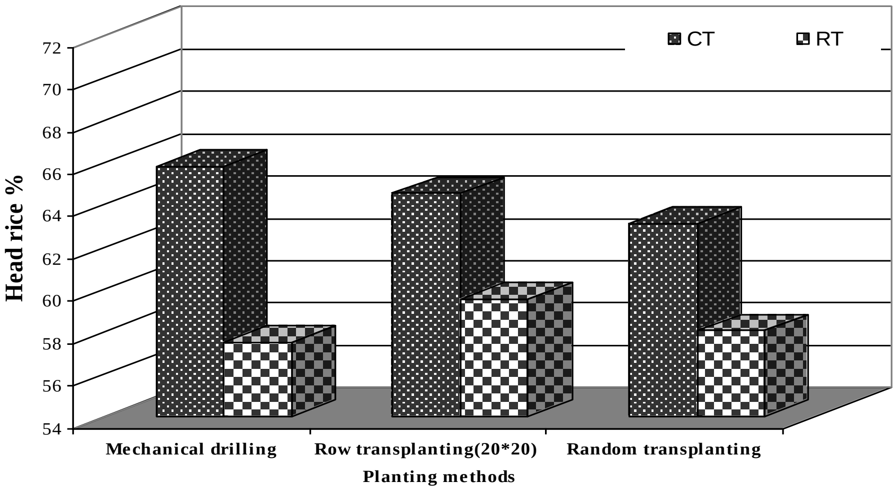
Measurements in this part aimed to declare the effect of different land preparation methods and planting systems on some physical and mechanical properties of rice grain (length (L) - width (W) - grain shape the factor (L/W) - grain rigidity).The results showed that as the grain shape decreased, the grain rigidity increased. Consequently, increasing the ability to withstand stresses during hulling and whitening processes, which resulted in higher head rice percentage (HRP). This behavior was clear in conventional tillage treatment (CT) with mechanical drilling system but in case of reduced tillage treatment (RT), it was recorded with transplanting (20*20).

5- Effect of different land preparation methods and planting systems on milling quality:

In this part, the overall objective was to evaluate the effect of different land preparation methods and planting systems on milling quality. The specific objectives were to determine (hulling recovery%, milling recovery %, head rice %, total milled rice %, broken rice % and bran & germ %).

5.1. Head rice percentage (HRP):

The trend of. the effect of land preparation and planting systems on head rice percentage (HRP) are similar to those of hulling recovery percentage (MRP) where, Sakha 101 surpassed Giza 182 in head rice percentage (HRP) as shown in Figure (3). In addition, results show that mechanical drilling gave highest value with conventional tillage treatment (CT). Random manual transplanting gave the lowest value. This result agrees with 1000- grain weight which discussed before. It means that the different agriculture practices have significant effects on the specific grain dimensions and also on building up layers of growing grain starch. Consequently, the grain strength may vary and different results would be obtained when subjected to milling process. This would enlighten the importance of milling when it comes to revenue assessment, especially, when one variety gives high yield with low milling quality and low head rice percentage. Eventually, without milling, there will not be a real estimate of return or profit according to Zein El Din (2000). In contrast, mechanical drilling system in case of reduced tillage treatment (RT) gave the lowest head rice percentage (HRP) while transplanting in rows (20*20) gave the higher values. In addition, the statistical analysis of data shows significant difference between tillage treatments (PLO). In addition, there were a significant interaction between tillage treatments with planting systems (PLO*PL).



a) -

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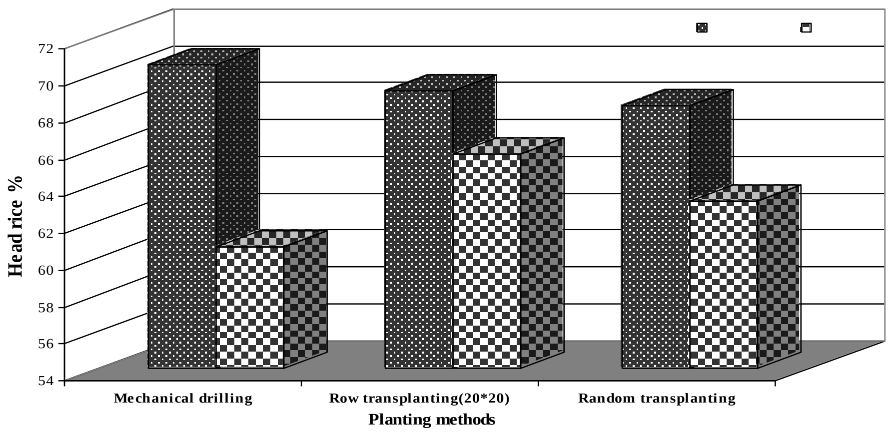

Figure (3) effect of land preparation and planting system on average head rice% for the two rice varieties a- Giza 182 b- Sakha 101

CONCLUSION

The present work was carried out to determine the effect of different land preparation methods and planting systems of rice on yield and milling quality. The conclusions drawn from these experiments are: I '

1- The maximum plant height was obtained from mechanical drilling combined with conventional tillage treatment (CT).However in case of reduced tillage treatment the row transplanting (20*20) gave higher plants followed by random manual transplanting, mechanical drilling respectively. Moreover, the statistical analysis showed a significant difference between tillage treatments (PLO). Also, between the two varieties (VAR) where, Sakha 101 exceeded Giza 182 in plant height as general trend.
2- For both seasons, there was a difference in panicle length between tillage treatments, where conventional tillage (CT) gave higher panicle length than reduced tillage treatment (RT). Mechanical drilling system combined with conventional tillage (CT) treatment obtained higher panicle length compared with transplanting in rows (20*20) and random manual transplanting. In case of reduced tillage treatment (RT) with transplanting in rows system recorded higher panicle length than other planting systems.
3- The trend of the effect of land preparation and planting systems on panicle weight and filled grain weight per panicle are similar to those of panicle length.
4- Different treatments of land preparation and. planting systems had significant effect on total grain yield and its components for the two seasons and both varieties.
5- In case of conventional tillage treatment (CT) mechanical drilling system resulted in higher total yield followed by transplanting in rows (20*20) and random manual transplanting. While, transplanting in rows (20*20) with reduced tillage treatment (RT) gave higher grain yield in both seasons for the two varieties.
6- The highest number of spike- bearing tillers per sq.m (457.65, 452.5 tillers) was obtained form the mechanical drilling system with conventional tillage (CT) treatment for Giza 182 and Sakha 101 respectively. The least number of tillers per sq.m (418.30, 422.8

tillers) from the random manual transplanting for Giza 182 and Sakha 101 respectively y.

7- The results of number of filled grains/ panicle I and 1000- grain weight were similar to number of tillers per sq.m and total grain yield.

8- There was an internal relationship between the grain shape and rigidity of grain. As the grain shape value (length to width ratio) decreased, the rigidity of the grain increased. This relationship was clear under conventional tillage treatment (CT) with mechanical drilling system,' but In case of reduced tillage treatment (R T) this behavior was recorded with transplanting in rows (20*20). It means increasing the ability of grains to withstand stresses during hulling and whitening processes, which resulted in higher head rice percentage (HRP).

9- The highest head rice and lowest broken rice percentage were recorded in conventional tillage treatment (CT) compared to reduced tillage treatment (RT).

10- The highest head rice and lowest broken rice percentage were obtained in mechanical drilling system with conventional tillage treatment (CT).

11- The highest head rice % and lowest broken rice % were obtained in row transplanting (20*20) system with reduced tillage treatment (RT).

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الملخص العربى

تأثير طرق إعداد التربة و الزراعة على الإنتاجية والخواص الهندسية لجودة ضرب الأرز

ا.د. عبد الله مسعد زين الدين* ا.د. طارق كمال الدين علي* أ.د. احمد عبد القادر الحصيوي م. رضا جلال عبد الحميد*****

الهدف من هذا البحث هو دراسة تأثير طرق مختلفة من إعداد التربة للزراعة وطرق مختلفة من الزراعة لأصناف مختلفة من الأرز على كل من إنتاجية الأرز(طن/فدان) وعلى مكونات الإنتاج والصفات المحصولية وأخيرا على جودة عملية الضرب واعلى نسبة أرز سليم ولتحقيق هذا الهدف تم الآتى:

١. تصميم تجربة كاملة تحتوى على طرق مختلفة من إعداد التربة وطرق مختلفة من الزراعة مع صنفين مختلفين من الأرز.
٢. قياس بعض الخواص الهندسية (الفيزيائية والكيميائية) لحبوب الأرز والتى لها علاقة بجودة عملية الضرب (طول الحبة-عرض الحبة-معامل شكل الحبة(طول الحبة/عرضها)-درجة الصلابة).
٣. تقدير جودة عملية الضرب عن طريق معرفة نسب المكونات الآتية(الأرز المقشور%-الأرز المبيض الكلى%-الأرز السليم%-الأرز الكسر%).
٤. التوصية بأفضل طريقة إعداد للتربة وأفضل طريقة زراعة وفقا لإنتاجية المحصول وجودة الحبوب وجودة عملية الضرب لكل من صنفى الأرز تحت الدراسة.

استخدام هذه الدراسة التصميم الأخصائى عديد الانشقاق (spilt-spilt plot design) وكررت التجربة فى موسمى زراعة٢٠٠٥ و٢٠٠٦ .وقد تم تحليل التربة ميكانيكيا لمعرفة قوام التربة،ثم تم تقدير بعض الخواص الفيزيائية للتربة منها (المحتوى الرطوبة للتربة-الكثافة الظاهرية للتربة-مقاومة التربة للاختراق-متوسط قطر حبيبات التربة) قبل وبعد إجراء عملية الحرث وذلك لوصف جودة تلك العملية.حيث تم إعداد التربة بطريقتين حرث كامل (Conventional tillage) باستخدام محراث حفار سكتين متعامدين ثم التنعيم باستخدام المشط القرصى والتسوية بالقصابية-حرث مخفض (Reduced tillage) باستخدام محراث حفار سكة واحدة) وثلاث طرق زراعة

* أستاذ الهندسة الزراعية- كلية الزراعة –جامعة الإسكندرية.
** أستاذ المحاصيل الحقلية- مركز البحوث الزراعية- مركز بحوث تكنولوجيا الأرز.
** طالبة دراسات عليا – كلية الزراعة - قسم الهندسة الزراعية- جامعة الإسكندرية.

{شتل يدوى عشوائى- شتل يدوى منتظم (بالحبل) على مسافات (٢٠ × ٢٠ سم) - التسطير الميكانيكى} لصنفين من الأرز احدهما طويل الأخر قصير الحبة (جيزة ١٨٢ سخا ١٠١ على الترتيب).

يمكن تلخيص نتائج البحث فى النقاط الآتية:

١. إن طريقة إعداد التربة للزراعة باستخدام الحرث الكامل (Conventional tillage) كانت أفضل طريقة إعداد التربة بالحرث المخفض (Reduced tillage) فى جميع الصفات المدروسة.

٢. إن هناك تداخل معنوى فى التأثير بين طرق إعداد التربة وطرق الزراعة على معظم الصفات المدروسة.

٣. إن الزراعة بالتسطير الميكانيكى أعطت أعلى النتائج مع طريقة إعداد التربة بالحرث الكامل (Conventional tillage)وذلك لجميع الصفات المحصولية والإنتاجية.

٤. استخدام الحرث المخفض (Reduced tillage) أعطى أفضل النتائج مع الزراعة بطريقة الشتل المنتظم (٢٠×٢٠) يليه الشتل اليدوى العشوائى ثم التسطير الميكانيكى.

٥. كلما قل نسبة طول الحبة إلى عرضها (شكل الحبة) كلما زادت درجة صلابتها وقدرتها على تحمل الاجهادات الواقعة عليها أثناء إجراء عمليتى التقشير والتبييض.

٦. وجد أن اعلى نسبة أرز سليم كانت مع الزراعة بطريقة التسطير الميكانيكى يليه الشتل المنتظم ثم الشتل اليدوى العشوائى وذلك فى حالة إعداد التربة بالحرث الكامل(Conventional tillage) أما فى حالة إعداد التربة بالحرث المخفض (Reduced tillage) فان الشتل المنتظم (٢٠×٢٠) أعطى اعلى نسبة أرز سليم فى الموسمين.

٧. نسبة الكسر تكون عالية دائما فى الأرز قصير الحبة (سخا١٠١) عن الصنف طويل الحبة (جيزة ١٨٢).