Journal of Plant Production

Journal homepage & Available online at: www.jpp.journals.ekb.eg

Effect of Planting Methods on the Productivity of some Egyptian Rice (*Oryza sativa* L.) cultivars

Mousa, A. M. M.[1*] and Mohamed Abdelghany[2]

[1] Rice Research Department, Field Crops Research Institute, ARC, Egypt
[2]Crop Science Department, Faculty of Agriculture, Damanhour University, Damanhour 22516, Egypt

Cross Mark

ABSTRACT

Two field experiments were carried out in two seasons (2020 and 2021) at Itay El-Baroud Agricultural Research Station, El-Beheira Governorate, Egypt to evaluate three Egyptian rice cultivars (Giza177, Sakha101 and Sakha108) under three planting methods (drilling seeded, regular transplanting and parachute transplanting). Days to heading, plant height, number of productive tillers m^{-2}, panicle length, panicle weight, number of filled grains panicle^{-1}, number of unfilled grains panicle^{-1} and 1000-grain weight, grain yield, biomass yield, harvest index and production efficiency were measured. There were no significant differences between regular and parachute transplanting methods on plant height, number of productive tillers\ m^2 and panicle length whereas the drill planting method recorded the lowest values in both seasons except days to heading showed no significant difference with parachute transplanting. The interaction between planting methods and rice cultivars had a significant effect on the number of days to heading, number of productive tillers m^{-2} and plant height. There were no significant differences between parachuting and regular transplanting methods in panicle weight, number of filled grains panicle^{-1} and 1000-grain weight where the parachute transplanting method recorded the highest values followed by regular transplanting in the first season. On contrary, the highest values were given by regular transplanting followed by parachuting in the second season. Also, there were no significant differences between regular and parachute transplanting in 1000-grain weight, grain yield, biomass yield and harvest index. These results revealed that regular and parachute transplanting methods are efficient and farmers can choose between them based on their capabilities.

Keywords: Rice, regular transplanting, parachute transplanting.

INTRODUCTION

Rice (Oryza sativa L.) is considered to be one of the most vital food crops for more than half of the world's population (Khush and Virk, 2000). It is one of the most versatile and important cereal crops of the Poaceae family, having been farmed for over ten thousand years (Sasaki, 2005). There are many varieties of rice in the world (about 10,000). It is the second most vastly consumed cereal crop all over the world after wheat (Kumari et al., 2014). In Egypt, rice also is one of the most important food and export crops which usually occupies most of the cultivated area in the Delta in the summer season. In 2021, the estimation of the cultivated rice area in nine governorates was 1.074 million acres (about 451 000 hectares) (FAO, 2021). The distribution of new high-yielding varieties of rice in the cultivated area buffered the decline in 2021 production (FAO, 2021). Rice is grown for many vital objectives such as a human nourishment crop and as an improving crop for salinity essentially in the north of Egypt.

There are many different methods for planting rice such as conventional transplanting, direct drilling seeding in lines and broadcast fashion, wet sowing, and dry sowing. There is a great difference between these methods in water irrigation amount, crop yields, labour expenses and the total economic outcomes. Consequently, it is essential to develop a method of crop sowing which is less labour-intensive and more efficient in water consumption to make farmers able to produce more with less expense of production (Bohra and Kumar, 2015). Regular transplanting is considered to be the traditional method for rice cultivation in Egypt, although the lack of labour makes it very expensive. Despite manual transplanting being the most popular method of rice production but it has several defects such as being very laborious, ponderous, time ravages and needs high cost of nursery uprooting and transplanting (Awan et al., 2008).

Manual transplanting also caused yield reductions because of the low plant population.

The drill sowing method is very efficient because it makes the sowing depth and spacing uniform. Direct seeding in rows not only saves transplanting labour but also simplify crop protection and gets rid of weed infestation, shortens the crop duration by 7-10 days and supplies comparable yield with transplanted rice (Abo El-Ees, 1985; Mishra et al., 2012). Efforts must be done to promote seeders of simple rows for direct seeding of rice under both wet and dry field conditions (Khan and El-Sahrigi, 1990). In response to a necessity for water productivity to increase, intermittent irrigation to establish plants occupied the second rank after the drill sowing method of seed into dry soil (Dunn et al., 2018). The drill sowing method of seed into dry soil is growing in popularity, representing >40% of rice cultivated area in the 2017–18 season and 70% in 2018–19 season in Australia(Dunn and Ford, 2018). Many factors have driven the uptake of drill sowing including the chance to decrease the production costs without decreasing productivity and

* **Corresponding author.**
E-mail address: abdelrahman.mosa81@gmail.com
DOI: 10.21608/jpp.2022.152877.1148

decreased risk of the bad establishment because of birds, wind and slime (Dunn et al., 2018) in addition to the most serious factor of decreasing water consumption (Dunn and Gaydon, 2011).

In several parts of the world, alternate methods of sowing are being used. Parachute technology is one of these methods. Some rice-growing regions in China have adopted the so-called "light rice cultivation" such as parachute technology for rice plant establishment due to the increase in the labour cost and shortened turnaround time in the cropping system of rice. In recent years, parachute technology has been quickly expanded due to its significant benefits, in addition to using the low-cost polyvinyl chloride (PVC) griddle for the seedlings growing (Cheng, 2000; Sheng-xiang, 2002). China has introduced the parachute rice planting method a few years ago. This technique needs plastic bubble sheets to breed seedlings (Awan et al., 2008). There are two distinguished merits of this method. The first one is the transplanting shock and seedling mortality not found at the early stage in this sowing method, while the second advantage is the possibility to achieve the optimum plant density(Mann and Meisner, 2002; Nabi et al., 2002). The lack of labour in addition to the increased labour cost through the searing heat of sowing months of rice (June and July) has forced both researchers and farmers to look for alternatives to traditional methods of rice transplanting (Awan et al., 2008). Many studies determined that the parachute rice sowing method is a simple method of transplanting with a high yield per hectare in comparison to the traditional transplanting method (Nabi et al., 2002).

The main objective of this study was to find out the highest productive cultivar and best method that is less labour-intensive and more efficient in water consumption to enable farmers to produce more rice with less expense.

MATERIALS AND METHODS

Field experiments and trait valuation

The field experiment was conducted on the experimental farm of Itay El-Baroud Agricultural Research Station, El-Beheira Governorate, Egypt, during two successive seasons (2020 and 2021) to study the effect of three planting methods on the productivity of some Egyptian rice cultivars. Three planting methods (drill or direct-seeded, regular transplanting and parachute transplanting), were compared in their effects on the productivity of three Egyptian rice cultivars (Giza177, Sakha101 and Sakha108). Concerning seeds rate, each of the regular transplanting and drill (direct-seeded) methods used about 100 kg seeds ha-1 while the parachute method of transplanting consumed about 60 kg seeds ha-1.

The wheat crop was the previous crop in both seasons. Concerning regular or traditional transplanting, the nursery bed was well ploughed and dry levelled. Phosphorus fertilizer in the form of calcium superphosphate (15.5% P2O5) was added to dry soil at the rate of 37 kg P2O5 ha-1 before the first tillage. The nitrogen fertilizer in the form of Urea (46 % N) at the rate of 144 kg N ha-1 was applied and incorporated into the dry soil after the last ploughing and immediately before the first irrigation in two splits (2/3) as a basal application, and (1/3) as a top-dressing at panicle initiation stage in case of transplanting methods, while the same rate of Urea was applied to drilling (direct-seeded) method in three equal doses, the first (one-third) was applied as a basal application and the second (one-third) was applied as a top-dressing after 30 days from sowing, while the last dose (one-third) was applied as a top-dressing at the panicle initiation stage. Zinc sulphate (22% Zn) at the rate of 57 kg Zn ha-1 was applied after paddling and before sowing the nursery. Potassium in the form of potassium sulphate (48% K2O) at the rate of 57 kg K2O ha-1 was applied as a basal application. Seeds were soaked in excess water for 24 hours and then incubated for 48 hours to enhance germination.

In the case of the parachute method, seedlings were grown in flexible plastic trays. The size of the tray was 60 cm in length, 30 cm in width and 2 cm in-depth and contained 406 holes and ¾ of each hole was filled with mud. Seeds were soaked in water for 24 hours then two to three healthy seeds were sowed in each hole with a thin cover of soil. These trays were placed in the well-levelled nursery and light irrigation was applied frequently. At 30 days, old seedlings were uprooted from the plastic trays which contained soil balls and thrown in the puddled field. Every hectare needs about 650 trays.

Concerning direct drilling, seeds were sown in well-levelling soil with no hollows for water to lay. Rows spacing was about 15 cm to hasten canopy closure which can stunt the late germination of grass and aquatic weeds. Seeds are placed at depth of 3 cm to enhance germination.

Soil samples were taken from different sites of the experimental location at 0-30 cm depth of soil surface, air-dried, ground to pass through a 2 mm sieve and well mixed. The procedure of preparation and measurements of the soil extract was done according to (Anderson and Black, 1965). The physical and chemical analysis of the experimental sites in 2020 and 2021 seasons are shown in Table 1.

Table 1. Physical and chemical analysis of the experimental sites in 2020 and 2021 seasons

	2020	2021
A. Physical properties		
1. Clay %	52.7	52.8
2. Silt %	25.8	25.1
3. Sand %	21.5	22.1
Soil texture class	Clayey	Clayey
B. Chemical properties		
1. pH	7.8	7.7
2. EC dS/m*	1.8	1.7
3. Organic matter %	0.41	0.43
4. Available (N) ppm	52	56
5. Available (P) ppm	23	27
6. Available (K) ppm	238	216
7. Available (Zn) ppm	2.2	1.7

***EC: Electrical conductivity**

Statistical analysis

The analysis of phenotypic data was performed using SAS V9.1.A split-plot arrangement in a randomized complete block design (RCBD) with three replications was used. The main plots were designated for the three sowing methods (drill or direct-seeded, regular transplanting and parachute transplanting), while sub-plots were devoted to the three Egyptian rice cultivars (Giza177, Sakha101 and Sakha108). The differences among treatment means were compared using LSD at a 0.05 probability level of significance, according to Duncan (1955). The correlation coefficient between different traits was calculated using R v3.5.1.

RESULTS AND DISCUSSION

The results in Table 2 summarized the effect of different planting methods and rice cultivars on days to 50% heading, plant height (cm), number of productive tillers m-2 and panicle length (cm).The longest period from sowing to 50% heading was obtained by regular transplanting while the direct drilling method was at par with the parachuting method of transplanting and recorded the shortest periods in the two seasons. Each of the drilling and parachuting methods did not expose to uprooting damages, on the contrary, regular transplanting takes at least 5 days to recover after transplanting shock. On the other hand, no significant differences were found between regular and parachuting methods in plant height (cm), number of productive tillers m-2 and panicle length (cm). Concerning plant height, the parachute transplanting method recorded the highest values followed by regular transplanting while the lowest values were recorded by the drill method in both seasons. The highest numbers of productive tillers m-2 were recorded with parachute transplanting followed by regular transplanting while the drill method recorded the lowest values in the 2020 and 2021seasons. It could be due to, the efficiency of plants to utilize nutrients, light and aeration under transplanting methods during the active tillering stage being higher than the drilling method. Other results also found that transplanting of rice significantly ($p<0.05$) increased the number of tillers per meter square compared with direct sowing (Javaid et al., 2012; Tahtayet al., 2013). For panicle length (cm), the parachuting method recorded the longest panicles followed by regular transplanting while the shortest panicles were recorded by drilling method in both seasons which is consistent with the findings of Hossain et al., (2002). They observed that transplanting of rice seedlings significantly increased panicle length compared with direct seeding

Table 2. Effect of planting methods and rice cultivars on days to heading, plant height (cm), number of productive tillers m^{-2} and panicle length (cm), during 2020 and 2021 seasons.

Main effect	Days to heading (day)		Plant height cm.		No. of productive tillers m^{-2}		Panicle length (cm).	
	2020	2021	2020	2021	2020	2021	2020	2021
A-Planting methods								
Drill seeded	96.1c	97.4b	99.2b	100.3b	470.5b	473.7b	20.6b	21.2b
Transplanting	100.7a	101.4a	103.8a	103.3a	562.6a	545.1a	24.3a	23.3a
Parachuting	97.9b	97.9b	104.1a	103.4a	569.1a	547.8a	24.4a	23.5a
F-test	*	*	*	*	*	*	*	*
B- Rice varieties								
Giza 177	93.0c	94.3c	109.4a	105.2a	494.6b	475.9b	22.8b	22.5
Sakha 108	95.8b	96.2b	100.8b	105.1a	555.2a	546.8a	23.5a	22.6
Sakha 101	105.8a	106.2a	96.9c	96.8b	552.5a	543.9a	22.9b	22.8
F-test	*	*	*	*	*	*	*	Ns
Interaction (A×B)	*	*	Ns	Ns	*	*	*	*

Data also revealed that Sakha 101 recorded the longest period from sowing up to 50% heading followed by Sakha 108 while the shortest periods were recorded by Giza 177 cultivar in the two seasons. Concerning plant height, Giza 177 was the highest followed by Sakha 108 while the lowest values were recorded by Sakha 101 in both seasons. On the other hand, the highest numbers of productive tillers m-2 were recorded by Sakha 108 followed by Sakha 101 while the lowest values were obtained by Giza 177 in both seasons. Respecting panicle length, there was a significant difference among the cultivars in the first season where Sakha 108 recorded the longest panicle followed by Sakha 101, while Giza 177 recorded the shortest panicles. Data of panicle length also revealed that there were no significant differences between the tested cultivars in the second season.

The interaction between planting methods and rice cultivars had a significant effect on the number of days to heading, the number of productive tillers m-2 and panicle length (Fig. 1).

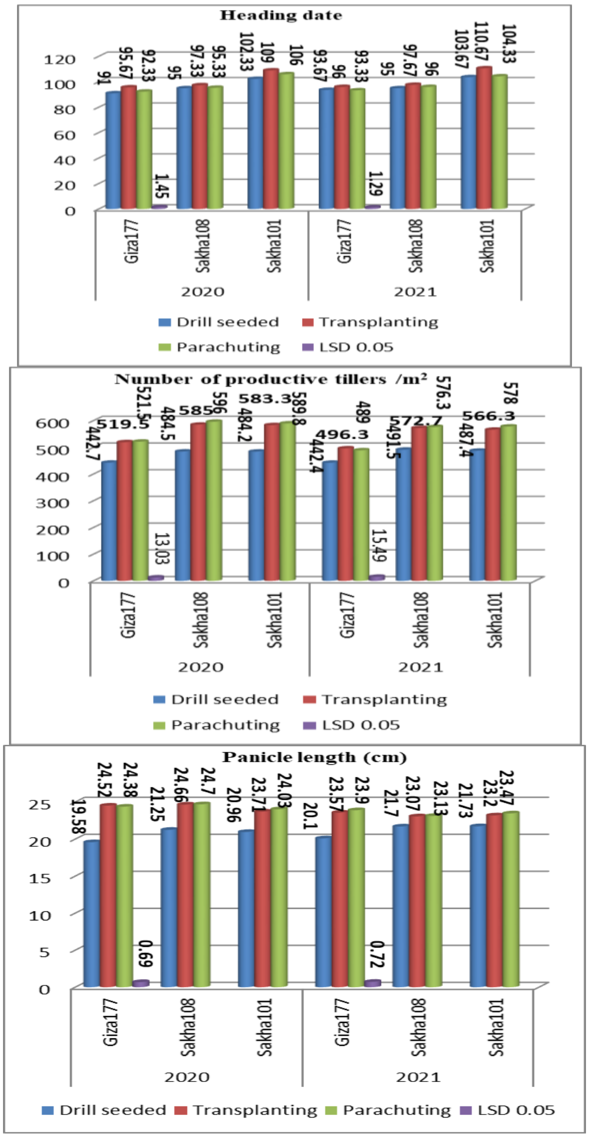

Fig. 1. Effect of interaction between sowing methods and rice cultivars on the heading date, the number of productive tillers|m^2 and panicle length during 2020 and 2021 seasons.

The shortest period from sowing to 50% heading was recorded under the drill method with Giza177 cultivar with no significant difference with the value recorded by the same cultivar under the parachute transplanting. On the other hand, the longest period was recorded by Sakha101 with regular transplanting in both seasons. Concerning the number of productive tillers m-2, there were no significant differences between Sakha-108 and Sakha-101 with both regular and parachute transplanting in the two seasons, with the highest values recorded, while Giza-177 rice cultivar recorded the lowest values with the drill method in both seasons. The longest panicles length was recorded by Sakha-108 and Sakha-101 with the parachuting method in the 2020 and 2021 seasons, respectively. Meanwhile, Giza-177 recorded the shortest panicles length in both seasons with the drill method.

The correlation between panicle length and productive tillers m-2 showed the strongest significant correlation (r = 0.76) (P < 0.001). whereas there was a reverse correlation (r = -0.15) between plant height and productive tilleres|m2 (Fig. 2)

Mean values of panicle weight (g), number of filled grains panicle-1, number of unfilled grains panicle-1 and 1000-grain weight (g) affected by sowing methods and rice cultivars in 2020 and 2021 seasons are listed in Table 3.

The analysis of variance indicated that the effect of planting methods and rice cultivars on panicle weight (g), number of filled grains panicle-1 and 1000-grain weight (g) were significant in both seasons. Regarding the number of unfilled grains/panicle, no significant differences were found between the planting methods and the cultivars in both seasons. Regarding planting methods, there were no significant differences between parachuting and conventional transplanting methods on panicle weight, the number of filled grains panicle-1 and 1000-grain weight, where the parachuting transplanting recorded the highest values followed by regular transplanting in the first season, contrary to the highest values were obtained by regular transplanting followed by parachuting transplanting in the second season. Whereas, the drilling method recorded the lowest values of panicle weight (g), the number of filled grains panicle-1 and 1000-grain weight (g) in both seasons. Similar findings were found by Hossain et al.,(2002) as they detected that 1000-grains weight was also higher in the transplanting method than that of direct seeding

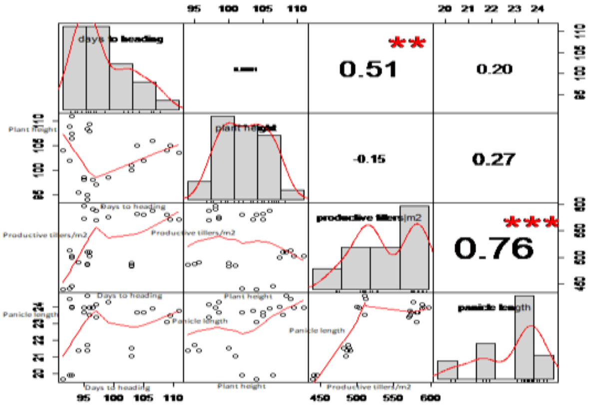

Fig. 2.The diagonal represents the frequency distribution for each of the four traits (days to heading, plant height, productive and panicle length, respectively) while, the right upper diagonal values represent the correlation coefficients among all possible combinations of the four traits (0.008, - 0.15, 0.76, 0.51, 0.27 and 0.20, respectively). On the other hand, the left lower diagonal represents the linear correlations among all possible combinations of the four traits (days to heading, plant height, productive and panicle length, respectively).

Regarding cultivars, there was a significant difference among the tested cultivars on panicle weight, the number of filled grains panicle-1 and 1000-grain weight. Sakha 101 recorded the highest number of filled grains panicle-1 followed by Sakha 108 while the lowest values were recorded by Giza 177 in both seasons. On the other hand, Sakha 108 recorded the highest panicle weight followed by Sakha 101 while the lowest panicle weight was obtained by Giza 177 in the first season, whereas in the second season the highest panicle weight was obtained by Sakha101 followed by Giza 177 and the lowest panicle weight was recorded by Sakha 108.

Table 3. Effect of sowing methods and rice cultivars on panicle weight (g), number of filled grains panicle^{-1}, number of unfilled grains panicle^{-1} and1000-grain weight (g), during 2020 and 2021 seasons.

Main effect	Panicle weight (g)		No. of filled grains/panicle		No. of unfilled grains/panicle		1000-grain weight (g).	
	2020	2021	2020	2021	2020	2021	2020	2021
A- Sowing methods								
Drill seeded	2.71b	2.69b	119.1b	127.1b	5.3	5.5	25.64b	24.63b
Transplanting	3.34a	3.46a	147.2a	145.1a	5.8	6.9	27.39a	27.47a
Parachuting	3.40a	3.44a	147.9a	144.1a	7.0	6.4	27.51a	27.37a
F_{test}	*	*	*	*	Ns	Ns	*	*
B- Rice varieties								
Giza 177	3.03b	3.18b	129.7c	126.3c	6.7	7.1	26.43b	26.41b
Sakha 108	3.22a	3.14b	138.6b	136.9b	7.0	6.7	27.86a	27.13a
Sakha 101	3.20a	3.27a	146.0a	153.1a	4.4	5.0	26.26b	25.92c
F_{test}	*	*	*	*	Ns	Ns	*	*
Interaction (A×B)	*	*	*	*	Ns	Ns	*	*

The interaction between planting methods and rice cultivars had a significant effect on panicle weight, the number of filled grains panicle-1 and 1000-grain weight (Fig. 3). Where the highest panicles weight was recorded by Sakha101 and Sakha 108 with parachute transplanting in both seasons, respectively while the lowest panicles weight was recorded by the same cultivars with drill method in the 2020 and 2021 seasons, respectively. Sakha-101 recorded the highest number of filled grains panicle-1 with the parachute and regular transplanting methods in the 2020 and 2021 seasons, respectively. Meanwhile, Giza-177 recorded the lowest number of filled grains panicle-1 in both seasons with the drill method. The highest values of 1000-grain weight were recorded by Sakha-108 under parachuting and regular transplanting methods in both seasons. On the other hand, the lowest values of 1000-grain weight were recorded by Sakha-101 and Sakha-108 with the drill method in both seasons, respectively.

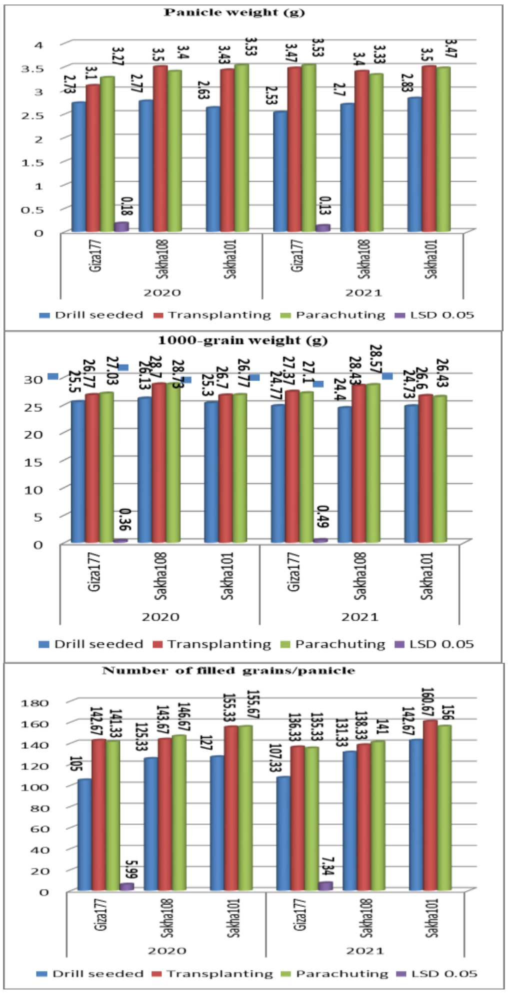

Fig. 3. Effect of interaction between sowing methods and rice cultivars on panicle weight, number of filled grains per panicle and 1000-grain weight during the two seasons.

The correlation between filled grains per panicle and panicle weight showed the strongest significant correlation (r = 0.8) (P < 0.001). whereas there was a reverse correlation (r = -0.09) between filled grains per panicle and unfilled grains per panicle (Fig.4).

Table 4 indicated grain yield (ton ha-1), biomass yield (ton ha-1), harvest index % and production efficiency (kg ha-1 day-1) traits values as affected by planting methods and some rice cultivars in 2020, 2021 seasons.

There were no significant differences between regular and parachute transplanting on 1000-grain weight, grain yield and biomass yield. Also, the results showed that there were no significant differences among planting methods on harvest index in both seasons. Parachute transplanting recorded the highest values of 1000-grain weight followed by regular transplanting in the first season, while in the second season the highest value was recorded by regular transplanting followed by the parachuting method whereas the drill method recorded the lowest values in the two seasons.

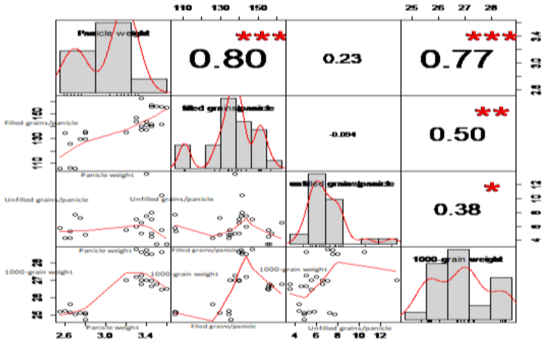

Fig. 4. The diagonal represents the frequency distribution for each of the four traits (panicle weight, filled grains /panicle, unfilled grains /panicle and 1000grains weight, respectively) while, the right upper diagonal values represent the correlation coefficients among all possible combinations of the four traits (0.8, - 0.09, 0.38, 0.23, 0.50 and 0.77, respectively). On the other hand, the left lower diagonal represents the linear correlations among all possible combinations of the four traits (panicle weight, filled grains /panicle, unfilled grains /panicle and 1000grains weight, respectively).

Table 4. Effect of sowing methods and rice cultivars on grain yield (ton ha^{-1}), biomass yield (ton ha^{-1}), harvest index % and production efficiency (kg ha^{-1} day^{-1}), during 2020 and 2021 seasons.

Main effect	Grain yield (ton ha^{-1})		Biomass yield (ton ha^{-1})		Harvest index %		production efficiency kg ha^{-1} day^{-1}	
	2020	2021	2020	2021	2020	2021	2020	2021
A- Sowing methods								
Drill seeded	8.40b	8.49b	17.90b	17.91c	46.95	47.46	64.64b	63.88b
Transplanting	9.57a	9.68a	20.46a	20.58a	46.84	47.07	91.06a	90.02a
Parachuting	9.55a	9.69a	20.60a	20.33b	46.42	47.66	91.14a	89.90a
F_{test}	*	*	*	*	Ns	Ns	*	*
B- Rice varieties								
Giza 177	8.81c	8.88c	18.45c	18.58c	47.74a	47.82a	83.23b	82.69b
Sakha 108	9.72a	9.87a	20.70a	20.37a	46.96a	48.44a	88.76a	87.30a
Sakha 101	8.99b	9.11b	19.81b	19.86b	45.52b	45.94b	74.85c	73.81c
F_{test}	*	*	*	*	*	*	*	*
Interaction (A×B)	*	*	*	*	*	Ns	*	*

Concerning grain yield, regular transplanting recorded the highest (9.57) followed by parachuting (9.55) in the first season, while the parachuting method recorded the highest yield (9.69) followed by regular transplanting (9.68) in the 2021 season. On the other hand, the lowest grain yields (8.40, 8.49) were obtained by the drilling method in both seasons. The highest grain yield obtained under transplanting might be because of the highest number of tillers and vigor plant stand due to less competition for growth resources (Tahtay *et al.*, 2013). The drill seeded method produced a lower grain yield due to inadequate soil moisture prevalent during the crop growth period (Hossain *et al.*, 2002).

In the 2020 season, the parachute transplanting method recorded the highest biomass yield (20.60) followed by regular transplanting (20.46). On the other hand, regular transplanting recorded the highest biomass yield (20.58) followed by parachute transplanting (20.33) in the second season. The lowest biomass yields (17.90, 17.91) were recorded by the drill method in the 2020 and 2021 seasons, respectively.Respecting the harvest index, the results indicated that there were no significant differences among planting methods in both seasons.

Results in Table 4 also showed that there was a significant difference among the cultivars in 1000-grain weight, grain yield, biomass yield and harvest index % in both seasons. The highest 1000-grain weights were recorded by Sakha 108 followed by Giza 177, while Sakha 101 recorded the lowest values in both seasons.

Sakha 108 rice cultivar also recorded the highest grain yields (9.72 and 9.87) followed by Sakha 101 (9.14 and 9.11) in the 2020 and 2021 seasons, respectively. While the lowest grain yields (8.81 and 8.88) were recorded by Giza 177 in the 2020 and 2021 seasons, respectively. The highest biomass yields (20.70 and 20.37) were recorded by Sakha 108 followed by Sakha 101 which was recorded (19.81 and 19.86) while the lowest biomass yields (18.45 and 18.58) were obtained by Giza 177 in both seasons, respectively. Regarding harvest index, there were no significant differences between Giza 177 and Sakha 108 which recorded the highest values in both seasons while Sakha 101 recorded the lowest harvest index% in both seasons.

The interaction between planting methods and rice cultivars had a significant effect on grain yield, biomass yield and production efficiency (Fig. 5). Whereas there was no significant difference in the interactions on the harvest index (Fig. 5). The highest grain yield was recorded by Sakha108 with parachute transplanting and regular in both seasons. Regarding biomass yield, Sakha108 recorded the highest yield with the parachute and regular transplanting methods in two seasons with no significant difference with Sakha 101 under the same methods. The highest production efficiency was recorded by Sakha108 under parachuting and regular transplanting methods in both seasons.

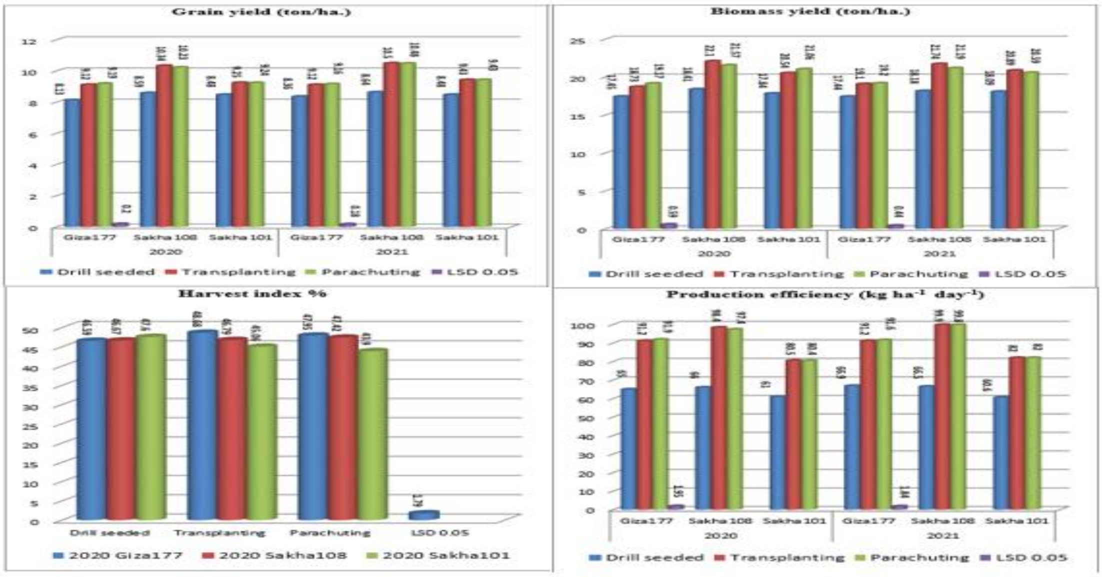

Fig. 5. Effect of interaction between sowing methods and rice cultivars on grain yield, biomass yield and production efficiency during the two seasons and the harvest index during the 2020 season.

The correlation between grain yield per hectare and biomass yield showed the strongest significant correlation (r = 0.93) (P < 0.001). whereas there was a reverse correlation (r = -0.22) between harvest index and biomass yield (Fig. 6).

Grain yield/ha

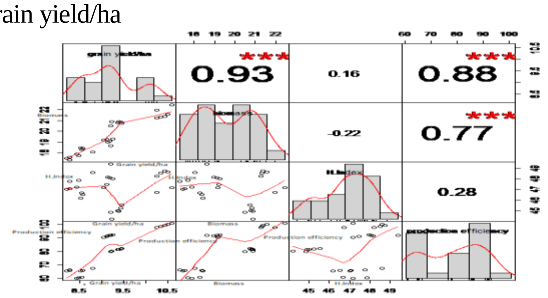

Fig. 6. The diagonal represents the frequency distribution for each of the four traits (grains yield/ha, biomass, H index and production efficiency, respectively) while, the right upper diagonal values represent the correlation coefficients among all possible combinations of the four traits (0.93, - 0.22, 0.28, 0.16, 0.77 and 0.88, respectively). On the other hand, the left lower diagonal represents the linear correlations among all possible combinations of the four traits (grains yield/ha, biomass, H index and production efficiency, respectively.

CONCLUSION

There were no significant differences between conventional and parachute transplanting in plant height, number of productive tillers m^{-2}, panicle length, panicle weight, number of filled grains panicle^{-1}, 1000-grain weight, grain yield, biomass yield and production efficiency. Regular and parachute transplanting methods are both effective, and farmers can pick between them based on their skills and capabilities.

REFERENCES

Abo El-Ees, N. A. (1985). The effect of seedbed preparation and method of planting on wheat yield. *Misr J. Agric. Eng*, *2*(4), 131–136.

Anderson, C. A., and Black, C. A. (1965). Separation of organic and inorganic phosphorus in soil extracts by mechanical and chromatographic filtration. *Soil Science Society of America Journal*, *29*(3), 255–259.

Awan, T., Ali, I., Safdar, M. E., Ahmad, M., and Akhtar, M. S. (2008). Comparison of parachute, line and traditional rice transplanting methods at farmer's field in rice growing area. *Journal of Agricultural Sciences*, *45*(4), 432–438.

Bohra, J. S., and Kumar, R. (2015). Effect of crop establishment methods on productivity, profitability and energetics of rice (*Oryza sativa*)-wheat (*Triticum aestivum*) system. *Indian Journal of Agricultural Sciences*, *85*(2), 217–223.

Cheng, Y. (2000). Extension services for rice production in China. *China Rice*, *1*, 21–24.

Duncan, D. B. (1955). Multiple ranges and multiple F tests. *Biometrics*, *11*(1), 1–42.

Dunn, B. W., and Ford, R. (2018). *Management of drill sown rice*. Primefact.

Dunn, B. W., & Gaydon, D. S. (2011). Rice growth, yield and water productivity responses to irrigation scheduling prior to the delayed application of continuous flooding in south-east Australia. *Agricultural Water Management*, *98*(12), 1799–1807.

Dunn, B. W., Smith, J., and Ford, R. (2018). Management of drill sown rice. *Primefacts*, *1253*(third edition), 1–4.https://static1.squarespace.com/static/5a03c05bd0e62846bc9c79fc/t/5b45a10df950b713d5ee95c6/1531289872052/Management+of+drill+sown+rice+2018-19.pdf

FAO (2021). GIEWS Country Brief 2021. *Glogbal Watch GIEWS*, *700*(May 2021), 2.

Hossain, M. F., Salam, M. A., Uddin, M. R., Pervez, Z., and Sarkar, M. A. R. (2002). A comparative study of direct seedling versus transplanting method on the yield of Aus rice. *Pakistan Journal of Agronomy (Pakistan)*.

Javaid, T., Awan, I. U., Baloch, M. S., Shah, I. H., Nadim, M. A., Khan, E. A., Khakwani, A. A., and Abuzar, M. R. (2012). Effect of planting methods on the growth and yield of coarse rice. *Journal of Animal and Plant Sciences*, *22*(2): 358-362.

Khan, A., and El-Sahrigi, A. F. (1990). Selective mechanization of rice farming system in tropical Asia. *Agric. Eng. Today*, *14*(3), 4.

Khush, G. S., and Virk, P. S. (2000). Rice breeding: achievements and future strategies. *Crop Improvement*, *27*(2), 115–144.

Kumari, P., Mishra, G. C., Pant, A. K., Shukla, G., and Kujur, S. N. (2014). Comparison of forecasting ability of different statistical models for productivity of rice (*Oryza sativa* L.) in India. *The Ecoscan*, *8*(3), 193–198.

Mann, R. A., and Meisner, C. A. (2002). Outcomes of the Workshop. *Workshop on Rice-Wheat Systems in Pakistan*, 1.

Mishra, J. S., Singh, V. P., Chandra, B., and Subrahmanyam, D. (2012). Crop establishment, tillage and weed management techniques on weed dynamics and productivity of rice (*Oryza sativa*)-chickpea (*Cicer arietinum*) cropping system. *Indian Journal of Agricultural Sciences*, *82*(1), 15–20.

Nabi, G., Akhtar, M. S., ul Hussan, M. M., and Gill, S. M. (2002). Root Growth in Parachute and Conventional Rice-Transplanting Methods. *Workshop on Rice-Wheat Systems in Pakistan*, 62.

Sasaki, T. (2005). The map-based sequence of the rice genome. *Nature*, *436*(7052), 793–800.

Sheng-xiang, T. (2002). Seedling broadcasting in China: an overview. *FOREWORD Vii ACKNOWLEDGMENTS Viii*, 177.

Tahtay, I., Wereda, K., and Birhane, A. (2013). *Effect Of Planting Methods On Yield And Yield Components Of Rice (Oryza Sativa* L *.) Varieties*. *1*(5), 1–5.

تأثير طرق الزراعة على إنتاجية بعض أصناف الأرز المصرية

عبد الرحمن محمود محمد موسى[1] و محمد عبد الغني[2]

[1]قسم بحوث الأرز ، معهد بحوث المحاصيل الحقلية ، مركز البحوث الزراعية ، مصر
[2]قسم المحاصيل ، كلية الزراعة ، جامعة دمنهور ، دمنهور 22516 ، مصر

الملخص

تم اجراء التجربة الحقلية خلال موسمي 2020 و2021 بمحطة إيتاي البارود للبحوث الزراعية بمحافظة البحيرة - جمهورية مصر العربية وذلك لمقارنة استخدام ثلاث طرق لزراعة الأرز (التسطير، الشتل المنتظم أو التقليدي، الشتل بالمظلات) على إنتاجية ثلاثة أصناف من الأرز المصري (جيزة 177، سخا 101، سخا 108). تم قياس الصفات المظهرية التالية: عدد الأيام إلى التزهير، ارتفاع النبات، عدد الفروع الحاملة للسنابل لكل متر مربع وطول السنابل ووزنها، عدد الحبوب الممتلئة وغير الممتلئة لكل سنبلة، وزن ال 1000 حبة، محصول الحبوب، المحصول البيولوجي، دليل الحصاد وكفاءة الإنتاج. أظهرت النتائج عدم وجود فروق معنوية بين طريقتي الشتل التقليدي والشتل بالمظلة على صفات طول النبات (سم)، وعدد الفروع الحاملة للسنابل بالمتر المربع، وطول السنبلة (سم) وقد سجلت طريقة التسطير أقل القيم في كلا الموسمين لهذه الصفات. كان للتفاعل بين طرق الزراعة وأصناف الأرز تأثير معنوي على عدد الأيام إلى التزهير وعدد الفروع الحاملة للسنابل لكل متر مربع وارتفاع النبات. كذلك لا توجد فروق معنوية بين طريقة الشتل بالمظلات والشتل التقليدي على صفات وزن السنبلة وعدد الحبوب الممتلئة للسنبلة ووزن ال 1000 حبة حيث سجلت طريقة الشتل بالمظلة أعلى القيم تليها الشتل التقليدي في الموسم الأول بينما في الموسم الثاني كان الشتل التقليدي هو الأعلى في هذه الصفات يليه الشتل بالمظلات. كما لا توجد فروق معنوية بين الشتل المنتظم والشتل بالمظلة على صفات محصول الحبوب (طن لكل هكتار)، المحصول البيولوجي (طن لكل هكتار) ودليل الحصاد. أظهرت هذه النتائج أن الشتل التقليدي والشتل بالمظلات كلاهما فعال ويمكن للمزارعين اختيار أي منهما بناء على قدراتهم.