Mansoura University
Faculty of Agriculture
Agronomy Department

THE EFFECT OF SYSTEM OF RICE INTENSIFICATION (SRI) ON PRODUCTIVITY OF RICE

BY

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INTRODUCTION

INTRODUCTION

Rice (*Oryza sativa L.*) is one of the most important cereal crops in the world as well as in Egypt. Rice is the principle food for more than half of the world people. The need to raise grain yield of rice per unit land area is considered a native goal to meet both consumption and export from this crop. Among various factors affecting rice production, such as cultivars, seedling age, transplanting spacing between hills, planting methods, nitrogen fertilization and other most important agronomic practice. **Ministry of Agriculture and Land Reclamation (2012).**

The system of rice intensification (SRI) developed in Madagascar during the early 1980 by Fr. Henri de Laulanie, who worked closely with farmers to understand how paddy production could be increased, has demonstrated some remarkable results. Yields on farmers' fields have been doubled, tripled, even quadrupled or more – without new varieties, chemical fertilizer, or other purchased inputs. What is required is different management practices for rice and farmer skills and investment of labor.

The system of rice intensification (SRI) is a system of growing rice where the plant growth environments on a micro scale, particularly within the root zone is deliberately modified. Multi-fold increase of rice yield through SRI is based on the assumption that micro scale modification rekindles the existing genetic potentials that have been suppressed by crop, soil, water and nutrient management practices when growing irrigated rice.

The basic strategy with SRI is to create soil, water and nutrient conditions for the young plant that are so favorable that its growth, when handled carefully, is accelerated. More- over the yield beneficial effect of SRI are reflected in terms of increased yields, increased returns labour. Water saving improvement of soil quality reduced requirements, better food quality and environmentally safety are the feature of SRI cultivation, **Fernandes and Uphoff (2002)**.

Transplanting rice seedlings from a nursery into the paddy field when the plants are relatively mature, 3 to 4 weeks old, as is common practice around the world, with SRI seedlings are transplanted before they are 15 days old, even 8 or 10 days old. This preserves the plants' potential for massive tillering if the other practices are followed. Transplanting seedlings in clumps of 3 or 4, as is almost universally done, with SRI seedlings are transplanted singly, so that there is no competition among plant roots to inhibit growth. Seedlings densely, as is common because having more plants seems likely to produce more rice, with SRI seedlings are planted widely spaced, in a square pattern (to facilitate weeding as well as to give more space between plants), 25 by 25 cm or more widely. Keeping paddy fields continually flooded, with SRI soils are kept well-aerated during the vegetative growth phase. the increase in the yield with SRI was attributed to the increase in number of ear bearing tillers /hill, total number of spikelet /panicle and total length, **Rafaralahy (2002).**

High yielding ability cultivars is very important to raise productivity. For this reason and other several traits are aiming to evaluate the new promising cultivars with the old traditional for scooping light on the best cultivar that can be used on a large scale, **Abou-Khalif** *et al.* **(2007**).

Seedling ages are considered in most cases the limiting factor for grain yield and quality. The youngest seedling recorded the highest significant values of grain yield and most of its components, **Makarim** *et al.* **(2002).**

Transplanting spaces plays an essential role in increasing rice crop productivity. With SRI seedlings are planted widely spaced in square pattern (to facilitate weeding as well as to give more spaced between plants) 25 by 25cm or more widely, **Shinde** *et al*. **(2005).**

There fore, the present investigation was performed to evaluate the influence of seedling age and spacing between plants on two cultivars and their interactions under the system of rice intensification (SRI) on growth, yield and its components as well as milling recovery.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Some of the previous works with regard to the effect of system of rice intensification (SRI) on growth, yield and yield components as well as milling recovery of rice will be reviewed as follows:

A- Effect of cultivars.

B- Effect of seedling ages.

C- Effect of transplanting spaces.

D- Effect of milling recovery.

E- Effect of the interactions.

A- Effect of cultivars:

High yielding ability cultivars are very important to raise productivity. For this reason and other several traits are aming to evaluate the new promsing cultivars with the old traditional for scooping light on the best cultivar that can be used on a large scale. There are many investigators worked on cultivars and came out with similar results, that we concluded.

Abdel-Rahman (1999a) noticed that Giza 178 produced the highest panicle length, number of filled grains/panicle, number of panicles/m, grain and straw yields.

Abdel-Rahman (1999b) revealed that Giza 178 produced the highest number of panicles/m^2, number of filled grains/panicle, grain and straw yields.

Abdel-Rahman *et al.* **(2004**a) found that varietals differences were detected in all studied characters where Giza 178 proved its superiority under saline soil with higher dry matter content, higher sink capacity, higher grain yield.

Abdel-Rahman *et al.* **(2004**b) indicated that. Giza 178 showed the highest panicle length, panicle dry weight, number of filled grains/panicle and grain yield (t/ha). GZ 1368 gave the highest values of plant height, number of panicles/m and straw yield while.

Sharief *et al.* **(2005**) revealed that Giza 178 cultivar was characterized with high number of tillers/hill.

Abou-Khalif *et al.* **(2007**) indicated that H1 hybrid rice variety surpassed other varieties for straw yield and grain yield (Ton/ha).

El-Bably *et al.* **(2007**) showed that Giza 178 significantly exceeded rice cv.

Zayed *et al.* **(2007**) found that the studied varieties (three hybrids: SK2034H, SK2046H and SK2058H and three inbred varieties; Giza 178 varied significantly in its growth parameters.

Abou-Khadra *et al.* **(2008**) showed that Giza 178 had the highest values of grain yield and yield components.

Abou khalifa (2009) found that H1 hybrid rice variety surpassed other varieties (H2, GZ 6522 and GZ 6903) for all characters studied.

Zaki *et al.* **(2009**) indicated that Giza 178 rice variety significantly for all tested growth and yield rice parameters.

Metwally *et al.* **(2010**) revealed that Giza 178-3 gave the highest values of no. of filled grain/panicle and no. of panicles/hill under low input of nitrogen.

B- Effect of seedling ages:

Seedling ages are considered in most cases the limiting factor for grain yield and quality. The youngest seedling recorded the highest significant values of grain yield and most of its components. Instead of transplanting rice seedlings from a nursery into the paddy field when the plants are relatively mature, 3 to 4 weeks old, as is common practice around the world, with SRI seedlings are transplanted before they are 15 days old, even 8 or 10 days old. This preserves the plants' potential for massive tillering if the other practices are followed. There are many investigations with respect to the effect of seedling ages on rice productivity. In this connections,

Molla *et al.* **(2001**) Stated that twenty-eight-day-old seedlings produced more tiller, panicles/m, and grain yield than 21-day-old seedlings.

Pattar *et al.* **(2001**) discriminated that planting of 35- or 45-day-old seedlings produced significantly higher yields, grain weight and number of filled grains per panicle compared to 25-day-old seedlings. When transplanting was delayed to the second fortnight of August, the performance of both 35- and 45-day-old seedlings was greater than that of 25-day-old seedlings.

Chopra *et al.* **(2002)** reported that the thirty-five-day-old seedlings had greater number of panicles per hill, panicle length, 1000-seed weight, test weight, and seed yield than 55- to 65-day-old seedlings.

Makarim *et al.* **(2002)** found that 15 day old seedlings gave significantly higher grain yields than 21-d-old seedlings when a single seedling was planted hill–1.

Sanico *et al.* **(2002**) identified that increasing seedling age from 2 to 5 weeks resulted in significant reductions in snail damage in terms of missing hills. Increasing seedling number per hill to 8, 6, 4 and 2 for 2-, 3-, 4-, and 5-week-old seedlings, respectively, also reduced snail damage significantly. In the snail-free experiment, grain yield was not affected significantly when seedling age increased from 2 to 5 weeks. Increasing seedling number per hill decreased or increased grain yield depending on the season and seedling age.

Upadhyay *et al.* **(2003**) noticed that growing of 20- and 30-day-old seedlings produced significantly higher grain yield over growing of 40- and 50-day-old seedlings.

Uphoff (2004) noticed that young seedlings (15 days) produce larger, more productive mature plants. This can be explained in terms of the physiology of phyllochrons, transplanting during the 2nd or 3rd phyllochron so as to disturb the plant minimally and preserve maximally its potential for tillering and root growth.

Khakwani *et al.* **(2005**) showed that older seedlings, with the exception of root dry weight, could not perform well compared to young seedlings in all physiological and morphological aspects.

Shen *et al.* **(2006)** noticed that the effect of seedling age on seedling quality and yield was predominant. The trend of grain yield reduction was obvious when seedling age was extended from 16 to 21 days after sowing.

Rao *et al.* **(2007)** indicated that transplanting of 45 days old seedlings recorded significantly higher gross returns as well as net returns as compared to 30 and 60 days old seedlings in rice and rice-green gram system.

Upadhyay *et al.* **(2007)** the youngest seedlings resulted in higher number of effective tillers per hill, panicle length, number of grains per panicle and grain yield than the other seedlings.

Chandrakar *et al.* **(2008**) indicated that the youngest seedlings resulted in the lowest number of days to greatest number of productive tillers per plant, plant height, panicle length and number of seeds per plant.

Kumar *et al.* **(2008)** found that the seedling age had significant effect on yield, and a higher mean grain yield was obtained with 30-day-old seedlings (28% increase over 40-day-old seedlings).

Pasuquin *et al.* **(2008)** showed that grain yield was consistently higher for younger seedlings, with, in some cases, a difference as large as 1 t ha between 7- and 21-day transplanting. In contrast, no significant difference was observed for the influence of nursery type on the timing of tiller emergence and on grain yield. Some differences in seedling vigor (plant dry weight, specific leaf area, N content), higher in the case of dapog and wet bed, and in maximum tillering, higher in the case of the seedling tray, however, were observed. But these differences did not have a significant impact on the late increase in crop dry matter and on panicle number at maturity.

Raj *et al.* **(2008)** found that 14-day-old seedlings recorded significantly higher plant height, number of productive tillers, number of Panicles, number of grains per panicle and 1000-grain weight than older aged seedlings.

Reddy *et al.* **(2008)** found that 12 days old of seedlings showed maximum no. of tillers/hill, dry weight no. of productive tillers/m, length of panicle, grain yield and straw yield.

Goel *et al.* **(2009)** found that 20 day old seedlings were most suitable for all traits under this study.

Hanumanthappa *et al.* **(2009)** indicated that twelve-day-old seedlings resulted in the highest number of tillers at 60 days after transplanting or (DAT) and grain yield.

Krishna *et al.* **(2009)** found that twelve-day-old seedlings produced higher number of tillers, number of Panicles and productive tillers per plant during harvesting compared to 8-, 16- and 25-day-old seedlings.

Manjunatha *et al.* **(2009)** noticed that Crops grown with 9- and 12-day-old seedlings recorded the significant highest grain yields over the rest of the treatments.

Manjunatha *et al.* **(2010**) younger seedlings of 9 days and 12 days produced significantly higher grain yield than other aged seedlings viz., 15 days, 18 days and 21 days.

Singh *et al.* **(2011**) indicated that ten days old seedling being at par with 20 days old seedling recorded maximum grain yield and straw yield.

C- Effect of transplanting spaces:

Instead of planting seedlings densely, as is common because having more plants seems likely to produce more rice, with SRI **seedlings are planted widely** spaced, in a square pattern (to facilitate weeding as well as to give more space between plants), 25 by 25 cm or more widely. There are many investigators working on transplanting spaces and came out similar results, in this connection,

Ferraris *et al.* **(1973)** found that plant spacing (25 × 25, 25 × 12.5 and 25 × 6.25 cm) did not influenced grain yield significantly.

Trivedi and Kwatra (1983) observed that length of panicle increased with wider spacing.

Sukla *et al*. **(1984)** recorded more fertile grains per panicle and length of panicle with wider spacing (30 × 10 cm) as compared to that with closer spacing.

Wagh and Thorat (1987) reported significantly higher grain and straw yield with closer spacing than that with wider spacing. They were further concluded that crop planted with 15 × 10 cm recorded significantly higher test weight than that with crop planted with 20 × 15 cm spacing.

Shah *et al*. **(1987)** reported that closer spacing of 10 × 10 cm recorded higher grain and straw yield than the wider spacing of 15 × 15cm.

Verma *et al*. **(1988)** found significantly higher harvest index with lower plant density 27 hills per m² (25 × 15 cm) than that with higher plant density of 44 hills per m² (15 × 15 cm).

Srinivasan (1990) revealed that closer spacing of 15 × 10 cm produced significantly higher grain yield of the main crop but spacing had no significant influenced on ratoon yield. However, productive tillers per m² were significantly higher with closer spacing both main and ratoon crop.

Balasubramaniyan and Palaniappan (1991) found higher grain and straw yield with closer spacing of 15 × 10 cm over the wider spacing of 20 × 15 cm.

Krishnan *et al.* **(1994)** more panicle length was found with wider spacing of 20 × 10 cm than the closer spacing of 15 × 10cm.

Samdhia (1996) recorded no significant effect of spacing (20 × 10, 15 × 15 and 20 × 15 cm) on harvest index. However, maximum harvest index was obtained with wider spacing.

Liu *et al.* **(1997)** found that wider spacing 16.5 × 19.8 cm plant spacing was significant effect on all character under this study.

Srivastav and Tripathi (1998) observed that number of fertile grain per panicle was more with closer spacing of 15 × 10 cm than with wider spacing of 20 × 15 cm.

Padmaja and Reddy (1998) recorded significantly higher grain yield with 15 × 15 cm spacing than that with 20 × 15 cm spacing. They were also found significantly more filled spikelets per panicle with wider spacing of 20 × 15 cm as compared to that closer spacing of 15 × 15 cm.

Sanico *et al.* **(1998)** concluded that plant spacing (20 × 20, 20 × 30, 15 × 30 and 10 × 30 cm) gave no significant differences on yield components.

Shrivastava *et al.* **(1999)** revealed that more panicle length, filled grains per panicle, 1000-grain weight and grain yield was recorded with closer spacing of 15 × 10 cm as compared with wider spacing of 20 × 10 and 20 ×15 cm.

Siddiqui *et al.* **(1999)** recorded significantly higher grain and straw yield with closer spacing of 10 × 10 cm over the wider spacing of 20 × 10 cm.

Geethadevi *et al.* **(2000)** noticed that maximum grain yield was obtained with 20 × 10 cm spacing than that 15 × 10 cm spacing.

Geethadevi *et al.* **(2000)** found that rice crop planted with 20 × 10 cm spacing produced significantly more effective tillers per hill than the crop planted with 15 × 10 and 10 × 10 cm.

Patra and Nayak (2001) found significantly higher panicle per m^2, grain yield and straw yield with closer spacing of 15 × 10 cm as compared to with wider spacing of 20 × 10 cm. However, panicle length, weight per panicle and 1000-grain weight did not influenced significantly by the spacing.

Pandey and Tripathi (2001) reported that closer spacing of 15 × 10 cm resulted more grain yield than the wider spacing of 20 × 10 cm.

Varma *et al.* **(2002)** found that spacing 20 × 15 cm produced higher grain yield and harvest index over the 20 × 10 cm spacing.

Verma *et al.* **(2002)** found that crop planted with 20 × 20 and 20 × 15 cm produced significantly more number of productive tillers per m² than the crop planted with 20 × 10 cm.

Nayak *et al.* **(2003)** revealed that wider spacing of 20 × 15 cm recorded maximum plant height, total and effective tillers per hill and dry matter accumulation per clump than that closer spacing of 20 × 10 and 15 × 15 cm.

Shivay and Singh (2003) observed that plant geometry (20 × 15, 25 × 12 and 30 × 10 cm) did not influenced the plant height significantly at the harvesting stage of the crop.

Rajesh and Thanunathan (2003) reported that crop planted with wider spacing of 20 × 15 cm recorded significantly higher grain yield as compared to crop planted with closer spicing of 20 × 10 and 15 × 15 cm.

Chopra and Ahopra (2004) noticed that wider spacing of 20 × 15 and 30 × 15 cm recorded significantly higher number of panicales than the closer spacing 15 × 15 cm. However, the seed yield was not affected due to diffenent spacing.

Uphoff (2004) found that the yield increased significantly, optimum performance with SRI methods has not yet been obtained. Optimum yield depends on spacing and the most appropriate management practices with the best selected variety for the particular conditions.

Zhang *et al.* **(2004)** found that transplanting density did not influenced plant height significantly.

Shinde *et al*. **(2005)** indicated that wider spacing of 30 cm produced significantly higher grain (t/ha) attribated mainly due to significantly higher value of number of panicle / m², length of panicale and 1000 grain weight over the closer spacing of 25 cm..

Uphoff (2005) concluded that the wider spacing between hills gives a higher population than in a standard square pattern with one plant per hill. When asked about the expected yield from these plots. The duration of the variety being used is 158 days, but he expects the SRI crop to mature in <152 days.

Krishna *et al.* **(2009)** found that wider spacing of 40x40 cm had significant effects on growth and quality parameters.

D- Effect of milling recovery:

El-Kady *et al.* **(2004**) indicated that the milling recovery of Sakha 102 was higher than that of Giza 178 for all planting methods except transplanting.

Singh *et al.* **(2004**) revealed that the highest yield was obtained in plots with 21-day-old seedlings, followed by 31-day-old seedlings. Seed yield and quality reduction was observed in seedlings aged 31 days and higher. Seedlings aged 41 days produced poor quality seeds that showed below standard germination capacity.

El-Maksoud (2008) noticed that the rice cultivars differed in their growth, grain yield, yield components and quality characters.

E- Effect of the interactions:

Fernandes and Uphoff (2002) reported that SRI cultivation has a yield advantage of over local practices. The yield beneficial effect of SRI are reflected in terms of increased yields, increased returns from labour, water saving, improvement of soil quality, reduced requirements of seeds, lowered cost of production, better food quality and environmentally safety are the feature of SRI cultivation.

Kewat *et al.* **(2002)** reported that the transplanting seedlings at the closest spacing of 20x10 cm produced significantly highest grain and straw yields and benefit than the wider spacing of 20x20 cm and 20x15 cm, but was comparable to the 15x15 spacing. Similarly, transplanting of 21- and 28-day-old seedlings recorded significantly higher grain and straw yields, net monetary returns and benefit: cost ratio than transplanting of thin and lanky 14-day-old seedlings.

Kumar *et al.* **(2002a**) reported that the Pusa RH.6 recorded higher grain and straw yields, than Pusa RH.10. With regard to seedling age, 20-day-old seedlings resulted in the highest grain and straw yields. Among the planting densities, 25 plants/m resulted in the highest grain yield, whereas 50 plants/m resulted in the highest straw yield. The interaction between treatments revealed that the highest grain yields were obtained with Pusa RH.6 planted at 25 plants/m, and with 20-day-old seedlings planted at the same density.

Kumar *et al.* **(2002b)** showed that the Pusa RH-6 cultivar proved significantly superior, recording higher values of growth and yield attributes, and resulted higher grain and straw yields. Transplanting of 20 days old seedlings exhibited higher growth and yield parameters, and registered higher grain yield over 30 days old seedlings. Plant density of 25 plants/m appeared more appropriate and yielded higher grain yield over 33 and 50 plants/m. Interaction effect further indicated that transplanting of 20 days old seedlings at 25 plants/m was the most appropriate combination to realize high yield from hybrid rice.

Rafaralahy (2002) reported grain yields above under SRI (with wider spaces and hybrid rice) method as compared to traditional method. The increase in the yield with SRI was attributed to the increase in number of ear bearing tillers per hill, total number of spikelets per panicle and panicle length.

Guilani *et al.* **(2003**) noticed that the statistical analysis showed that crop yield decreased with increased seedling age. The highest crop yield was obtained by LD 183 in 15x15 cm crop density plot. The highest and lowest biomasses were obtained by 25- and 45-day-old seedlings, respectively. Champa and Anboori had the highest and lowest dry matter. Grain number per panicle was not significantly different among cultivars, crop density and seedling age. The highest grain number per panicle was obtained with 25-day-old Anboori seedlings. Grain number per panicle decreased with increased crop density. Grain fertility percentages were not significantly affected by seedling age and crop density, but were different among cultivars. One thousand grain weight increased with increased seedling age but decreased with increased crop density. Among cultivars, LD 183 had the highest grain weight.

Rajesh and Thanunathan (2003) noticed that the seedling age (30, 40 and 50 days) and spacing (20x15, 20x10 and 15x15 cm) were tested. Planting of 40-day-old seedlings with a spacing of 20x15 cm recorded the maximum grain yield.

Uphoff (2003) reported that water productivity was definitely highest with SRI, and also yield (though the latter not by a large margin, for reasons not clear to me given experience elsewhere; possibly this is another case where on-station soil conditions inhibit soil microbiological dynamics compared to what is possible on farmers' fields).

Rahaman *et al.* **(2004**) found that 20-day-old seedlings of photo-insensitive early cultivars Narendra 97 and IR 36, and 30-day-old seedlings of photo-sensitive late cultivars Swarna (MTU 7029) and Gayatri (CR 1018) recorded the highest yields, 1000-seed weight, and seed germination and seedling vigour index. During the boor season, 45-day-old seedlings of Narendra 97 and IR 36, and 45- and 55-day-old seedlings of Swarna and Gayatri recorded the highest seed yields, seed germination and vigour index.

Tahir *et al.* **(2004**) found that the analysis of variance was significant in rice yield and other characters. Overall, the increase in seedling age prolonged days to 50% flowering and maturity with a slighter stability for the local cultivar JP 5. Dil Rosh-97, TAI SEN YU 255, and KAOHSIUNG SEN YU 338, however, flowered and matured earlier at 55 DANS.

Ingale *et al.* **(2005**) noticed that transplanting two seedlings per hill at 20x15-cm spacing produced significantly a higher yield than transplanting of one seedling per hill. The above treatment combinations resulted in the highest net returns and benefit: cost ratio. Transplanting two 25-day-old seedlings per hill at 20x15-cm spacing with 150 kg N/ha is recommended for the commercial cultivation of Sahyadri rice hybrid.

Jamil *et al.* **(2006)** found that the highest mean grain yields were obtained with 35- and 42-day-old seedlings. Among the cultivars, SRI-13 registered the lowest mortality rate. PB-95 was superior with regard to the average plant height, number of grains per panicle and grain yield. The average number of fertile tillers was highest for PB-95 and SRI-8. Shaheen Basmati, PB-95 and SRI-8 recorded the highest 1000-grain weights.

Vijayakumar *et al.* **(2006**) reported that the treatment combination of 14 days old seedlings planted at 25x25 spacing+water-saving irrigation and SRI weeding significantly recorded the tallest plants, highest total dry matter production and greatest leaf area index. However, the tiller density per m was significantly highest in the treatment combination of 14 days old seedlinggs+15x10 cm spacing+water-saving irrigation+conventional weeding. During wet season, the number of days to first flowering was 85 days in the treatment combination of 14 days old seedlings planted at 20x20 cm spacing+conventional irrigation, the combination of 14 days old seedlings from dapog nursery planted at a spacing of 15x10 cm under limited irrigation of 2 cm on hair-line crack development+conventional weeding recorded 80 days to first flowering. Between panicle initiations (PI) to flowering (FL) and between FL to maturity stage the crop growth rate, relative growth rate and net assimilation rate were significantly increased by the treatment combination of 14 days old seedlings, wider spacing of 25x25 cm, limited irrigation of 2 cm with incorporation of weeds and disturbing the soil through SRI weeding.

Amin *et al.* **(2007)** noticed that the yield and yield contributing characters were influenced by seedling age, variety and their interaction. BRRI-38 cultivar gave the highest number of effective tillers/hill, panicle length, total spikelets panicle, grains panicle, 1000-grains weight and grain yield. Likewise, yield and yield contributing characters were the highest in youngest seedling. On the other hand, the variety (BRRI-38) with the same age as of seedlings 35 days old seedlings was found superior to other interactions, but, in the production of grains panicle and 1000-grains weight there was no significant effect in this interaction. From the findings it may be inferred that BRRI-38 with 35 days old seedlings produced the highest grain yield.

El-Rewainy *et al.* **(2007)** have shown that the youngest seedling, at panicle initiation stage, recorded the highest significant values of grain yield and most of its components of both cultivars (Sakha 101 and Sakha 102), while, the oldest seedling gave the tallest plants.

Mobasser *et al.* **(2007**) noticed that the effect of seedling age on the total number of tillers and number of panicles/m was significant probability level. The seedling age had a significant effect on the number of fertile tillers probability level. The spacing had a significant effect on the total number of tillers, number of fertile tillers, number of panicles/m, total number of spikelets per panicle, and grain yield. For this cultivar, transplanting of 25-day-old seedlings at a spacing of 15x15 cm is optimum with regard to yield attributes.

Reddy *et al.* **(2007)** Data were recorded for panicles per m, grains per panicle, grain weight per panicle, sterility, panicle length, grain yield, days to physiological maturity, water requirement, cost of cultivation, net returns and returns per rupee invested. Although traditional cultivation produced the highest grain yield in Tellahamsa and BPT 5204, SRI also yielded on par to that of traditional cultivation.

Krishna and Biradarpatil (2009) found that the 12 days seedlings produced more number of tillers per plant and productive tillers per plant. Wider spacing of 40x40 cm found to have significant influence on growth parameters. Significantly higher seed yield per ha was produced by 12 days seedlings. The treatment combination of 12 days old seedling with wider spacing recorded maximum seed yield per ha. The seeds produced by transplanting of 12 days old seedlings with wider spacing recorded significantly higher germination and vigour index values.

Ahmadikhah (2010) found that the effect of variety was significant for all of traits, except for thousand seed weight and biomass weight, totally indicating that varieties respond differentially to cultural practices. Breeding variety produced more yield than local one, although local variety also produced its maximum yield. Local variety had an invariable response to different levels of nitrogen, while breeding variety had a variable response. Breeding variety had maximum biomass in 15 cm spacing and local variety did not differentially respond to spacing level. However,

MATERIALS AND METHODS

MATERIALS AND METHODS

Two field experiments were carried out at the Farm of Rice Research Section, Agricultural Research Station, El-Gemmiza, Gharbia Governorate, during the two successive summer seasons of 2008 and 2009. The objective of these experiments was to evalluatte the influence of the seedling ages and spacing between transplanting seedlings on some rice cultivars and there interactions under the system of rice intensification (SRI) on growth yield and its components as well as milling recovery.

Rice seeds of the studied cultivars Giza 178 and Egyptian Hybrid1 were obtained from Agricultural Cooperation Agricultural Research station, El-Gemmiza, Gharbia Governorate.

Treatments and Experimental Design:

The experiments were carried out in split split plot design with three replications in both seasons as follows:

The main plots were assigned to the two cultivars as following:

1- Giza 178. 2- Egyptian Hybrid 1.

The sup plots were occupied to three seedling ages as following:

1- 15 days after planting. 2- 20 days after planting.

3- 25 days after planting.

The sub sup plots were devoted to three transplanting spaces between hills as following:

1. 20 × 20 cm between hills and rows.
2. 25 × 25 cm between hills and rows.
3. 30 × 30 cm between hills and rows.

Agricultural practices:

The experimental field was prepared as recommended. The nursery seedbed preparations were well performed, the nursery land was fertilized with calcium super phosphate (15.5 % P2O5) at the rate of 4kg /kirat on the dray soil before ploughing. Nitrogen in the form of urea (46 % N) was added at the rate of 3kg /kirat before the last ploughing and leveling. Seeds of rice Giza 178 and Egyptian Hybrid 1 rice cultivars at the rate of 60 and 10 kg/fed, respectively, were planted dry seed on dry land and then irrigation on 6th May. Weeds were chemically controlled with Saturn (50%) at seven days after sowing and then transplanting on 21st, 26th and 31st may in 2008 and 2009 seasons, respectively.

The permanent land were well performed, calcium super phosphate (15.5 % P2O5) was added at the rate of 100kg /fed. On the dray soil before ploughing, the land was flushed with water. Nitrogen fertilizer in the form of urea (46 % N) was added at the rate of 60 units/fed. The first part was added before transplanting the seedlings, the second was added after 30 days from sowing, and the third was added after 20 days from the second one.

Transplanting was done with seedlings at 15, 20 and 25 day old with spacing between hills 20 × 20, 25 × 25 and 30 × 30 cm, under the system of rice intensification (SRI). Weeds were chemically with Saturn 50 % EC at the rate of 2 L/fed.

The experimental plot size was 3m width and 3.5m length, resulted an area of 10.5 m² (1/400 fed).

The previous crop was Egyptian clover (*Trifolium alexandrinum*) in both seasons.

However, the common agricultural practices for growing rice according to the recommendations of Ministry of Agriculture and Land Reclamation were followed, except the factors under study. SRI watering management was followed (Irrigation was when the onset of cracking of the soil, or once a week).

The studied characters:

A. <u>Yield and its components:</u>

At harvest, the following data were recorded:

1- Plant height (cm): Average of plant height was measured in a random sample of 5 guarded plants from soil surface up to top of the main stem panicle.

2- Number of tillers/m^2: measured by counting number of tillers per square meter.

3- Number of panicles/m^2: measured by counting number of panicles per square meter.

4- Panicle length (cm): The main panicle length was measured from the panicle node up to apiculus of the upper most spikelet of the panicle.

5- Number of total grains /panicle: Average number of grains formed on ten main stem panicle randomly chosen was estimated.

6- Number of filled grains /panicle: Average number of filled grains formed on ten main stem panicle randomly chosen was estimated.

7- 1000- grain weight (g): Random of thousand rough rice grains from each plot were weighted with a sensitive balance to the nearest gram.

8- Grain yield (t/fed): The plants in the inner two square meter of each experimental unit were harvested, collected together, labeled and tied. Thereafter, plants were transported to the threshing floor for air drying for five days, threshed and the grains were separated. The grain yield was recorded in kg/m^2 and converted to t/fed at 14 moisture content.

9- Straw yield (t/fed): It was estimated using the same steps for grain yield estimation.

B. <u>Milling recovery:</u>

1- Hulling percentage: About 150g cleaned rough rice samples at moisture content 12.14 % were estimated using experimental huller machine (stake) in Rice Research and Training Center, grain quality lab

$$\textbf{Hulling } \% = \frac{\text{Weight of brown rice}}{\text{Weight of rough rice}} \times 100$$

2- <u>Milling percentage:</u> Brown rice was consequently milled using McGILL Millerno2. The sample was milled for 60sec. the milled rice sample was then collected and the weight was taken and percentage of total milled rice was computed.

$$\textbf{Milled rice } \% = \frac{\text{Weight of milled rice}}{\text{Weight of rough rice}} \times 100$$

3- <u>Head rice percentage:</u> Whole grains were separated from the total milled rice using a rice sizing gdevice. The separation of these particles is termed as granding. However, the broken are fragments of grains, which the lengths are less than ¾ of the whole grains, are after separated into two different sizes. The amount of head rice yield is then obtaind and calculated.

$$\textbf{Head rice } \% = \frac{\text{Weight of milled grains}}{\text{Weight of total milled rice}} \times 100$$

STATISTICAL ANALYSIS

All data of this study were subjected to the statistical analyzed as the technique of analysis of variance (ANOVA) for the split split plot design as mentioned by **Gomez and Gomez (1984)**, by using means of "MSTAT-C" computer software package. Least Significant Difference (LSD) method was used to test the differences between treatment means at 5 % level of probability as described by **Snedecor and Cochran (1980)**.

RESULTS AND DISCUSSION

RESULTS AND DISCUSSION

Focusing light on the obtained data, of growth yield was evaluated the effect of seedling age and spacing between plants on two cultivars and their interactions under the system of rice intensification (SRI) on growth, yield and its components as well as milling recovery and will be explained and discussed in separate topics under the following headings:

A.YIELD AND ITS COMPONENTS

B. MILLING RECOVERY

A.YIELD AND ITS COMPONENTS:

A.1- Number of tillers/m²:

Means of number of tillers/m² of rice plant as affected by cultivars, seedling ages and spacing between plants under the system of rice intensification (SRI) on rice productivity as well as their interactions during 2008 and 2009 seasons are showed in Table 1.

Effect of cultivars:

In both seasons, the results in Table 1 indicated that the two tested cultivars significantly differed in number of tillers/m². Egyptian Hybrid 1 rice cultivar significantly produced the highest number of tillers/m² (423.1 and 420.6) in the first and second seasons, respectively. While Giza 178 rice cultivar produced the lowest number of tillers/m² (407.8 and 405.6) in the first and second seasons, respectively. Differential performance of two cultivars may be attributed to differences in genetically back ground and constitution of these cultivars. Egyptian Hybrid 1 cultivar was characterized by strong growth, a lot of tillers and panicles. These results were parallel with those reported by Sharief *et al.* (2005), El-Bably *et al.* (2007), Zayed *et al.* (2007), Abou-Khadra *et al.* (2008), Abou khalifa (2009) and Zaki *et al.* (2009).

Effect of seedling ages:

The results in Table 1 indicated that number of tillers/m² were significantly affected by seedling ages. The highest number of tillers/m² (427.0 and 425.7) were produced when using the youngest seedling 15 day old in the first and second seasons, respectively. On the other hand the oldest seedling ages 25 day old gave the lowest number of tillers/m² (406.7 and 399.3) in the first and second seasons, respectively. Transplant seedlings while still young, <15 days, i.e., prior to the start of the 4th phyllochron of growth, Nemoto *et al.*, (1995). This preserves plants' potential for tillering and root growth that is reduced by later transplanting. Direct seeding is an option, however, since what is important is that plant roots not be traumatized after they start their growth trajectory, on or about the 15th day. Careful transplanting promotes rapid resumption of growth. Similar results were also obtained by Reddy *et al* (2008). On the other hand Molla (2001) found that twenty – eight day old seedlings produced more tillers/m² than 21 day old seedlings.

Effect of transplanting spaces:

The statistical analyses of data in Table 1, recorded that number of tillers/m² were significantly affected by transplanting spaces. The highest number of tillers/m² (417.7 and 421.9) in the first and second seasons, respectively. Were produced when using the widest spacing between hills (30×30 cm) in both seasons. These increases in all traits may be due to the regular space between plants that make solar radiation enable to pass all canopy and make plants are well in photosynthesis process. While the lowest number of tillers/m² (403.4 and 403.1) were obtained when using the closest spacing between hills (20×20 cm) in the first and second seasons, respectively.

Table 1: Means of number of tillers/m², number of Panicles/m² and plant height (cm) of rice as affected by cultivars, seedling ages and transplanting spaces during 2008 and 2009 seasons.

Characters / Treatments	**Number of tillers/m²**		**Number of Panicles/m²**		**Plant height (cm)**	
	2008	2009	2008	2009	2008	2009
A- cultivars:						
Giza178	407.8	405.6	384.4	395.4	99.9	98.5
Egyptian Hybrid 1	423.1	420.6	402.5	410.5	101.0	100.9
F. test	**	**	**	**	*	**
B- seedling ages:						
15 day	427.0	425.7	406.4	415.6	101.8	100.8
20 day	412.6	414.2	388.0	404.0	100.9	99.6
25 day	406.7	399.3	385.9	389.3	98.7	98.8
F. test	**	**	**	**	*	**
LSD at 5 %	4.1	3.08	2.5	3.1	2.28	0.72
C- transplanting spaces:						
20×20 cm	403.4	403.1	382.5	393.0	99.9	99.1
25×25 cm	417.7	414.2	396.9	403.8	100.4	99.8
30×30 cm	425.2	421.9	401.8	412.0	101.2	100.2
F. test	**	**	**	**	*	**
LSD at 5 %	2.4	1.2	3.0	3.6	0.8	0.61
Interaction:						
A ×B	**	NS	NS	NS	**	**
A ×C	NS	**	NS	**	NS	NS
B ×C	NS	**	**	**	**	**
A ×B ×C	**	**	**	**	NS	**

These results are in good concordance with those found by Geethadevi *et al.* (2000), Verma *et al.* (2002), Nayak *et al.* (2003) and Krishna *et al.* (2009**)**. Maintain wide spacing between plants with preferably just one plant per hill, and set them out in a square pattern, 30x30 cm or even wider if soil fertility is good This gives room for profuse root and tiller growth, achieving 'the border effect' throughout the whole filled, Uphoff (2005). On other hand Verma *et al.* (1988) and Srinivasan (1990) revealed that tillers per m² were significantly higher with closer spacing (15×10 cm).

Effect of interaction between cultivars and seedling ages:

The results in Table 2 indicated that the interaction between cultivars and seedling ages had a significant effect on number of tillers/m². The highest number of tillers/m² (435.3) in the first season. Were recorded when using Egyptian Hybrid 1 cultivar and youngest seedling ages (15 day old). On the other hand, the lowest number of tillers/m² (397.5) was obtained when using Giza178 cultivar and oldest seedling ages 25 day. Several researchers have recorded similar results regarding number of tillers/m², such as; Uphoff (2003), Jamil *et al.* (2006), El-Rewainy *et al.* (2007), Amin *et al*. (2007), Wang Ran *et al.* (2010) and .

Table 2: Means of number of tillers/m² of rice as affected by the interaction between cultivars and seedling ages during 2008 season:

ages / ***Cultivars***	15 day	20 day	25 day
2008			
Giza178	418.7	407.2	397.5
Egyptian Hybrid 1	435.3	418.0	416.0
F. test	**		
LSD at 5 %	2.28		

Effect of interaction between cultivars and transplanting spaces:

The results in Table 3 indicated that the interaction between cultivars and transplanting spaces on number of tillers/m² had a significant effect. The highest number of tillers/m² (428.0) in the second season. Were recorded when using Egyptian Hybrid 1 and widest spacing between hills (30×30 cm). On the other hand, the lowest number of tillers/m² (395.3) was produced when using Giza178 and closest spacing between hills (20×20 cm). These results are in good concordance with those found by Ahmadikhah (2010).

Table3: Means of number of tillers/m² of rice as affected by the interaction between cultivars and transplanting spaces during 2009 season:

spaces / ***Cultivars***	20×20cm	25×25cm	30×30cm
2009			
Giza178	395.3	405.7	415.8
Egyptian Hybrid 1	410.9	422.7	428.0
F. test	**		
LSD at 5 %	1.66		

Effect of interaction between seedling ages and transplanting spaces:

The results in Table 4 showed that, the interaction between seedling ages and transplanting spaces on number of tillers/m² differ significantly. The highest number of tillers/m² (433.2) in the second season, were recorded when using youngest seedling ages (15 day old) and widest spacing between hills (30×30 cm). On the other hand, while the lowest number of tillers/m² (388.0) in the second season, were obtained when using oldest seedling ages (25 day old) and closest spacing between hills (20×20 cm). These results are in good accordance with those reported by Vijayakumar *et al.* (2006), Mobasser *et al.* (2007), Chandrakar *et al.* (2008), Krishna and Biradarpatil (2009) and Sreedhar and Ganesh (2010),

Table 4: Means of number of tillers/m² of rice as affected by the interaction between seedling ages and transplanting spaces during 2009 season.

ages / ***spaces***	20×20 cm	25×25 cm	30×30 cm
	2009		
15 day	419.6	424.3	433.2
20 day	401.7	416.9	424.1
25 day	388.0	401.5	408.4
F. test	**		
LSD at 5 %	2.18		

Effect of interaction between cultivars, seedling ages, and transplanting spaces:

The results in Table 5 indicated that the interaction between cultivars, seedling ages and transplanting spaces on number of tillers/m² differ significantly. The highest number of tillers/m² (445.8 and 442.7) in the first and second seasons, res., were recorded when using Egyptian Hybrid 1 cultivar, youngest seedling ages (15 day old) and widest spacing between hills (30×30 cm). On the other hand, while the lowest number of tillers/m² (384.3 and 382.6) in the first and second seasons, res., were obtained when using Giza178 cultivar, oldest seedling ages (25 day old) and closest spacing between hills (20×20 cm). These results are in good concordance with those found by Ingale *et al.* (2005), Vijayakumar *et al.* (2006), and Reddy *et al.* (2007).

Table 5: Means of number of tillers/m² of rice as affected by the interaction between cultivars, seedling ages and transplanting spaces during 2008 and 2009 seasons:

Cultivars / Spaces \ ages	Giza178			Egyptian Hybrid 1		
	15 day	20 day	25 day	15 day	20 day	25 day
2008						
20×20cm	406.8	396.4	384.3	425.1	406.0	402.0
25×25cm	421.0	412.3	396.9	435.1	420.6	420.3
30×30cm	428.2	412.9	411.3	445.8	427.5	425.7
F. test	**					
LSD at 5 %	3.95					
2009						
20×20cm	412.1	391.2	382.6	427.1	412.3	393.5
25×25cm	417.4	409.9	389.8	431.2	423.8	413.2
30×30cm	423.8	419.7	404.0	442.7	424.5	426.9
F. test	**					
LSD at 5 %	2.87					

A.2- Number of Panicles/m²:

Means of number of Panicles/m² of rice plant as affected by cultivars, seedling ages and spacing between plants under the system of rice intensification (SRI) on rice productivity as well as their interactions during 2008 and 2009 seasons are showed in Table 1.

Effect of cultivars:

In both seasons the results in Table 1 indicated that the two tested cultivars significantly differed in number of Panicles/m². Egyptian Hybrid 1 rice cultivar significantly produced the highest number of Panicles/m² (402.5 and 410.5) in the first and second seasons, respectively. While Giza 178 rice cultivar produced the lowest number of Panicles/m² (384.4 and 395.4) in the first and second seasons, respectively. Differential performance of two cultivars may be attributed to differences in genetically back ground and constitution of these cultivars. These results were parallel with those reported by Abdel-Rahman (1999b), Uphoff (2005), Zayed *et al*. (2007), Abou-Khadra *et al.* (2008), Zaki *et al.* (2009).

Effect of seedling ages:

The results in Table 1 indicated that number of Panicles/m² were significantly affected by seedling ages. The highest number of Panicles/m² (406.4 and 415.6), were produced when using the youngest seedling 15 day old in the first and second seasons, respectively. The oldest seedling ages 25 day old gave the lowest number of Panicles/m² (385.9 and 389.3) in the first and second seasons, respectively. These are in agreement with those obtained by Raj *et al*. (2008)**,** Manjunatha *et al*. (2009) and Krishna *et al.* (2009). On the other hand Molla (2001) found that twenty – eight day old seedlings produced more tillers/m² than 21 day.

Effect of transplanting spaces:

The statistical analyses of data in Table 1, recorded that number of Panicles/m² were significantly affected by transplanting spaces. The highest number of Panicles/m² (401.8 and 412.0). Were produced when using the widest spacing between hills (30×30 cm) in both seasons. While the lowest number of Panicles/m² (382.5 and 393.0 0). Were obtained when using the closest spacing between hills (20×20 cm). These increases in this trait may be due to the regular space between plants that make solar radiation enable to pass all canopy and make plants are well in photosynthesis process. These results are in agreement with those obtained by Samdhia (1996), Liu *et al.* (1997), Sanico *et al.* (1998), Chopra and Chopra (2004), Chopra and Ahopra (2004), Uphoff (2005).. On the other hand Verma *et al.* (1988), Patra and Nayak (2001) and Varma *et al.* (2002) they found significantly higher harvest index with lower plant density than that wider plant density.

Effect of interaction between cultivars and transplanting spaces:

The results in Table 6 indicated that the interaction between cultivars and transplanting spaces on number of Panicles/m² had a significant effect. The highest number of Panicles/m² (418.2) in the second season. Were recorded when using Egyptian Hybrid 1 and widest spacing between hills (30×30 cm). On the other hand, the lowest number of Panicles/m² (385.2) were produced when using Giza178 and closest spacing between hills (20×20 cm). These results were parallel with those reported by Uphoff (2003) and Ahmadikhah (2010).

Table 6: Means of number of Panicles/m² of rice as affected by the interaction between cultivars and transplanting spaces during 2009 season:

spaces / ***Cultivars***	20×20cm	25×25cm	30×30cm
2009			
Giza178	385.2	395.0	405.9
Egyptian Hybrid 1	400.9	412.5	418.2
F. test	**		
LSD at 5 %	1.75		

Effect of interaction between seedling ages and transplanting spaces:

The results in Table 7 showed that, the interaction between seedling ages and transplanting spaces on number of Panicles/m² differ significantly. The highest number of Panicles/m² (416.1 and 423.5) in the first and second seasons, res. were recorded when using youngest seedling ages (15 day old) and widest spacing between hills (30×30 cm). On the other hand, the lowest number of Panicles/m² (372.3 and 378.0). were obtained when using oldest seedling ages (25 day old) and closest spacing between hills (20×20 cm). These results are in good accordance with those reported by Uphoff (2003), as well as Mobasser *et al.* (2007), Chandrakar *et al.* (2008), Krishna and Biradarpatil (2009) and Sreedhar and Ganesh (2010).

Table 7: Means of number of Panicles/m² of rice as affected by the interaction between seedling ages and transplanting spaces during 2008 and 2009 seasons.

spaces / ***ages***	20×20 cm	25×25 cm	30×30 cm
		2008	
15 day	395.2	407.9	416.1
20 day	380.1	394.0	390.0
25 day	372.3	388.7	396.8
F. test		**	
LSD at 5 %		5.25	
		2009	
15 day	409.3	414.0	423.5
20 day	391.9	406.0	414.0
25 day	378.0	391.4	398.6
F. test		**	
LSD at 5 %		2.89	

Effect of interaction between cultivars, seedling ages, and transplanting spaces:

The results in Table 8 indicated that the interaction between cultivars, seedling ages and transplanting spaces on number of Panicles/m² differ significantly. The highest number of Panicles/m² (428.6 and 433.1) in the first and second seasons, res. Were recorded when using Egyptian Hybrid 1 cultivar, youngest seedling ages (15 day old) and widest spacing between hills (30×30 cm).

Table 8: Means of number of Panicles/m² of rice as affected by the interaction between cultivars, seedling ages and transplanting spaces during 2008 and 2009 seasons:

Cultivars	Giza178			Egyptian Hybrid 1		
Spaces / ages	15 day	20 day	25 day	15 day	20 day	25 day
2008						
20×20cm	386.4	375.9	362.6	404.1	384.4	381.9
25×25cm	401.3	382.0	375.9	414.4	397.7	401.6
30×30cm	403.7	382.3	390.0	428.6	406.1	413.7
F. test	**					
LSD at 5 %	7.03					
2009						
20×20cm	401.7	381.3	372.7	416.9	402.5	383.3
25×25cm	407.4	397.9	379.8	420.6	405.0	403.1
30×30cm	414.0	409.6	394.1	433.1	409.5	414.0
F. test	**					
LSD at 5 %	3.03					

On the other hand, the lowest number of Panicles/m² (362.6 and 372.7) were obtained when using Giza178 cultivar, oldest seedling ages (25 day old) and closest spacing between hills (20×20 cm). These results are in agreement with those obtained by Vijayakumar *et al.* (2006), Jamil *et al.* (2006), Mobasser *et al.* (2007) and Reddy *et al.* (2007).

A.3- <u>Plant height (cm):</u>

Means of plant height (cm) of rice plant as affected by cultivars, seedling ages and spacing between plants under the system of rice intensification (SRI) on rice productivity as well as their interactions during 2008 and 2009 seasons are showed in Table 1.

Effect of cultivars:

In both seasons the results in Table 1 indicated that the two tested cultivars significantly differed in Plant height. Egyptian Hybrid 1 rice cultivar significantly produced the highest Plant height (101.0 and 100.9cm) in the first and second seasons, res. While Giza 178 rice cultivar produced the lowest Plant height (99.9 and 98.5cm) in the first and second seasons, res. These results are in good accordance with those reported by Abdel-Rahman (1999a), Abdel-Rahman *et al.* (2004b), Sharief *et al.* (2005), Uphoff (2005), Zayed *et al.* (2007), Abou-Khadra *et al.* (2008), Zaki *et al.* (2009).

Effect of seedling ages:

The results in Table 1 indicated that Plant height were significantly affected by seedling ages. The highest Plant height (101.8 and 100.8 cm) in the first and second seasons, res., were produced when using the youngest seedling 15 day old in the first and second seasons. On the other hand the oldest seedling ages 25 day old gave the lowest Plant height (98.7 and 98.8 cm) in the first and second seasons, respectively. These results are in good concordance with those found by Khakwani *et al.* (2005), Raj *et al.* (2008) and Goel *et al.* (2009). On the other hand Chandrakar *et al.* (2008), Rao *et al.* (2007) they indicated that the youngest seedlings resulted in the lowest number of days to greatest plant height.

Effect of transplanting spaces:

The statistical analyses of data in Table 1 recorded that Plant height were significantly affected by transplanting spaces. The highest Plant height (101.2 and 100.2 cm) in the first and second seasons, res., were produced when using the widest spacing between hills (30×30 cm) in both seasons. While the lowest Plant height (99.9 and 99.1 cm) in the first and second seasons, res. was obtained when using the closest spacing between hills (20×20 cm). These results are in agreement with those obtained by Samdhia (1996), Liu *et al.* (1997), Varma *et al.* (2002), Uphoff (2004) and Krishna *et al.* (2009). On the other hand Verma *et al.* (1988), Zhang *et al.* (2004) they found significantly higher harvest index with lower plant density than that wider plant density.

Effect of interaction between cultivars and seedling ages:

The results in Table 9 indicated that the interaction between cultivars and seedling ages had a significant effect on Plant height. The tallest Plant height (102.5 and 101.7 cm) in the first and second seasons, res., were recorded when using Egyptian Hybrid 1 cultivar and youngest seedling ages (15 day old).

Table 9: Means of Plant height (cm) of rice as affected by the interaction between cultivars and seedling ages during 2008 and 2009 seasons:

ages / ***Cultivars***	15 day	20 day	25 day
2008			
Giza178	101.1	100.6	97.1
Egyptian Hybrid 1	102.5	101.7	101.2
F. test	**		
LSD at 5 %	1.59		
2009			
Giza178	99.8	99.1	96.6
Egyptian Hybrid 1	101.7	101.0	100.1
F. test	**		
LSD at 5 %	1.19		

On the other hand, the lowest Plant height (97.1 and 96.6 cm) in the first and second seasons, res. was obtained when using Giza178 cultivar and oldest seedling ages 25 day. These results are in good concordance with those found by Jamil *et al.* (2006). On the other hand El-Rewainy *et al.* (2007) have shown that the youngest seedling, at panicle initiation stage, recorded the highest significant values of grain yield and most of its components of both cultivars (Sakha 101 and Sakha 102), while, the oldest seedling gave the tallest plants.

Effect of interaction between seedling ages and transplanting spaces:

The results in Table 10 showed that, the interaction between seedling ages and transplanting spaces on Plant height differ significantly.

Table 10: Means of Plant height (cm) of rice as affected by the interaction between seedling ages and transplanting spaces during 2008 and 2009 seasons.

ages \ spaces	20×20 cm	25×25 cm	30×30 cm
	2008		
15 day	100.4	101.6	103.5
20 day	99.5	100.4	101.9
25 day	96.1	98.5	101.3
F. test	**		
LSD at 5 %	1.39		
	2009		
15 day	99.8	99.5	103.6
20 day	98.0	100.1	101.8
25 day	96.7	99.5	100.5
F. test	**		
LSD at 5 %	1.06		

The tallest Plant height (103.5 and 103.6 cm) in the first and second seasons, res., were recorded when using youngest seedling ages (15 day old) and widest spacing between hills (30×30 cm). On the other hand, the lowest Plant height (96.1 and 96.7 cm) in the first and second seasons, res. were obtained when using oldest seedling ages (25 day old) and closest spacing between hills (20×20 cm).

Effect of interaction between cultivars, seedling ages, and transplanting spaces:

The results in Table 11 indicated that the interaction between cultivars, seedling ages and transplanting spaces on Plant height differ significantly. The tallest Plant height (103.2 cm) in the second season, were recorded when using Egyptian Hybrid 1 cultivar, youngest seedling ages (15 day old) and widest spacing between hills (30×30 cm). On the other hand, while the lowest Plant height (94.7 cm) in the second seasons. Were obtained when using Giza178 cultivar, oldest seedling ages (25 day old) and closest spacing between hills (20×20 cm).

Table 11: Means of Plant height (cm) of rice as affected by the interaction between cultivars, seedling ages and transplanting spaces during 2009 season:

Cultivars	Giza178			Egyptian Hybrid 1		
Spaces \ ages	15 day	20 day	25 day	15 day	20 day	25 day
2009						
20×20cm	99.1	98.2	94.7	98.9	99.8	99.2
25×25cm	99.9	99.8	94.8	101.9	101.6	100.1
30×30cm	101.9	101.1	100.1	103.2	102.6	101.3
F. test	**					
LSD at 5 %	2.06					

A.4- <u>Panicle length (cm):</u>

Means of Panicle length of rice plant as affected by cultivars, seedling ages and spacing between plants under the system of rice intensification (SRI) on rice productivity as well as their interactions during 2008 and 2009 seasons are showed in Table 12.

Effect of cultivars:

In both seasons the results in Table 12 indicated that the two tested cultivars significantly differed in Panicle length. Egyptian Hybrid 1 rice cultivar significantly produced the tallest Panicle length (22.90 and 23.94 cm) in the first and second seasons, res. While Giza 178 rice cultivar produced the shortest Panicle length (22.90 and 23.94 cm) in the first and second seasons, res.

Table 12: Means of Panicle length (cm), number of total grains/ panicle / panicle and number of filled grains / panicle of rice as affected by cultivars, seedling ages and transplanting spaces during 2008 and 2009 seasons.

Characters / Treatments	**Panicle length (cm)**		**Number of total grains/ panicle**		**Number of filled grains / panicle**	
	2008	2009	2008	2009	2008	2009
A- cultivars:						
Giza178	21.78	22.07	141.03	139.03	141.03	139.03
Egyptian Hybrid 1	22.90	23.94	164.07	162.03	164.07	162.03
F. test	*	*	**	**	**	**
B- seedling ages:						
15 day	23.48	24.12	166.61	164.55	166.61	164.55
20 day	22.06	22.50	150.50	148.50	150.50	148.50
25 day	21.48	20.91	140.55	138.55	140.55	138.55
F. test	**	**	**	**	**	**
LSD at 5 %	0.22	0.13	7.50	7.4	7.50	7.4
C- transplanting spaces:						
20×20 cm	21.67	21.81	155.16	153.16	149.50	147.50
25×25 cm	22.31	22.48	149.50	147.50	153.00	152.94
30×30 cm	23.04	23.23	165.16	163.16	155.16	155.16
F. test	*	*	**	**	**	**
LSD at 5 %	0.03	0.06	4.30	4.03	0.30	3.04
Interaction:						
A ×B	**	*	*	*	**	**
A ×C	**	NS	NS	NS	NS	**
B ×C	**	**	**	**	**	**
A ×B ×C	*	NS	**	**	**	**

Differential performance of two cultivars may be attributed to differences in genetically back ground and constitution of these cultivars. These results were parallel with those reported by Abdel-Rahman (1999a), Abdel-Rahman *et al.* (2004b), Uphoff (2005), Zayed *et al.* (2007), Abou khalifa *et al* (2009), Zaki *et al.* (2009) .

Effect of seedling ages:

The results in Table 12 indicated that Panicle length was significantly affected by seedling ages. The tallest Panicle length (23.48 and 24.12 cm), were produced when using the youngest seedling 15 day old in the first and second seasons, res. On the other hand the oldest seedling ages 25 day old gave the shortest Panicle length (21.48 and 20.91 cm) in the first and second seasons, res. These are in agreement with those obtained by Upadhyay *et al.* (2007) and Reddy *et al.* (2008). On the other hand Rao *et al.* (2007) indicated that the oldest seedlings recorded significantly higher gross returns as well as net returns as compared to the youngest seedlings.

Effect of transplanting spaces:

The statistical analyses of data in Table 12 recorded that Panicle length was significantly affected by transplanting spaces. The tallest Panicle length (23.04 and 23.23 cm) in the first and second seasons, res, was produced when using the widest spacing between hills (30×30 cm) in both seasons. While the shortest Panicle length (21.67 and 21.81 cm) in the first and second seasons, res., were obtained when using the closest spacing between hills (20×20 cm).The better panicle length maybe ascribed to the more available plant nutrients and distribution of plants which lead to the better solar interception and transport of photosynsis. These results are in agreement with those obtained by Trivedi and Kwatra (1983), Sukla *et al.* (1984), Krishnan *et al.* (1994), Shinde *et al*. (2005) and Krishna *et al.* (2009).

Effect of interaction between cultivars and seedling ages:

The results in Table 13 indicated that the interaction between cultivars and seedling ages had a significant effect on Panicle length. The tallest Panicle length (23.7 and 23.0 cm) in the first and second seasons, res. were recorded when using Egyptian Hybrid 1 cultivar and youngest seedling ages (15 day old). On the other hand, the shortest Panicle length (20.9 and 20.2 cm) was obtained when using Giza178 cultivar and oldest seedling ages 25 day. These results are in good accordance with those of Uphoff (2003), and El-Rewainy *et al.* (2007).

Table 13: Means of Panicle length (cm) of rice as affected by the interaction between cultivars and seedling ages during 2008 and 2009 seasons:

ages / ***Cultivars***	15 day	20 day	25 day
2008			
Giza178	22.9	21.4	20.9
Egyptian Hybrid 1	23.7	22.1	21.3
F. test	**		
LSD at 5 %	0.11		
2009			
Giza178	23.0	22.7	20.2
Egyptian Hybrid 1	24.5	22.8	21.4
F. test	*		
LSD at 5 %	0.18		

Effect of interaction between cultivars and transplanting spaces:

The results in Table 14 indicated that the interaction between cultivars and transplanting spaces on Panicle length had a significant effect. The tallest Panicle length (23.7 cm) in the first season, were recorded when using Egyptian Hybrid 1 and widest spacing between hills (30×30 cm).

Table14: Means of Panicle length (cm) of rice as affected by the interaction between cultivars and transplanting spaces during 2008 and 2009 seasons:

spaces / *Cultivars*	20×20cm	25×25cm	30×30cm
	2008		
Giza178	21.1	21.8	22.3
Egyptian Hybrid 1	22.1	22.7	23.7
F. test	**		
LSD at 5 %	0.11		

On the other hand, the shortest Panicle length (21.1 cm) in the first season was produced when using Giza178 and closest spacing between hills (20×20 cm). These results are in harmony with those recorded by Rafaralahy (2002).

Table 15: Means of Panicle length (cm) of rice as affected by the interaction between seedling ages and transplanting spaces during 2008 and 2009 seasons.

spaces / *ages*	20×20 cm	25×25 cm	30×30 cm
	2008		
15 day	22.5	23.2	24.5
20 day	21.7	22.2	22.2
25 day	20.7	21.3	22.3
F. test	**		
LSD at 5 %	0.23		
	2009		
15 day	23.5	24.0	24.8
20 day	21.9	22.5	23.0
25 day	19.9	20.8	21.9
F. test	**		
LSD at 5 %	0.25		

Effect of interaction between seedling ages and transplanting spaces:

The results in Table 15 showed that, the interaction between seedling ages and transplanting spaces on Panicle length differ significantly. The tallest Panicle length (24.5 and 24.8 cm) in the first and second seasons, res., were recorded when using youngest seedling ages (15 day old) and widest spacing between hills (30×30 cm). On the other hand, the shortest Panicle length (20.7 and 19.9 cm) in the first and second seasons, res. were obtained when using oldest seedling ages (25 day old) and closest spacing between hills (20×20 cm). These results are in good accordance with those reported by Chandrakar *et al.* (2008) indicated that the youngest seedlings resulted in the greatest number of panicle length.

A.5- <u>Number of total grains/ panicle:</u>

Means of number of total grains/ panicle of rice plant as affected by cultivars, seedling ages and spacing between plants under the system of rice intensification (SRI) on rice productivity as well as their interactions during 2008 and 2009 seasons are showed in Table 12.

Effect of cultivars:

In both seasons the results in Table 12 indicated that the two tested cultivars significantly differed in number of total grains/ panicle. Egyptian Hybrid 1 rice cultivar significantly produced the highest number of total grains/ panicle (164.07 and 162.03), in the first and second seasons, res. While Giza 178 rice cultivar produced the lowest number of total grains/ panicle (164.07 and 162.03), in the first and second seasons, res. Differential performance of two cultivars may be attributed to differences in genetically back ground and constitution of these cultivars. These results were parallel with those reported by Zayed *et al.* (2007), Abou-Khadra *et al.* (2008), Zaki *et al.* (2009) .

Effect of seedling ages:

The results in Table 12 indicated that number of total grains/ panicle was significantly affected by seedling ages. The highest number of total grains/ panicle (166.61 and 164.55), were produced when using the youngest seedling 15 day old in the first and second seasons. On the other hand the oldest seedling ages 25 day old gave the lowest number of total grains/ panicle (140.55 and 138.55), in the first and second seasons, res. . These are in agreement with those obtained by Uphoff (2004), Upadhyay *et al.* (2007) Chandrakar *et al.* (2008), Raj *et al.* (2008) and Goel *et al.* (2009).

Effect of transplanting spaces:

The statistical analyses of data in Table 12, recorded that number of total grains/ panicle were significantly affected by transplanting spaces. The highest number of total grains/ panicle (165.16 and 163.16), in the first and second seasons, res., were produced when using the widest spacing between hills (30×30 cm) in both seasons. These increases in this trait may be due to the regular space between plants that make solar radiation enable to pass all canopy and make plants are well in photosynthesis process. While the lowest number of total grains/ panicle (153.00 and 150.94), in the first and second seasons, res. were obtained when using the closest spacing between hills (20×20 cm). These results are in agreement with those obtained by Samdhia (1996), Liu et al. (1997), Padmaja and Reddy (1998). On the other hand Srivastav and Tripathi (1998) observed that number of fertile grain per panicle was more with closer spacing of 15 × 10 cm than with wider spacing of 20 × 15 cm.

Effect of interaction between cultivars and seedling ages:

The results in Table 16 indicated that the interaction between cultivars and seedling ages had a significant effect on number of total grains/ panicle. The highest number of total grains/ panicle (180.88 and 178.77) in the first and second seasons, res. was recorded when using Egyptian Hybrid 1 cultivar and youngest seedling ages (15 day old).

Table 16: Means of number of total grains/ panicle of rice as affected by the interaction between cultivars and seedling ages during 2008 and 2009 seasons:

ages / ***Cultivars***	15 day	20 day	25 day
2008			
Giza178	152.33	141.77	129.00
Egyptian Hybrid 1	180.88	159.22	152.11
F. test	*		
LSD at 5 %	5.60		
2009			
Giza178	150.33	139.77	127.00
Egyptian Hybrid 1	178.77	157.22	150.11
F. test	*		
LSD at 5 %	5.63		

On the other hand, the lowest number of total grains/ panicle (129.00 and 127.00), in the first and second seasons, res. were obtained when using Giza178 cultivar and oldest seedling ages 25 day. These results are in good accordance with those obtained by Rahaman et al. (2004), El-Rewainy *et al.* (2007) and Amin *et al.* (2007).

Effect of interaction between seedling ages and transplanting spaces:

The results in Table 17 showed that, the interaction between seedling ages and transplanting spaces on number of total grains/ panicle differ significantly. The highest number of total grains/ panicle (177.16 and 175.00), in the first and second seasons, res., were recorded when using youngest seedling ages (15 day old) and widest spacing between hills (30×30 cm). On the other hand, while the lowest number of total grains/ panicle (135.16 and 133.16) in the first and second seasons, res. were obtained when using oldest seedling ages (25 day old) and closest spacing between hills (20×20 cm). These results stand in line with those obtained by Amin *et al.* (2007).

Table17: Means of number of total grains/ panicle of rice as affected by the interaction between seedling ages and transplanting spaces during 2008 and 2009 seasons.

spaces / ***ages***	20×20 cm	25×25 cm	30×30 cm
	2008		
15 day	168.16	154.50	177.16
20 day	162.16	149.83	139.50
25 day	135.16	144.16	142.33
F. test	**		
LSD at 5 %	5.24		
	2009		
15 day	166.16	152.50	175.00
20 day	160.16	147.83	137.50
25 day	133.16	142.16	140.33
F. test	**		
LSD at 5 %	5.27		

Effect of interaction between cultivars, seedling ages, and transplanting spaces:

The results in Table 18 indicated that the interaction between cultivars, seedling ages and transplanting spaces on number of total grains/ panicle differ significantly. The highest number of total grains/ panicle (197.33 and 195.00), in the first and second seasons, res., were recorded when using Egyptian Hybrid 1 cultivar, youngest seedling ages (15 day old) and widest spacing between hills (30×30 cm).

Table18: Means of number of total grains/ panicle of rice as affected by the interaction between cultivars, seedling ages and transplanting spaces during 2008 and 2009 seasons:

Cultivars	Giza178			Egyptian Hybrid 1		
ages / Spaces	15 day	20 day	25 day	15 day	20 day	25 day
2008						
20×20cm	157.66	150.33	119.66	178.66	174.00	150.66
25×25cm	142.33	140.00	131.33	166.66	159.66	157.00
30×30cm	157.00	135.00	136.00	197.33	144.00	148.66
F. test	**					
LSD at 5 %	9.71					
2009						
20×20cm	155.66	148.33	117.66	176.66	172.00	148.66
25×25cm	140.33	138.00	129.33	164.66	157.66	155.00
30×30cm	155.00	133.00	134.00	195.00	142.00	146.66
F. test	**					
LSD at 5 %	9.75					

On the other hand, while the lowest number of total grains/ panicle (119.66 and 117.66) in the first and second seasons, res., were obtained when using Giza178 cultivar, oldest seedling ages (25 day old) and closest spacing between hills

(20×20 cm). These results are in harmony with those recorded by Krishna and Biradarpatil (2009).

A.6- <u>Number of filled grains /panicle:</u>

Means of number of filled grains /panicle of rice plant as affected by cultivars, seedling ages and spacing between plants under the system of rice intensification (SRI) on rice productivity as well as their interactions during 2008 and 2009 seasons are showed in Table 12.

Effect of cultivars:

In both seasons the results in Table 12 indicated that the two tested cultivars significantly differed in number of filled grains /panicle. Egyptian Hybrid 1 rice cultivar significantly produced the highest number of filled grains /panicle (164.07 and 162.03) in the first and second seasons, res. While Giza 178 rice cultivar produced the lowest number of filled grains /panicle (141.03 and 139.03). Differential performance of two cultivars may be attributed to differences in genetically back ground and constitution of these cultivars. These results were parallel with those reported by Abdel-Rahman (1999a), Abdel-Rahman (1999b) Abdel-Rahman *et al.* (2004a), Abdel-Rahman *et al.* (2004b), Zayed *et al.* (2007), Abou-Khadra *et al.* (2008) and Zaki *et al.* (2009).

Effect of seedling ages:

The results in Table 12 indicated that number of filled grains /panicle was significantly affected by seedling ages. The highest number of filled grains /panicle (166.61 and 164.55), were produced when using the youngest seedling 15 day old in the first and second seasons, res. On the other hand the oldest seedling ages 25 day old gave the lowest number of filled grains /panicle

(140.55 and 138.55) in the first and second seasons, res. These are in agreement with those obtained by Uphoff (2004), Upadhyay *et al.* (2007) and Rao *et al.* (2007).

Effect of transplanting spaces:

The statistical analyses of data in Table 12, recorded that number of filled grains /panicle were significantly affected by transplanting spaces. The highest number of filled grains /panicle (155.16 and 155.16), were produced when using the widest spacing between hills (30×30 cm) in both seasons, res. While the lowest number of filled grains /panicle (149.50 and 147.50) in both seasons, res., were obtained when using the closest spacing between hills (20×20 cm).Such effect may be attributed to the increase of competition between individual plants and to elongation of panicle and the increase of fertility in panicle. These results are in agreement with those obtained by Sukla *et al.* (1984), Liu *et al.* (1997), Padmaja and Reddy (1998) and Krishna *et al.* (2009).

Effect of interaction between cultivars and seedling ages:

The results in Table 19 indicated that the interaction between cultivars and seedling ages had a significant effect on number of filled grains /panicle. The highest number of filled grains /panicle (176.33 and 174.33) in the first and second seasons, res., was recorded when using Egyptian Hybrid 1 cultivar and youngest seedling ages (15 day old).

Table 19: Means of number of filled grains /panicle of rice as affected by the interaction between cultivars and seedling ages during 2008 and 2009 seasons:

ages / Cultivars	15 day	20 day	25 day
2008			
Giza178	135.22	126.00	111.88
Egyptian Hybrid 1	176.33	153.11	144.11
F. test	**		
LSD at 5 %	5.87		
2009			
Giza178	133.22	124.00	109.88
Egyptian Hybrid 1	174.33	151.11	142.11
F. test	**		
LSD at 5 %	5.87		

On the other hand, the lowest number of filled grains /panicle (111.88 and 109.88) in the first and second seasons, res., were obtained when using Giza178 cultivar and oldest seedling ages 25 day. These results stand in line with those obtained by Amin *et al.* (2007).

Effect of interaction between cultivars and transplanting spaces:

The results in Table 20 indicated that the interaction between cultivars and transplanting spaces on number of filled grains /panicle had a significant effect. The highest number of filled grains /panicle (159.22) in the second season was recorded when using Egyptian Hybrid 1 and widest spacing between hills (30×30 cm). On the other hand, the lowest number of filled grains /panicle (121.66) in the second season was produced when using Giza178 and closest spacing between hills (20×20 cm). These results stand in line with those obtained by Ahmadikhah (2010).

Table 20: Means of number of filled grains /panicle of rice as affected by the interaction between cultivars and transplanting spaces during 2008 and 2009 seasons:

Cultivars \ *spaces*	20×20cm	25×25cm	30×30cm
	2009		
Giza178	121.66	119.55	125.88
Egyptian Hybrid 1	153.11	155.22	159.22
F. test	**		
LSD at 5 %	5.87		

Effect of interaction between seedling ages and transplanting spaces:

The results in Table 21 showed that, the interaction between seedling ages and transplanting spaces on number of filled grains /panicle differ significantly.

Table 21: Means of number of filled grains /panicle of rice as affected by the interaction between seedling ages and transplanting spaces during 2008 and 2009 seasons.

ages \ *spaces*	20×20 cm	25×25 cm	30×30 cm
	2008		
15 day	153.33	144.66	169.33
20 day	151.83	137.83	129.00
25 day	122.16	132.50	129.33
F. test	**		
LSD at 5 %	6.90		
	2009		
15 day	151.33	142.66	167.33
20 day	149.83	135.83	127.00
25 day	120.16	130.50	127.33
F. test	**		
LSD at 5 %	6.90		

The highest number of filled grains /panicle (169.33 and 167.33) in the first and second seasons, res., were recorded when using youngest seedling ages (15 day old) and widest spacing between hills (30×30 cm). On the other hand, the lowest number of filled grains /panicle (122.16 and 120.16) in the first and second seasons, res., were obtained when using oldest seedling ages (25 day old) and closest spacing between hills (20×20 cm). These results stand in line with those obtained by Mobasser *et al.* (2007) and Krishna and Biradarpatil (2009).

Table 22: Means of number of filled grains /panicle of rice as affected by the interaction between cultivars, seedling ages and transplanting spaces during 2008 and 2009 seasons:

Cultivars	Giza178			Egyptian Hybrid 1		
ages / Spaces	15 day	20 day	25 day	15 day	20 day	25 day
2008						
20×20cm	142.33	135.00	119.66	166.66	144.00	148.66
25×25cm	157.00	140.00	131.33	178.66	159.66	150.66
30×30cm	157.66	150.33	136.00	197.33	174.00	157.00
F. test	**					
LSD at 5 %	9.71					
2009						
20×20cm	140.66	148.33	117.66	166.66	148.00	162.00
25×25cm	145.33	138.00	129.33	174.66	157.66	140.66
30×30cm	155.00	133.00	134.00	195.00	162.00	148.66
F. test	**					
LSD at 5 %	9.75					

Effect of interaction between cultivars, seedling ages, and transplanting spaces:

The results in Table 22 indicated that the interaction between cultivars, seedling ages and transplanting spaces on number of filled grains /panicle differ significantly. The highest number of filled grains /panicle (197.33 and 195.00) in the first and second seasons, res., were recorded when using Egyptian Hybrid 1 cultivar, youngest seedling ages (15 day old) and widest spacing between hills (30×30 cm). On the other hand, while the lowest number of filled grains /panicle (119.66 and 117.66) in the first and second seasons, res., were obtained when using Giza178 cultivar, oldest seedling ages (25 day old) and closest spacing between hills (20×20 cm). These results are in harmony with those recorded by Reddy *et al.* (2007).

A.7- <u>1000- grain weight (g):</u>

Means of 1000- grain weight (g) of rice plant as affected by cultivars, seedling ages and spacing between plants under the system of rice intensification (SRI) on rice productivity as well as their interactions during 2008 and 2009 seasons are showed in Table 23.

Effect of cultivars:

In both seasons the results in Table 23 indicated that the two tested cultivars significantly differed in 1000- grain weight (g). Egyptian Hybrid 1 rice cultivar significantly produced the highest 1000- grain weight (26.38 and 26.28 g) in the first and second seasons, res. While Giza 178 rice cultivar produced the lowest 1000- grain weight (25.37 and 25.27 g) in the first and second seasons, res. Differential performance of two cultivars may be attributed to differences in genetically back ground and constitution of these cultivars. These results were parallel with those reported by Abdel-Rahman (1999a), Abdel-Rahman *et al.* (2004a), Abdel-Rahman *et al.* (2004b), El-Bably *et al.* (2007), Zayed *et al.* (2007), Abou-Khadra *et al.* (2008), Zaki *et al.* (2009) .

Table 23: Means of 1000- grain weight (g), grain yield (t/fed) and grain yield (t/fed) of rice as affected by cultivars, seedling ages and transplanting spaces during 2008 and 2009 seasons.

Characters / Treatments	1000- grain weight		Grain yield (t/fed)		Straw yield (t/fed)	
	2008	2009	2008	2009	2008	2009
A- cultivars:						
Giza178	25.37	25.27	3.96	3.64	4.29	5.00
Egyptian Hybrid 1	26.38	26.28	4.75	4.95	5.35	5.84
F. test	**	**	**	**	**	**
B- seedling ages:						
15 day	26.91	26.80	4.61	4.45	5.97	6.31
20 day	25.88	25.75	4.36	4.03	4.62	5.40
25 day	24.83	24.77	4.09	3.50	3.87	4.53
F. test	**	**	**	**	**	**
LSD at 5 %	0.26	0.09	0.14	0.05	0.16	0.05
C- transplanting spaces:						
20×20 cm	23.83	23.78	4.01	3.38	4.08	4.58
25×25 cm	25.82	25.78	4.30	4.10	4.85	5.35
30×30 cm	27.97	27.76	4.46	4.90	5.53	6.32
F. test	**	**	*	*	**	**
LSD at 5 %	.026	0.24	0.14	0.11	0.17	0.06
Interaction:						
A ×B	*	NS	*	**	**	**
A ×C	NS	**	*	**	*	**
B ×C	NS	NS	**	**	**	**
A ×B ×C	*	*	NS	NS	*	**

Effect of seedling ages:

The results in Table 23 indicated that 1000- grain weight (g) were significantly affected by seedling ages. The highest 1000- grain weight (26.91 and 26.80 g), were produced when using the youngest seedling 15 day old in the first and second seasons. On the other hand the oldest seedling ages 25 day old gave the lowest 1000- grain weight (24.83 and 24.77 g) in the first and second seasons, res. These are in agreement with those obtained by Chopra *et al.* (2002), Raj *et al.* (2008) and Goel *et al.* (2009).

Effect of transplanting spaces:

The statistical analyses of data in Table 23, recorded that 1000- grain weight (g) were significantly affected by transplanting spaces. The highest 1000- grain weight (27.97 and 27.76 g), Were produced when using the widest spacing between hills (30×30 cm) in the first and second seasons, res.. While the lowest 1000- grain weight (23.83 and 23.78 g) in the first and second seasons, res., were obtained when using the closest spacing between hills (20×20 cm). These results maybe attributed to regular spaces which allow through the canopy so plants can use it in photosynthesis. These results stand in line with those obtained by Liu *et al.* (1997), Shrivastava *et al.* (1999), Shinde *et al.* (2005) and Krishna *et al.* (2009). While Patra and Nayak (2001) found 1000-grain weight did not influenced significantly by the spacing.

Table 24: Means of 1000- grain weight (g) of rice as affected by the interaction between cultivars and seedling ages during 2008 season:

ages / ***Cultivars***	15 day	20 day	25 day
2008			
Giza178	26.27	25.44	24.38
Egyptian Hybrid 1	27.55	26.33	25.27
F. test	*		
LSD at 5 %	0.27		

Effect of interaction between cultivars and seedling ages:

The results in Table 24 indicated that the interaction between cultivars and seedling ages had a significant effect on 1000- grain weight (g). The highest 1000- grain weight (27.55 g) in the first season, were recorded when using Egyptian Hybrid 1 cultivar and youngest seedling ages (15 day old). On the other hand, the lowest 1000- grain weight (24.38 g) in the first season, were obtained when using Giza178 cultivar and oldest seedling ages 25 day. These results are in harmony with those recorded by Rahaman et al. (2004), Amin *et al.* (2007) and El-Rewainy *et al.* (2007).

Effect of interaction between cultivars and transplanting spaces:

The results in Table 25 indicated that the interaction between cultivars and transplanting spaces on 1000- grain weight (g) had a significant effect. The highest 1000- grain weight (28.46 g) in the second season, were recorded when using Egyptian Hybrid 1 and widest spacing between hills (30×30 cm). On the other hand, the lowest 1000- grain weight (27.06 g) in the second season, was produced when using Giza178 and closest spacing between hills (20×20 cm).

Table 25: Means of 1000- grain weight (g) of rice as affected by the interaction between cultivars and transplanting spaces during 2009 season:

spaces / ***Cultivars***	20×20cm	25×25cm	30×30cm
2009			
Giza178	23.46	25.30	27.06
Egyptian Hybrid 1	24.10	26.27	28.46
F. test	**		
LSD at 5 %	0.20		

Effect of interaction between cultivars, seedling ages, and transplanting spaces:

The results in Table 26 indicated that the interaction between cultivars, seedling ages and transplanting spaces 1000- grain weight (g) traits differ significantly. The highest 1000- grain weight (29.86 and 29.90 g) in the first season, were recorded when using Egyptian Hybrid 1 cultivar, youngest seedling ages (15 day old) and widest spacing between hills (30×30 cm). On the other hand, while the lowest 1000- grain weight (22.33 and 22.46 g) in the first and second seasons, res., were obtained when using Giza178 cultivar, oldest seedling ages (25 day old) and closest spacing between hills (20×20 cm).

Table 26: Means of 1000- grain weight (g) of rice as affected by the interaction between cultivars, seedling ages and transplanting spaces during 2008 and 2009 seasons:

Cultivars	Giza178			Egyptian Hybrid 1		
ages / Spaces	15 day	20 day	25 day	15 day	20 day	25 day
2008						
20×20cm	24.16	23.50	22.33	25.50	24.33	23.16
25×25cm	26.33	25.50	24.50	27.30	26.16	25.16
30×30cm	28.33	27.33	26.33	29.86	28.50	27.50
F. test	*					
LSD at 5 %	0.46					
2009						
20×20cm	24.30	23.63	22.46	25.06	24.20	23.03
25×25cm	26.40	25.30	24.20	27.16	26.10	25.56
30×30cm	28.00	27.03	26.16	29.90	28.26	27.23
F. test	*					
LSD at 5 %	0.36					

A.8- <u>Grain yield (t/fed):</u>

Means of grain yield (t/fed) of rice plant as affected by cultivars, seedling ages and spacing between plants under the system of rice intensification (SRI) on rice productivity as well as their interactions during 2008 and 2009 seasons are showed in Table 23.

Effect of cultivars:

In both seasons the results in Table 23 indicated that the two tested cultivars significantly differed in grain yield (t/fed). Egyptian Hybrid 1 rice cultivar significantly produced the highest grain yield (4.75 and 4.95 t/fed) in the first and second seasons, res. While Giza 178 rice cultivar produced the lowest grain yield (3.96 and 3.64 t/fed) in the first and second seasons, res. Differential performance of two cultivars may be attributed to differences in genetically back ground and constitution of these cultivars. Egyptian Hybrid 1 cultivar was characterized by strong growth, a lot of tillers and panicles and thus works to increase the grain yield/ fed. These results were parallel with those reported by Abdel-Rahman (1999a), Abdel-Rahman (1999b), Abdel-Rahman *et al.* (2004a), Abdel-Rahman *et al.* (2004b), Uphoff (2005), Abou-Khalif *et al.* (2007), Zayed *et al.* (2007), Abou-Khadra *et al.* (2008), Zaki *et al.* (2009) .

Effect of seedling ages:

The results in Table 23 indicated that grain yield (t/fed) were significantly affected by seedling ages. The highest grain yield (4.61 and 4.45 t/fed) in the first and second seasons, res, were produced when using the youngest seedling 15 day old in the first and second seasons. On the other hand the oldest seedling ages 25 day old gave the lowest grain yield (4.09 and 3.50 t/fed) in the first and second seasons, res. These are in agreement with those obtained by Molla *et al.* (2001), Pattar *et al.* (2001), Chopra *et al.* (2002), Makarim *et al.* (2002), Upadhyay *et al.* (2003), Shen *et al.* (2006), Rao *et al.* (2007b), Upadhyay *et al.* (2007), Kumar *et al.* (2008), Pasuquin *et al.* (2008), Reddy *et al.* (2008), Goel *et al.* (2009), Manjunatha *et al.* (2009), Manjunatha *et al.* (2010) and Singh *et al.* (2011).

Effect of transplanting spaces:

The statistical analyses of data in Table 23 recorded that grain yield (t/fed) were significantly affected by transplanting spaces. The highest grain yield (4.75 and 4.95 t/fed) in the first and second seasons, res., were produced when using the widest spacing between hills (30×30 cm) in the first and second seasons, res. This increase in this trait may be due to the regular space between plants that make solar radiation enable to pass all canopy and make plants are well in photosynthesis process. While the lowest grain yield (4.46 and 4.90 t/fed) in the first and second seasons, res were obtained when using the closest spacing between hills (20×20 cm). These results are in harmony with those recorded by Liu *et al.* (1997), Sanico *et al.* (1998), Varma *et al.* (2002), Chopra and Ahopra (2004), Shinde *et al.* (2005), and Krishna *et al.* (2009). On the other hand Ferraris *et al.* (1973), Shah *et al.* (1987), Srinivasan (1990), Balasubramaniyan and Palaniappan (1991), Samdhia (1996) and Patra and Nayak (2001) found significantly higher panicle per m^2, grain yield with closer spacing as compared to with wider spacing.

Effect of interaction between cultivars and seedling ages:

The results in Table 27 indicated that the interaction between cultivars and seedling ages had a significant effect on grain yield (t/fed). The highest grain yield (5.12 and 4.98 t/fed) in the first and second seasons, res. were recorded when using Egyptian Hybrid 1 cultivar and youngest seedling ages (15 day old). On the other hand, the lowest grain yield (3.71 and 3.30 t/fed) were obtained when using Giza178 cultivar and oldest seedling ages 25 day These results are in harmony with those recorded by Rahaman et al. (2004), Amin *et al.* (2007) and El-Rewainy *et al.* (2007).

Table 27: Means of grain yield (t/fed) of rice as affected by the interaction between cultivars and seedling ages during 2008 and 2009 seasons:

ages / ***Cultivars***	15 day	20 day	25 day
2008			
Giza178	4.11	4.06	3.71
Egyptian Hybrid 1	5.12	4.66	4.47
F. test	*		
LSD at 5 %	0.21		
2009			
Giza178	3.92	3.71	3.30
Egyptian Hybrid 1	4.98	4.36	3.70
F. test	**		
LSD at 5 %	0.12		

Effect of interaction between cultivars and transplanting spaces:

The results in Table 28 indicated that the interaction between cultivars and transplanting spaces on grain yield (t/fed) had a significant effect. The highest grain yield (4.95 and 4.86 t/fed) in the second season, were recorded when using Egyptian Hybrid 1 and widest spacing between hills (30×30 cm). On the other hand, the lowest grain yield (4.75 and 4.95 t/fed) were produced when using Giza178 and closest spacing between hills (20×20 cm).

Table 28: Means of grain yield (t/fed) of rice as affected by the interaction between cultivars and transplanting spaces during 2008 and 2009 seasons:

spaces / ***Cultivars***	20×20cm	25×25cm	30×30cm
2008			
Giza178	3.90	4.01	3.97
Egyptian Hybrid 1	4.72	4.18	4.95
F. test	*		
LSD at 5 %	0.21		
2009			
Giza178	2.91	3.87	4.14
Egyptian Hybrid 1	3.85	4.33	4.86
F. test	**		
LSD at 5 %	0.12		

Effect of interaction between seedling ages and transplanting spaces:

The results in Table 29 showed that, the interaction between seedling ages and transplanting spaces on grain yield (t/fed) traits differ significantly. The highest grain yield (5.03 and 5.15 t/fed) in the first and second seasons, res., were recorded when using youngest seedling ages (15 day old) and widest spacing between hills (30×30 cm). On the other hand, while the lowest grain yield (4.16 and 4.16 t/fed) in the first and second seasons, res., were obtained when using oldest seedling ages (25 day old) and closest spacing between hills (20×20 cm). These results are in good accordance with those obtained by Rajesh and Thanunathan (2003) Mobasser *et al.* (2007), Reddy *et al.* (2007) and Krishna and Biradarpatil (2009).

Table 29: Means of grain yield (t/fed) of rice as affected by the interaction between seedling ages and transplanting spaces during 2008 and 2009 seasons.

spaces / ***ages***	20×20 cm	25×25 cm	30×30 cm
2008			
15 day	4.41	4.40	5.03
20 day	4.35	4.35	4.40
25 day	4.16	4.15	3.96
F. test	**		
LSD at 5 %	0.25		
2009			
15 day	3.73	4.48	5.15
20 day	3.51	4.13	4.46
25 day	2.90	3.70	3.90
F. test	**		
LSD at 5 %	0.19		

A.9- <u>Straw yield (t/fed):</u>

Means of straw yield (t/fed) of rice plant as affected by cultivars, seedling ages and spacing between plants under the system of rice intensification (SRI) on rice productivity as well as their interactions during 2008 and 2009 seasons are showed in Table 23.

Effect of cultivars:

In both seasons the results in Table 23 indicated that the two tested cultivars significantly differed in straw yield (t/fed). Egyptian Hybrid 1 rice cultivar significantly produced the highest straw yield (t/fed) (5.35 and 5.84 t/fed), in the first and second seasons, res. While Giza 178 rice cultivar produced the lowest straw yield (t/fed) (4.29 and 5.00 t/fed), in the first and second seasons, res. Differential performance of two cultivars may be attributed to differences in genetically back ground and constitution of these cultivars. These results were parallel with those reported by Abdel-Rahman (1999a), Uphoff (2005), Abou-Khalif *et al.* (2007), Zayed *et al.* (2007), Abou-Khadra *et al.* (2008) and Zaki *et al.* (2009).

Effect of seedling ages:

The results in Table 23 indicated that straw yield (t/fed) were significantly affected by seedling ages. The highest straw yield (t/fed) (5.97 and 6.31 t/fed), were produced when using the youngest seedling 15 day old in the first and second seasons. On the other hand the oldest seedling ages 25 day old gave the lowest straw yield (t/fed) (3.87 and 4.53 t/fed), in the first and second seasons, res. These are in agreement with those obtained by Uphoff (2004), Reddy *et al.* (2008) and Singh *et al.* (2011).

Effect of transplanting spaces:

The statistical analyses of data in Table 23, recorded that straw yield (t/fed) were significantly affected by transplanting spaces. The highest straw yield (t/fed) (5.53 and 6.32 t/fed), were produced when using the widest spacing between hills (30×30 cm) in the first and second seasons, res. While the lowest straw yield (t/fed) (4.08 and 4.58 t/fed), in the first and second seasons, res., This increase in this trait may be due to the regular space between plants that make solar radiation enable to pass all canopy and make plants are well in photosynthesis process. Were obtained when using the closest spacing between hills (20×20 cm). These results are in agreement with those obtained by Shah *et al.* (1987) and Krishna *et al.* (2009). On the other hand Wagh and Thorat (1987), Balasubramaniyan and Palaniappan (1991), Siddiqui *et al.* (1999) and Patra and Nayak (2001) reported significantly higher straw yield with closer spacing than that with wider spacing.

Effect of interaction between cultivars and seedling ages:

The results in Table 30 indicated that the interaction between cultivars and seedling ages had a significant effect on straw yield (t/fed). The highest straw yield (t/fed) (6.45 and 6.66 t/fed) in the first and second seasons, res. were recorded when using Egyptian Hybrid 1 cultivar and youngest seedling ages (15 day old). On the other hand, the lowest straw yield (t/fed) (3.30 and 4.08 t/fed) were obtained when using Giza178 cultivar and oldest seedling ages 25 day. These results are in harmony with those recorded by Rahaman *et al.* (2004), Amin *et al.* (2007) and El-Rewainy *et al.* (2007).

Table 30: Means of straw yield (t/fed) of rice as affected by the interaction between cultivars and seedling ages during 2008 and 2009 seasons:

ages / ***Cultivars***	15 day	20 day	25 day
	2008		
Giza178	5.48	4.08	3.30
Egyptian Hybrid 1	6.45	5.16	4.45
F. test	**		
LSD at 5 %	0.20		
	2009		
Giza178	5.96	4.94	4.08

Egyptian Hybrid 1	6.66	5.86	4.98
F. test	**		
LSD at 5 %	0.08		

Effect of interaction between cultivars and transplanting spaces:

The results in Table 31 indicated that the interaction between cultivars and transplanting spaces on straw yield (t/fed) had a significant effect. The highest straw yield (t/fed) (6.18 and 6.84 t/fed) in the first and the second seasons, res. were recorded when using Egyptian Hybrid 1 and widest spacing between hills (30×30 cm). On the other hand, the lowest straw yield (t/fed) (3.63 and 4.17 t/fed) in the first and the second seasons, res. were produced when using Giza178 and closest spacing between hills (20×20 cm).

Table31: Means of straw yield (t/fed) of rice as affected by the interaction between cultivars and transplanting spaces during 2008 and 2009 seasons:

spaces / ***Cultivars***	20×20cm	25×25cm	30×30cm
2008			
Giza178	3.63	4.36	4.87
Egyptian Hybrid 1	4.54	5.34	6.18
F. test	*		
LSD at 5 %	0.20		
2009			
Giza178	4.17	5.01	5.81
Egyptian Hybrid 1	4.98	5.68	6.84
F. test	**		
LSD at 5 %	0.08		

Effect of interaction between seedling ages and transplanting spaces:

The results in Table 32 showed that, the interaction between seedling ages and transplanting spaces on straw yield (t/fed) differ significantly. The highest straw yield (t/fed) (7.31 and 7.35 t/fed) in the first and second seasons, res., were recorded when using youngest seedling ages (15 day old) and widest spacing between hills (30×30 cm). On the other hand, while the lowest straw yield (t/fed) (3.88 and 3.66 t/fed) in the first and second seasons, res., were obtained when using oldest seedling ages (25 day old) and closest spacing between hills (20×20 cm). These results are in good accordance with those obtained by Krishna and Biradarpatil (2009).

Table 32: Means of straw yield (t/fed) of rice as affected by the interaction between seedling ages and transplanting spaces during 2008 and 2009 seasons.

spaces / *ages*	20×20 cm	25×25 cm	30×30 cm
2008			
15 day	4.76	5.83	7.31
20 day	3.61	4.93	5.33
25 day	3.88	3.80	3.94
F. test	**		
LSD at 5 %	0.31		
2009			
15 day	5.55	6.05	7.35
20 day	4.53	5.33	6.35
25 day	3.66	4.66	5.28
F. test	**		
LSD at 5 %	0.11		

Effect of interaction between cultivars, seedling ages, and transplanting spaces:

The results in Table 33 indicated that the interaction between cultivars, seedling ages and transplanting spaces on straw yield (t/fed) differ significantly. The highest straw yield (t/fed) (7.83 and 7.86 t/fed) in the first and second seasons, res., were recorded when using Egyptian Hybrid 1 cultivar, youngest seedling ages (15 day old) and widest spacing between hills (30×30 cm). On the other hand, while the lowest straw yield (t/fed) (3.46 and 3.10 t/fed) in the first and second seasons, res., were obtained when using Giza178 cultivar, oldest seedling ages (25 day old) and closest spacing between hills (20×20 cm). These results are in harmony with those recorded by Kumar *et al.* (2002a). Kumar *et al.* (2002b) and Reddy *et al.* (2007).

Table 33: Means of straw yield (t/fed) of rice as affected by the interaction between cultivars, seedling ages and transplanting spaces during 2008 and 2009 seasons:

Cultivars	Giza178			Egyptian Hybrid 1		
Spaces \ ages	15 day	20 day	25 day	15 day	20 day	25 day
2008						
20×20cm	4.33	3.10	3.46	5.20	4.13	4.30
25×25cm	5.33	4.36	3.40	6.33	5.50	4.20
30×30cm	6.80	4.80	3.03	7.83	5.86	4.86
F. test	*					
LSD at 5 %	0.35					
2009						
20×20cm	5.23	4.20	3.10	5.86	4.86	4.23
25×25cm	5.83	4.80	4.40	6.26	5.86	4.93
30×30cm	6.83	5.83	4.76	7.86	6.86	5.80
F. test	**					
LSD at 5 %	0.15					

B. Milling recovery:

B. 1- Hulling%:

Means of hulling% of rice plant as affected by cultivars, seedling ages and spacing between plants under the system of rice intensification (SRI) on rice productivity as well as their interactions during 2008 and 2009 seasons are showed in Table 34.

Effect of cultivars:

In both seasons the results in Table 34 indicated that the two tested cultivars significantly differed in hulling%. Egyptian Hybrid 1 rice cultivar significantly produced the highest hulling% (83.43 and 83.53%), in the first and second seasons, res. While Giza 178 rice cultivar produced the lowest hulling% (82.36 and 82.58 %), in the first and second seasons, res. Differential performance of two cultivars may be attributed to differences in genetically back ground and constitution of these cultivars. These results were parallel with those reported by El-Maksoud (2008).

Effect of seedling ages:

The results in Table 34 indicated that hulling% was significantly affected by seedling ages. The highest hulling% (84.00 and 83.99%), were produced when using the youngest seedling 15 day old in the first and second seasons. On the other hand the oldest seedling ages 25 day old gave the lowest hulling% (81.93 and 82.11 %), in the first and second seasons, res. These are in agreement with those obtained by Singh *et al.* (2004).

Effect of transplanting spaces:

The statistical analyses of data in Table 34, recorded that hulling% were significantly affected by transplanting spaces. The highest hulling% (83.95 and 84.06%), were produced when using the widest spacing between hills (30×30 cm) in both seasons. While the lowest hulling% (81.81 and 81.99 %), in the first and second seasons, res., were obtained when using the closest spacing between hills (20×20 cm). These results are in good accordance with this obtained by

Table 34: Means of hulling%, Milled% and Head rice% of rice as affected by cultivars, seedling ages and transplanting spaces during 2008 and 2009 seasons.

Characters / Treatments	Hulling%		Milled%		Head rice%	
	2008	2009	2008	2009	2008	2009
A- cultivars:						
Giza178	82.36	82.58	70.29	70.39	60.97	62.16
Egyptian Hybrid 1	83.43	83.53	71.25	71.50	62.11	63.60
F. test	**	**	**	**	**	**
B- seedling ages:						
15 day	84.00	83.99	71.59	71.92	62.63	63.87
20 day	82.75	83.06	70.49	70.97	61.08	62.89
25 day	81.93	82.11	70.23	69.94	60.91	61.88
F. test	**	**	**	**	**	**
LSD at 5 %	0.08	0.18	0.50	0.02	0.26	0.08
C- transplanting spaces:						
20×20 cm	81.81	81.99	69.78	69.99	60.15	61.82
25×25 cm	82.92	83.11	70.94	71.00	61.30	62.81
30×30 cm	83.95	84.06	71.59	71.84	63.17	64.02
F. test	**	**	**	**	**	**
LSD at 5 %	0.08	0.13	0.29	0.17	0.12	0.06
Interaction:						
A ×B	NS	NS	**	**	**	NS
A ×C	NS	*	**	NS	**	*
B ×C	**	*	**	NS	**	*
A ×B ×C	*	NS	**	NS	**	NS

Effect of interaction between cultivars and transplanting spaces:

The results in Table 35 indicated that the interaction between cultivars and transplanting spaces on hulling% had a significant effect in the second season. The highest hulling% (84.39%) in the second season, were recorded when using Egyptian Hybrid 1 and widest spacing between hills (30×30 cm). On the other hand, the lowest hulling% (81.37 %), were produced when using Giza178 and closest spacing between hills (20×20 cm).

Table 35: Means of hulling% of rice as affected by the interaction between cultivars and transplanting spaces during 2009 season:

spaces / ***Cultivars***	20×20cm	25×25cm	30×30cm
2009			
Giza178	81.37	82.64	83.72
Egyptian Hybrid 1	82.61	83.58	84.39
F. test	*		
LSD at 5 %	0.27		

Effect of interaction between seedling ages and transplanting spaces:

The results in Table 36 showed that, the interaction between seedling ages and transplanting spaces on hulling% differ significantly. The highest hulling% (85.18 and 85.04%) in the first and the second seasons, res., were recorded when using youngest seedling ages (15 day old) and widest spacing between hills (30×30 cm). On the other hand, while the lowest hulling% (80.87and 81.06%) in the first and second seasons, res., were obtained when using oldest seedling ages (25 day old) and closest spacing between hills (20×20 cm).

Table 36: Means of hulling% of rice as affected by the interaction between seedling ages and transplanting spaces during 2008 and 2009 seasons.

spaces / ***g ages***	20×20 cm	25×25 cm	30×30 cm
2008			
15 day	82.86	83.95	85.18
20 day	81.68	82.73	83.85
25 day	80.87	82.10	82.82
F. test	**		
LSD at 5 %	0.15		
2009			
15 day	82.92	84.00	85.04
20 day	81.99	82.99	84.20
25 day	81.06	82.34	82.94
F. test	*		
LSD at 5 %	0.23		

Effect of interaction between cultivars, seedling ages, and transplanting spaces:

The results in Table 37 indicated that the interaction between cultivars, seedling ages and transplanting spaces on hulling% differ significantly. The highest hulling% (85.76%) in the first season, were recorded when using Egyptian Hybrid 1 cultivar, youngest seedling ages (15 day old) and widest spacing between hills (30×30 cm). On the other hand, while the lowest hulling% (80.48 %) in the first season, were obtained when using Giza178 cultivar, oldest seedling ages (25 day old) and closest spacing between hills (20×20 cm).

Table37: Means of hulling% of rice as affected by the interaction between cultivars, seedling ages and transplanting spaces during 2008 season:

Cultivars / ages / Spaces	Giza178			Egyptian Hybrid 1		
	15 day	20 day	25 day	15 day	20 day	25 day
2008						
20×20cm	82.40	81.21	80.48	83.33	82.16	81.26
25×25cm	83.26	82.39	81.36	84.63	83.07	82.83
30×30cm	84.60	83.21	82.29	85.76	84.49	83.34
F. test	*					
LSD at 5 %	0.36					

B. 2- Milled%:

Means of milled% of rice plant as affected by cultivars, seedling ages and spacing between plants under the system of rice intensification (SRI) on rice productivity as well as their interactions during 2008 and 2009 seasons are showed in Table 34.

Effect of cultivars:

In both seasons the results in Table 34 indicated that the two tested cultivars significantly differed in milled%. Egyptian Hybrid 1 rice cultivar significantly produced the highest milled% (71.25 and 71.50 %), in the first and second seasons, res. While Giza 178 rice cultivar produced the lowest milled% (70.29 and 70.39 %), in the first and second seasons, res. Differential performance of two cultivars may be attributed to differences in genetically back ground and constitution of these cultivars. These results were parallel with those reported by El-Kady *et al.* (2004) and El-Maksoud (2008).

Effect of seedling ages:

The results in Table 34 indicated that milled% was significantly affected by seedling ages. The highest milled% (71.59 and 71.92 %), were produced when using the youngest seedling 15 day old in the first and second seasons. On the other hand the oldest seedling ages 25 day old gave the lowest milled% (70.23 and 69.94 %) in the first and second seasons, res. These are in agreement with those obtained by Singh *et al.* (2004).

Effect of transplanting spaces:

The statistical analyses of data in Table 34, recorded that milled% were significantly affected by transplanting spaces. The highest milled% (71.59 and 71.84 %), were produced when using the widest spacing between hills (30×30 cm) in both seasons. While the lowest milled% (69.78 and 69.99 %) in the first and second seasons, res., were obtained when using the closest spacing between hills (20×20 cm).

Effect of interaction between cultivars and seedling ages:

The results in Table 38 indicated that the interaction between cultivars and seedling ages had a significant effect on milled%. The highest milled% (72.34 and 72.41%) in the first and second seasons, res. were recorded when using Egyptian Hybrid 1 cultivar and youngest seedling ages (15 day old). On the other hand, the lowest milled% (69.99 and 69.21 %) in the first and second seasons, res., were obtained when using Giza178 cultivar and oldest seedling ages 25 day.

Table 38: Means of milled% of rice as affected by the interaction between cultivars and seedling ages during 2008 and 2009 seasons:

Cultivars / ***ages***	15 day	20 day	25 day
2008			
Giza178	70.84	70.04	69.99
Egyptian Hybrid 1	72.34	70.94	70.47
F. test	**		
LSD at 5 %	0.26		
2009			
Giza178	71.43	70.53	69.21
Egyptian Hybrid 1	72.41	71.41	70.67
F. test	**		
LSD at 5 %	0.25		

Effect of interaction between cultivars and transplanting spaces:

The results in Table 39 indicated that the interaction between cultivars and transplanting spaces on milled% had a significant effect. The highest milled% (72.03 %) in the second season, were recorded when using Egyptian Hybrid 1 and widest spacing between hills (30×30 cm). On the other hand, the lowest milled% (69.24 %) in the second season, were produced when using Giza178 and closest spacing between hills (20×20 cm).

Effect of interaction between seedling ages and transplanting spaces:

The results in Table 40 showed that, the interaction between seedling ages and transplanting spaces on milled% differ significantly. The highest milled% (72.64 %) in the first season, were recorded when using youngest seedling ages (15 day old) and widest spacing between hills (30×30 cm).

Table 39: Means of milled% of rice as affected by the interaction between cultivars and transplanting spaces during 2008 and 2009 seasons:

spaces / ***Cultivars***	20×20cm	25×25cm	30×30cm
2008			
Giza178	69.24	70.47	71.15
Egyptian Hybrid 1	70.32	71.40	72.03
F. test	**		
LSD at 5 %	0.26		

On the other hand, while the lowest milled% (68.96 %) in the first season, were obtained when using oldest seedling ages (25 day old) and closest spacing between hills (20×20 cm).

Table 40: Means of milled% of rice as affected by the interaction between seedling ages and transplanting spaces during 2008 season:

ages / ***Spaces***	20×20 cm	25×25 cm	30×30 cm
	2008		
15 day	70.86	71.26	72.64
20 day	69.53	70.91	71.03
25 day	68.96	70.64	71.09
F. test	**		
LSD at 5 %	0.50		

Effect of interaction between cultivars, seedling ages, and transplanting spaces:

The results in Table 41 indicated that the interaction between cultivars, seedling ages and transplanting spaces on milled% differ significantly. The highest milled% (73.67 %) in the first season, were recorded when using Egyptian Hybrid 1 cultivar, youngest seedling ages (15 day old) and widest spacing between hills (30×30 cm). On the other hand, while the lowest milled% (68.27 %) in the first season, were obtained when using Giza178 cultivar, oldest seedling ages (25 day old) and closest spacing between hills (20×20 cm).

Table 41: Means of milled% of rice as affected by the interaction between cultivars, seedling ages and transplanting spaces during 2008 and 2009 seasons:

Cultivars	Giza178			Egyptian Hybrid 1		
Spaces \ ages	15 day	20 day	25 day	15 day	20 day	25 day
2008						
20×20cm	70.20	69.26	68.27	71.52	69.80	69.66
25×25cm	70.70	70.30	70.42	71.83	71.53	70.86
30×30cm	71.62	70.55	71.27	73.67	71.50	70.91
F. test	**					
LSD at 5 %	0.45					

B. 3- <u>Head rice%:</u>

Means of head rice% of rice plant as affected by cultivars, seedling ages and spacing between plants under the system of rice intensification (SRI) on rice productivity as well as their interactions during 2008 and 2009 seasons are showed in Table 34.

Effect of cultivars:

In both seasons the results in Table 34 indicated that the two tested cultivars significantly differed in head rice%. Egyptian Hybrid 1 rice cultivar significantly produced the highest head rice% (62.11 and 63.60 %), in the first and second seasons, res. While Giza 178 rice cultivar produced the lowest head rice% (60.97 and 62.16 %), in the first and second seasons, res. Differential performance of two cultivars may be attributed to differences in genetically back ground and constitution of these cultivars.

Effect of seedling ages:

The results in Table 34 indicated that head rice% was significantly affected by seedling ages. The highest head rice% (62.63 and 63.87 %), were produced when using the youngest seedling 15 day old in the first and second seasons. On the other hand the oldest seedling ages 25 day old gave the lowest head rice% (60.91 and 61.88 %), in the first and second seasons, res.

Effect of transplanting spaces:

The statistical analyses of data in Table 34, recorded that head rice% were significantly affected by transplanting spaces. The highest head rice% (63.17 and 64.02 %), were produced when using the widest spacing between hills (30×30 cm) in both seasons. While the lowest head rice% (60.15 and 61.82 %), in the first and second seasons, res., were obtained when using the closest spacing between hills (20×20 cm).

Effect of interaction between cultivars and seedling ages:

The results in Table 42 indicated that the interaction between cultivars and seedling ages had a significant effect on head rice%. The highest head rice%

(63.41%) in the first season, were recorded when using Egyptian Hybrid 1 cultivar and youngest seedling ages (15 day old). On the other hand, the lowest head rice% (60.52%) in the first, were obtained when using Giza178 cultivar and oldest seedling ages 25 day.

Table 42: Means of head rice% of rice as affected by the interaction between cultivars and seedling ages during 2008 season:

ages / *Cultivars*	15 day	20 day	25 day
2008			
Giza178	61.86	60.54	60.52
Egyptian Hybrid 1	63.41	61.62	61.30
F. test	**		
LSD at 5 %	0.23		

Effect of interaction between cultivars and transplanting spaces:

The results in Table 43 indicated that the interaction between cultivars and transplanting spaces on head rice% had a significant effect.

Table 43: Means of head rice% of rice as affected by the interaction between cultivars and transplanting spaces during 2008 and 2009 seasons:

spaces / *Cultivars*	20×20cm	25×25cm	30×30cm
2008			
Giza178	59.73	60.77	62.42
Egyptian Hybrid 1	60.57	61.83	63.93
F. test	**		
LSD at 5 %	0.23		
2009			
Giza178	61.11	62.21	63.17
Egyptian Hybrid 1	62.52	63.42	64.87
F. test	*		

LSD at 5 %	0.23

The highest head rice% (63.93 and 64.87 %) in the first and second seasons, res., were recorded when using Egyptian Hybrid 1 and widest spacing between hills (30×30 cm). On the other hand, the lowest head rice% (59.73 and 61.11 %) in the first and second seasons, res., were produced when using Giza178 and closest spacing between hills (20×20 cm).

Effect of interaction between seedling ages and transplanting spaces:

The results in Table 44 showed that, the interaction between seedling ages and transplanting spaces on head rice% differ significantly. The highest head rice% (64.46 and 65.00 %) in the first and second seasons, res., were recorded when using youngest seedling ages (15 day old) and widest spacing between hills (30×30 cm). On the other hand, while the lowest head rice% (59.04 and 60.93 %) in the first and second seasons, res., were obtained when using oldest seedling ages (25 day old) and closest spacing between hills (20×20 cm).

Table 44: Means of head rice% of rice as affected by the interaction between seedling ages and transplanting spaces during 2008 and 2009 seasons.

spaces / ***ages***	20×20 cm	25×25 cm	30×30 cm
2008			
15 day	61.76	61.68	64.46
20 day	59.65	60.95	62.65
25 day	59.04	61.27	62.41
F. test	**		
LSD at 5 %	0.22		
2009			
15 day	62.78	63.85	65.00
20 day	61.75	62.89	64.03
25 day	60.93	61.70	63.03

F. test	*
LSD at 5 %	0.15

Effect of interaction between cultivars, seedling ages, and transplanting spaces:

The results in Table 45 indicated that the interaction between cultivars, seedling ages and transplanting spaces on head rice% differ significantly. The highest head rice% (65.50%) in the first season, were recorded when using Egyptian Hybrid 1 cultivar, youngest seedling ages (15 day old) and widest spacing between hills (30×30 cm). On the other hand, while the lowest head rice% (58.80 %) in the first season, were obtained when using Giza178 cultivar, oldest seedling ages (25 day old) and closest spacing between hills (20×20 cm).

Table 45: Means of head rice% of rice as affected by the interaction between cultivars, seedling ages and transplanting spaces during 2008 season:

Cultivars	Giza178			Egyptian Hybrid 1		
Spaces / ages	15 day	20 day	25 day	15 day	20 day	25 day
2008						
20×20cm	61.16	59.23	58.80	62.36	60.07	59.29
25×25cm	61.00	60.43	60.89	62.37	61.47	61.66
30×30cm	63.43	61.96	61.86	65.50	63.33	62.96
F. test	**					
LSD at 5 %	0.40					

SUMMARY

SUMMARY

Two field experiments were carried out at the farm of Rice Research section Agricultural Research station, El-Gemmiza, Gharbia Governorate, during the two successive summer seasons of 2008 and 2009. The objective of these experiments was to determine the effect of cultivars, seedling age and spacing between plants under the system of rice intensification (SRI), growth, yield components as well as milling recovery.

Rice grains of the studied cultivar (Giza 178) and (Egyptian Hybrid 1) were obtained from Agricultural Cooperation Rice Research section Agricultural Research station, El-Gemmiza, Gharbia Governorate.

The experiments were carried out in a split split plot design with three replications.

The main plots were assigned to two cultivars as follows:

1. Giza 178.
2. Egyptian Hybrid 1.

The sup plots were occupied with the following three seedling age:

1. 15 day from planting.
2. 20 day from planting.
3. 25 day from planting.

The sup sub plots were assigned to three transplanting spaces as follows:

1. 20×20 cm between plants.
2. 25×25 cm between plants.
3. 30×30 cm between plants.

STUDIED CHARACTERS:

A. <u>Yield and its components:</u>

1. **Number of tillers/m².**
2. **Number of Panicles/m².**
3. **Plant height (cm).**
4. **Panicle length (cm).**
5. **Number of total grains/panicle.**
6. **Number of filled grains /panicle.**
7. **1000- grain weight (g).**
8. **Grain yield (t/fed).**
9. **Straw yield (t/fed).**

B. <u>Milling recovery:</u>

1. **Hulling%**
2. **Milled%**
3. **Head rice%**

❑ *The most important results obtained from this investigation can be summarized as follows:*

1. Yield and its components:

1.1- *Effect of cultivars:*

As seems to appear from obtained data, the two tested cultivars significantly differed in all studied characters in both seasons. Egyptian Hybrid 1 rice cultivar significantly produced the highest number of tillers /m², number of panicles /m², Plant height (cm), panicle length (cm), number of total grains/ panicle, number of filled grains /panicle, 1000- grain weight, grain yield (t/fed) and Straw yield (t/fed). While Giza 178 rice cultivar produced the lowest values in both seasons.

1.2- *Effect of seedling age:*

The statistical analysis of obtained results manifested that seedling age had a significant effect on all studied characters in both seasons. The highest values of these traits were produced when using the youngest seedling 15 day old. On the other hand the oldest seedling age 25 day old gave the lowest values of these traits.

1.3- *Effect of transplanting spaces:*

Transplanting spaces exhibited significant effect on all traits study in both seasons. The highest values of these traits were produced when using the widest spacing between hills (30×30 cm) in both seasons. While the lowest values were obtained when using the closest spacing between hills (20×20 cm).

1.4- *Effect of the interaction between cultivars and seedling age:*

In both growing seasons of this study, the results indicated that the interaction between cultivars and seedling age had a significant effect on number of tillers /m² in the first season, Plant height (cm) in the first and second seasons, res., panicle length (cm) in the first and second seasons, res., number of total grains/ panicle in the first and second seasons, res., number of filled grains /panicle in the first and second seasons, res., 1000- grain weight in the first season, grain yield (t/fed) in the first and second seasons, res. and Straw yield (t/fed) in the first and second seasons, res. The highest values were recorded when using Egyptian Hybrid 1 cultivar and youngest seedling age (15 day old). On the other hand, the lowest values of these characters were obtained when using Giza178 cultivar and oldest seedling age 25 day.

1.5- *Effect of the interaction between cultivars and transplanting spaces:*

The obtained data indicated that the interaction between cultivars and transplanting spaces on number of tillers /m² in the second season, number of panicles /m² in the first and second seasons, res., panicle length (cm) in the first season, number of filled grains /panicle in the second season, 1000- grain weight in the second season, grain yield (t/fed) in the second season and Straw yield (t/fed) in the first and second seasons, res. had a significant effect. The highest values were recorded when using Egyptian Hybrid 1 and widest spacing between hills (30 × 30 cm). On the other hand, the lowest values of these traits were produced when using Giza178 and closest spacing between hills (20 × 20 cm).

1.6- *Effect of the interaction between seedling age and transplanting spaces:*

In both growing seasons of this study, the results showed that, the interaction between seedling age and transplanting spaces on number of tillers /m² in the second season, number of panicles /m² in the first and second seasons, res., Plant height (cm) in the first and second seasons, res., panicle length (cm) in the first and second seasons, res., number of total grains/ panicle in the first and second seasons, res., number of filled grains /panicle in the first and second seasons, res., grain yield (t/fed) in the first and second seasons, res. and Straw yield (t/fed) in the first and second seasons, res. differ significantly. The highest values were recorded when using youngest seedling age (15 day old) and widest spacing between hills (30 × 30 cm). On the other hand, the lowest values of these traits were obtained when using oldest seedling age (25 day old) and closest spacing between hills (20 × 20 cm).

1.7- *Effect of the interaction between cultivars, seedling age and transplanting spaces:*

In both growing seasons of this study, the results indicated that the interaction between cultivars, seedling age and transplanting spaces on number of tillers /m² in the first and second seasons, res., number of panicles /m² in the first and second seasons, res., Plant height (cm) in the second season, number of total grains/ panicle in the first and second seasons, res., number of filled grains

/panicle in the first and second seasons, res., 1000- grain weight in the first season and Straw yield (t/fed) in the first and second seasons, res. differ significantly. The highest values were recorded when using Egyptian Hybrid 1 cultivar, youngest seedling age (15 day old) and widest spacing between hills (30 × 30 cm). On the other hand, while the lowest values of these traits were obtained when using Giza178 cultivar, oldest seedling age (25 day old) and closest spacing between hills (20 × 20 cm).

2- Milling recovery:

2.1- *Effect of cultivars:*

As seems to appear from obtained data, the two tested cultivars significantly differed in all studied characters. Egyptian Hybrid 1 rice cultivar significantly produced the highest hulling%, milled% and head rice% while Giza 178 rice cultivar produced the lowest values in both seasons.

2.2- *Effect of seedling age:*

The statistical analysis of obtained results manifested that seedling age had a significant effect on hulling%, milled% and head rice% during the two growing seasons, the highest values were produced when using the youngest seedling 15 day old in the first and second seasons. On the other hand the oldest seedling age 25 day old gave the lowest values of these traits in both seasons.

2.3- *Effect of transplanting spaces:*

Transplanting spaces exhibited significant effect on hulling%, milled% and head rice% during the two growing seasons, the highest values were produced when using the widest spacing between hills (30×30 cm). While the lowest values were obtained when using the closest spacing between hills (20×20 cm) in both seasons.

2.4- *Effect of the interaction between cultivars and seedling age:*

In this study, the results indicated that the interaction between cultivars and seedling age had a significant effect milled% in the first and second seasons, res. and head rice% in the first season. The highest values were recorded when using Egyptian Hybrid 1 cultivar and youngest seedling age (15 day old). On the other hand, the lowest values of these characters were obtained when using Giza178 cultivar and oldest seedling age 25 day.

2.5- *Effect of the interaction between cultivars and transplanting spaces:*

The obtained data indicated that the interaction between cultivars and transplanting spaces on hulling% in the second season, milled% in the second season and head rice% in the first and second seasons, res. had a significant effect. The highest values were recorded when using Egyptian Hybrid 1 and widest spacing between hills (30 × 30 cm). On the other hand, the lowest values of these traits were produced when using Giza178 and closest spacing between hills (20 × 20 cm).

2.6- ***Effect of the interaction between seedling age and transplanting spaces:***

In this study, the results showed that, the interaction between seedling age and transplanting spaces on hulling% in the first and the second seasons, res., milled% in the first season and head rice% in the first and second seasons, res. differ significantly. The highest values were recorded when using youngest seedling age (15 day old) and widest spacing between hills (30 × 30 cm). On the other hand, the lowest values of these traits were obtained when using oldest seedling age (25 day old) and closest spacing between hills (20 × 20 cm).

2.7- ***Effect of the interaction between cultivars, seedling age and transplanting spaces:***

In study, the results indicated that the interaction between cultivars, seedling age and transplanting spaces on hulling% in the first season, milled% in the first season and head rice% in the first season differ significantly. The highest values were recorded when using Egyptian Hybrid 1 cultivar, youngest seedling age (15 day old) and widest spacing between hills (30 × 30 cm). On the other hand, while the lowest values of these traits were obtained when using Giza178 cultivar, oldest seedling age (25 day old) and closest spacing between hills (20 × 20 cm).

CONCLUSION

We have been studying some factors of the system of rice intensification (SRI), According to the obtained results from this study, it can be concluded that, application Egyptian Hybrid 1 cultivar with youngest seedling age (15 day old) and widest spaces between hills and rows (30 × 30 cm) under the system of rice intensification (SRI), could be recommend to raise rice productivity under the environmental conditions of Rice Research section Agricultural Research station, El-Gemmiza, Gharbia Governorate.

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