J. Agric. Sci. Mansoura Univ., 33 (1): 805 - 813, 2008

PRODUCING MORE RICE WITH LESS WATER BY INDUCING PLANTING METHODS IN NORTH DELTA, EGYPT

Meleha, M.E.[1]; A.Z. El-Bably[2]; A.A. Abd Allah[3] and W.M. El-Khoby[3]

[1] Water Management Res. Inst., National Water Res.Center, Cairo, Egypt

[2] Soil, Water and Environment Res. Institute, Agric. Res. Center, Egypt

[3] Rice Res. and Training Center, Field Crops Research, ARC, Egypt

ABSTRACT

Two field experiments were conducted during 2006 and 2007 growing seasons at El-Karada Water Requirements Research Station, Kafr El-Sheikh governorate, Egypt. The investigation aimed to produce more rice with less water by inducing planting methods in North Delta, Egypt. The main plots were randomly occupied by three planting methods while the rice cultivars were assigned to sub-plots. Planting methods were traditional planting, planting in bottom of beds and furrows, while the rice cultivars were Sakha 101, Sakha 102, and Giza 177.

Results showed that planting in bottom of beds significantly increased plant height, number of tillers/hill, number of panicles/hill and panicle length by 4.1%, 21.3%, 17.5% and 5.6%, respectively, while insignificantly increased panicle weight and grain yield compared with traditional planting method. At the same time, the results showed that there were no significant differences in grain yield between methods of planting in bottom of furrows and beds.

Rice cv. Sakha 101 significantly exceeded rice cvs. Sakha 102 and Giza 177 in number of tillers/hill by 15.6%, and 29.6%, number of panicles/hill by 10.7%, and 19.2%, panicle weight by 26% and 31%; 1000-grain weight by 3.5%, and 12%, and grain yield by 7.5% and 17.7%, respectively.

Means of irrigation water applied were 1480 mm, 1013 mm, and 919 mm for traditional planting, planting in bottom of furrows and beds respectively. Methods of planting in bottom of furrows and beds saved 31.6% and 37.9% of irrigation water compared with traditional planting method, respectively. Mean of amount of irrigation water applied for rice cvs. Sakha 101, Sakha 102 and Giza 177 were 1181 mm, 1116 mm, and 1116 mm, respectively.

Method of planting in bottom of beds increased field water use efficiency (FWUE) by 65.8% and 11.6% more than traditional planting and planting in bottom of furrows methods, respectively. Rice cv. Sakha 101 surpassed rice cvs. Sakha 102 and Giza 177 by 7.3% and 17.3% in FWUE, respectively.

Therefore, Method of planting in bottom of beds could be applied for the rice cultivars in North Delta Egypt because it increased rice productivity by 3.7%, enhanced FWUE by 65.8% and saved water by 37.9%, compared with traditional planting.

Keywords: Planting methods, traditional planting, planting in bottom of furrows and beds, rice productivity, rice cultivars, irrigation water applied, field water use efficiency, and saving water.

INTRODUCTION

Rice is one of the most important crops in Egypt providing a good source of income. It is a main stable food for the majority of the population and has become a cash export crop. So, increasing its production is a national target. Rice is adapted to grow in flooded soils, but it also can grow in non-flooded soils. Regarding the Egyptian conditions, rice is one of the major water consuming crops and continuous flooding is the only method used for irrigation by the farmers. The limitation of water resources and the remarkable increase in population should be forced research workers to find ways for saving some of this water without significant reduction in yield. It is considered a highly water consumed specially under the conventional irrigation method, thus saving the water is becoming decisive factor for agricultural expansion. Great efforts should be done through improving the agronomic practices, such as planting methods and water management to finding ways for saving more irrigation water.

Atta *et al.* (2006) showed that planting in strips of furrows 80 cm wide resulted in the highest value of grain yield (9.05 t/ha), followed by planting in strips of furrows 60 cm wide (9.00 t/ha) and traditional planting (8.71t/ha). They also indicated that irrigation water applied was 9028.6, 10047.6, and 15628.6 m3/ha, respectively, and water use efficiency values were 1.0, 0.896 and 0.558 kg grain /m3 of water applied for planting in stripes of furrows 80 cm wide, planting in strips of furrows 60 cm wide and traditional planting, respectively. In comparison with traditional planting, saving water values were 42.23%, and 35.71% for planting in strips of furrows 80 cm, planting in stripes of furrows 60 cm wide, respectively. Atta (2005) found that by applying the innovative planting method for cv. Sakha 104 obtained the highest grain yield per hectare, compared with traditional planting (3.4% increment). He also indicated reduction of the total water applied from 14870 m^3 ha^{-1} to 9545 m^3 ha^{-1}, this achieved water saving of 35.8% of the total water applied and increased water use efficiency from 0.66 to 1.06 kg m^{-3} (60.6% increment). Jagroop *et al.* (2007) revealed that the grain yield of rice transplanted in furrows and on beds was at par with recommended planting method of flat planting. The furrow and bed planting saved 119.5 cm (39.0%) irrigation water from puddling to harvest and 44.2 to 50.0% more water expense efficiency than the recommended practice of flat planting under same age (30 days) of seedlings. Khattak *et al.* (2006), indicated that planting on raised bed was significantly better than all other techniques in terms of yield parameters. Planting on raised bed gave the maximum paddy yield (6.70 t ha^{-1}), followed by drill sowing through bed planter (6.0 t ha^{-1}). Hence, drill sowing through bed planter and planting on raised beds were the best planting techniques regarding yield and yield components of rice. Devinder *et al.* (2005), indicated that direct sown rice in rows or by broadcasting showed lower yields and required 73.5 cm more irrigation water than furrow transplanted rice. Seedlings transplanted in beds and furrows saved approximately 60 cm irrigation water than planting seedlings in flat puddles. Park *et al.* (1998) showed that technology of corrugated furrow seeding recorded an average milled rice yield of 5.19 t/ha, 14% higher than that of conventional water seeded rice and 3% higher than that of conventional dry seeded rice.

Concerning rice cultivars, Rice cv. Giza 178 significantly exceeded rice cv. Giza 177 in number of tillers/m^2 by 20.7%, panicle weight by 28.0% and grain yield by 21.2%. However, rice cv. Giza 177 was superior in plant height by 10.3% and 1000-grain weight by 28.2% (El-Bably *et al.*, 2007). Rice cv. Sakha 101 produced higher number of tillers/m^2, number of panicles/m^2 and grain yield. However, cv. Sakha 102 surpassed cv. Sakha 101 in plant height, and 1000-grain weight (El-Refaee and El-Bably, 2007). Significant differences were observed between the two tested rice cultivars, where hybrid rice SK2047 H surpassed inbred rice (Giza 178) in panicle weight, 1000 grain weight, and number of grains/panicle (Abou Khalifa *et al.*, 2005, Ebaid and El-Mowafy, 2005 and Gorgy, 2007).

The objective of this investigation was to produce more rice with less water by inducing planting methods in North Delta, Egypt.

MATERIALS AND METHODS

Two field experiments were conducted at El-Karada Water Requirements Research Station, Kafr El-Sheikh Governorate, North Delta, Egypt, during 2006 and 2007 rice growing seasons. The soil of the experimental site was clayey texture and contained 53.4% clay, 26.9% silt and 19.7% sand. The average of the electrical conductivity of soil salinity over 0-60 cm depth was 1.62 dSm^{-1}, the electrical conductivity of irrigation water was 0.45 dSm^{-1}. The preceding crop was clover in both seasons.

The experiment was designed as a split-plot design with four replicates. Planting methods were in the main plot while rice cultivars were in the sub-plot. Planting methods were traditional transplanting on flat soil, transplanting in bottom of furrow (30 cm), and transplanting in bottom of bed (35 cm). The raised furrow was 20cm high x 35 cm wide with 60-cm distance from mid furrow to mid another, while the raised beds was 20cm high x 45 cm wide with 80-cm distance from mid bed to mid another. The plots were isolated by ditches of 2.5 m in width to avoid lateral movement of water.

Rice cultivars were Sakha 101, Sakha 102, and Giza 177. On June 3rd and 5th in 2006 and 2007, respectively, twenty five days old seedlings were transplanted in hills spaced 20 by 20 cm to gave 25 hills/m^2 for traditional planting, and spaced 13 by 13 cm in the two rows in bottom of furrows to keep population on 25 hills/m^2 for furrows, and spaced 10 by 10 cm in the two rows in bottom of bed to keep population on 25 hills/m^2 for beds. Cultural practices were similar to those used in the area. Rice plants were harvested at 140 days from sowing for cv. Sakha 101, and 125 days for cvs. Sakha 102 and Giza 177.

Data collected were plant height in cm, number of tillers per hill, number of panicles per hill, panicle weight in g, 1000-grain weight in g, panicle length in cm and rice grain yield t ha^{-1} at maturity. The grains were separated from the straw, and the grains were weighed. Grain yield was calculated based on the adjustment to grain moisture content of 140 g kg^{-1}.

All the obtained data were statistically analyzed using the procedure outlined by Snedecor and Cochran (1980). Combined analysis was conducted for the data of the two growing seasons. The differences between the mean values were compared by Duncan’s multiple range test (1955).

Irrigation water applied (IWA):

Plots were continuously flooded to a depth of 7 cm every six days in permanent field for traditional planting and 7 in bottom of furrows and beds. The amount of irrigation water was measured by flow meter.

Field water use efficiency (FWUE):

Field water use efficiency was calculated according to Michael (1978).

$$\frac{\text{Grain yield in kg ha}^{-1}}{\text{Amount of applied water in mm}}$$

RESULTS AND DISCUSSION

1.Yield and its attributes:

Data in Table 1 showed that planting in bottom of beds significantly increased plant height, number of tillers/hill, number of panicles/hill, and panicle length by 4.1%, 21.3%, 17.5% and 5.6%, respectively, while insignificantly increased other traits compared with traditional transplanting. No significant differences in numbers of panicles/hill, panicle weight, 1000-grain weight, panicle length and grain yield between method of planting in bottom of furrow and bed. These results coincided with those obtained by Atta (2005), Atta *et al.* (2006), Khattak, *et al.* (2006), Mishra and Saha (2007) and Jagroop *et al.* (2007) who mentioned that grain yield of rice transplanted in bed and furrow was higher compared with the recommended planting method of flat planting.

Table (1): Average values of plant height, number of tillers/hill, number of panicles/hill, panicle weight, 1000-grain weight, panicle length and grain yield as influenced by planting methods and rice cultivars in combined analysis of 2006 and 2007 seasons.

Treatments	Plant height (cm)	Number of tillers/hill	Number of panicles/ hill	Panicle weight (g)	1000-grain weight (g)	Panicle length (cm)	Grain yield (t ha^{-1})
Planting methods							
Traditional	97c	23.0c	20.6b	2.69a	26.84a	21.3b	10.11a
Furrows	99b	25.4b	23.2a	2.73a	26.84a	22.6a	10.32a
Bed	101a	27.9a	24.2a	2.72a	27.22a	22.8a	10.48a
Rice cultivars:							
Sakha 101	93c	28.9a	24.8a	3.31a	28.17a	22.2b	11.12a
Sakha 102	106a	25.0b	22.4b	2.63b	27.22b	24.6a	10.34b
Giza 177	97b	22.3c	20.8c	2.53b	25.14c	18.8c	9.45c
Interactions:							
Irrig. Transplant. x Years	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
Irrig. Transplant. x Cultivars	**	**	**	N.S.	N.S.	N.S.	**
Irrig. Transplant. x Cultivars x Years	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

Means designed by the same letter at each cell are not significantly different at the 5% level according to Duncan's multiple range test.
n.s: Indicate not significant.

Also, data presented in Table 1 revealed that significant differences were obvious between the three rice cultivars for all studied characters. Rice cv. Sakha 101 significantly exceeded rice cvs. Sakha 102 and Giza 177 in number of tillers/hill by 15.6%, and 29.6%; number of panicles/hill by 10.7% and 19.2%; panicle weight by 26% and 31%;1000-grain weight by 3.5% and 12% and grain yield by 7.5% and 17.7%, respectively. However, rice cv. Sakha 102 was superior in plant height and panicle length. These results are in agreement with those obtained by Abd Allah, (2004), El-Refaee *et al.* (2005), Abou Khalifa *et al.* (2005), Ebaid and El-Mowafy (2005), Gorgy (2007), and El-Bably *et al.* (2007).

1.2.Interaction between planting methods and rice cultivars:

It is clear form Table 2 that the highest mean values of plant height was obtained from planting in bottom beds and furrows using rice cv. Sakha 102. However, the lowest value of plant height was obtained from traditional planting using rice cv. Sakha 101. Also, results in Table 2 indicated that rice cv. Sakha 101 gave the highest number of both tillers/hill and panicles/hill when method of planting in bottom of beds was used compared to traditional method using rice cvs. Sakha 102 and Giza 177.

The highest grain yield was obtained with planting in bottom of bed, furrow and traditional planting methods using cv. Sakha 101; however, the lowest yield resulted from traditional planting using cv. Giza 177. These results could be attributed to the varietal differences (El-Refaee *et al.*, 2005, Abou Khalifa *et al.*, 2005, Ebaid and El-Mowafy, 2005, Gorgy 2007, El-Refaee and El-Bably (2007) and El-Bably *et al.* (2007).

Table (2): Interaction between methods of planting and rice cultivars on plant height, no. of tillers/hill, no. of panicles/hill, and grain yield, over both growing seasons.

Rice cultivars	Methods of planting		
	Traditional	**Furrow**	**Bed**
	Plant height (cm)		
Rice cultivars:			
Sakha 101	90.7f	92.7e	95.7d
Sakha 102	102.7b	107.3a	108.7a
Giza 177	96.0cd	97.3c	98.0c
	No. of tillers/hill		
Rice cultivars:			
Sakha 101	25.7c	28.8b	32.3a
Sakha 102	22.7de	25.0c	27.3b
Giza 177	20.7e	22.3de	24.0d
	No. of panicles/hill		
Rice cultivars:			
Sakha 101	23.0b	25.0b	26.3a
Sakha 102	20.0d	22.2bc	25.0b
Giza 177	18.7e	22.3bc	21.3de
	Grain yield in t ha^{-1}		
Rice cultivars:			
Sakha 101	11.06a	11.10a	11.20a
Sakha 102	10.07c	10.34bc	10.60b
Giza 177	9.20de	9.53d	9.63d

Means designed by the same letter at each cell are not significantly different at the 5% level according to Duncan's multiple range test.

2. Water relations:

2.1. Irrigation water applied (IWA):

The amount of irrigation water, which was used, is presented in Table 3. The amount of water used via methods of traditional planting, planting in bottom of furrows and beds were 1531 mm, 1054 m, and 958 mm for cv. Sakha 101, and 1455 mm, 992 mm and 900 mm for cvs. Sakha 102 and Giza 177. It was clear from Table 3 that means of irrigation water applied were 1480 mm, 1013 mm, and 919 mm for methods of traditional planting, planting in bottom of furrows and beds, respectively. It was evident that planting in bottom of beds received the lowest amount of irrigation water, followed by planting in bottom of furrow, and traditional planting in the descending order. In this respect, planting in bottom of furrows and beds saved 31.6% and 37.9% of irrigation water compared with traditional planting method, respectively. These results are in accordance with those reported by Atta (2005), Devinder *et al.* (2005), Atta *et al.* (2006), and Jagroop *et al.* (2007).

Table (3): Irrigation water applied in mm as related to planting methods and rice cultivars over both growing seasons.

Rice cultivars	Sakha 101			Sakha 102			Giza 177		
Planting methods	Traditional	Furrow	Bed	Traditional	Furrow	Bed	Traditional	Furrow	Bed
land preparation of the nursery	25	25	25	25	25	25	25	25	25
seedling raising (25 days)	34	34	34	34	34	34	34	34	34
preparation of the permanent field	225	---	---	225	---	---	225	---	---
Planting	----	160	140	----	160	140	----	160	140
June	342	217	203	342	217	203	342	217	203
July	520	335	312	520	335	312	520	335	312
August	309	221	186	309	221	186	309	221	186
September	76	62	58						
Total	1531	1054	958	1455	992	900	1455	992	900
Mean of irrigation water applied (mm) for traditional, furrow, and bed planting methods	Traditional planting =1480 mm; Furrow = 1013 mm; Bed = 919 mm								
Mean of irrigation water applied (mm) for three rice cultivars	Sakha 101= 1181 mm ; Sakha 102 = 1116 mm ; Giza 177 = 1116 mm								

Means of amount of irrigation water applied for rice cvs. Sakha 101, Sakha 102 and Giza 177 were 1181 mm, 1116 mm, and 1116 mm, respectively. Mean water applied for rice cv. Sakha 101 was higher by 5.6% than rice cvs. Sakha 102 and Giza 177 (125 days), such differences could be attributed to difference in growth duration of the three rice cultivars which leads to different numbers of irrigation and consequently affected the total amount of water (El-Refaee and El-Bably, 2007, and El-Bably *et al.*, 2007).

Data in Table 3 showed that the amount of irrigation water applied was gradually increased from June to reach it's maximum value in July for all methods of planting over both seasons. This result could be attributed to both growth stage and climatic factors.

2.2. Field water use efficiency (FWUE):

Mean values of field water use efficiency of rice (kg grain/mm of water applied) as affected by planting methods and rice cultivars were shown in Table 4. Results showed that method of planting in bottom of beds increased FWUE by 65.8% and 11.6% more than traditional planting and planting in bottom of furrows methods, respectively. Similar results were reported by Vethaiya *et al.* (2003), Atta (2005), Atta *et al.* (2006) and Choudhury *et al.* (2007).

Rice cv. Sakha 101 surpassed rice cvs. Sakha 102 and Giza 177 by 7.3% and 17.3% in FWUE, respectively, as shown in Table 4. These results could be attributed to superiority of rice cv. Sakha 101 in producing higher productivity.

The interaction between planting methods and rice cultivars is shown in Table 4. Planting in bottom of beds with rice cv. Sakha 101 resulted in the highest FWUE of 11.69 kg grain yield/mm of water applied. However, the lowest value resulted from traditional planting with rice cv. Giza 177 to be 6.01 kg grain yield/mm of water applied. This result is in producing higher grain yield of cv. Sakha 101 and less amount of irrigation water applied that used in method of planting in bottom of beds.

Table (4): Field water use efficiency for rice as influenced by planting methods and rice cultivars, over both growing seasons.

Variables	Field water use efficiency			Mean
	Planting methods			
	Traditional	Furrow	Bed	
Rice cultivars:				
Sakha 101	7.22g	10.52d	11.69a	9.82A
Sakha 102	6.56h	9.81e	11.06b	9.15B
Giza 177	6.01i	9.05f	10.05c	8.37C
Mean	6.60C	9.80	10.94A	

Means designed by the same letter at each cell are not significantly different at the 5% level according to Duncan's multiple range test.

Conclusions

As irrigation water demand increases and development of new water resources for irrigation becomes more expensive, water use efficiency in rice production should be improved. From the results presented in this investigation, it can be concluded that irrigation water applied in rice fields could be significantly reduced without sacrificing rice yield or without increasing the production cost by using the varieties Sakha 101, Sakha 102 and Giza 177. Planting method in bottom of furrows and beds saved 31.6% and 37.9% of irrigation water and produced higher yield by 3.7% and 1.6% compared with traditional planting method, respectively. Planting method in bottom of beds increased FWUE by 65.8% and 11.6% more than traditional planting and planting in bottom of furrows methods, respectively. Rice cv. Sakha 101 surpassed rice cvs. Sakha 102 and Giza 177 by 7.3% and 17.3% in FWUE, respectively. So, planting in bottom of beds could be applied by the farmers for the above mentioned rice cultivars because it increased rice productivity by 3.7% and FWUE by 65.8% and saved water by 37.9% compared with traditional planting in North Delta, Egypt.

REFERENCES

Abd Allah, A.A. (2004). A breeding study on drought tolerance in rice (*Oryza sativa* L.).. Egypt. J. Agric. Res., 82(1): 149-166.

Abou Khalifa, A.A.; B.A. Zayed; R.N. Gorgy and I.S. El-Refaae (2005). Effect of sowing dates, seedlings ages and some rice cultivars on grain yield and its components. The 11th Conf. of Agron., Agron. Dept. Fac. of Agric. Assiut Univ., 15-16 November, p. 215-222.

Atta, Y. I. M.; M.E. Meleha; A. Tallet and U.M. Gawish (2006). Improving water productivity in rice cultivation with high potential for water saving. The 3rd Arab world region conference, Cairo, 4-11 December, 2006.

Atta, Y.I.M. (2005). Strip planting of rice: A new method for increasing water use efficiency under splitting of nitrogen fertilizer. Egypt. J. of Appl. Sci, 20 (10B): 501-511.

Choudhury, B. U; B. A. M. Bouman, and A. K. Singh (2007). Yield and water productivity of rice-wheat on raised beds at New Delhi, India. Field Crops Research. 100(2/3): 229-239

Devinder, S.; R.K. Mahey; K.K. Vashist; and S.S. Mahal (2005). Economizing irrigation water use and enhancing water productivity in rice (Oryza sativa L.) through bed/furrow planting. Environment and Ecology. 23(3): 606-610

Duncan, B.D. (1955). Multiple range and multiple F-tests.Biometrics. 11: 1-42.

Ebaid, R.A. and H.F. El-Mowafi (2005). Effect of split-applied nitrogen on the productivity of two rice hybrids and Sakha 104 rice cultivar. J. Agric. Res. Tanta Univ., 31(4-B): 760-774.

El-Bably, A.Z.; A.A. Abd Allah and M.I. Meleha (2007). Influence of field submergence depths on rice productivity in North Delta, Egypt. Alex. J. Agric. Res. 52 (2): 29-35.

El-Refaee, I.S.; R.N. Gorgy; S. El-Gewaily and W.H. El-Kallawy (2005). Physiological aspects of grain yield variation in short and medium duration cultivars of rice grown under water stress conditions. The 11th Conference of Agronomy, Agro. Dept., Fac of Agric., Assiut Univ., Nov. 13-16. p: 281-291.

El-Refaee, S.H. and A.Z. El-Bably (2007). Response of two rice cultivars to scheduling irrigation based on class A pan evaporation. J. Agric. Sci. Mansoura Univ., 32(1): 11-21.

Gorgy, R.N. (2007). Performance of hybrid and inbred rice cultivars under different planting geometry and number of seedlings per hill. J. Agric. Sci. Mansoura Univ., 32(1): 117-131.

Jagroop, K. ; R. K. Mahey; K.K. Vashist and S. S. Mahal (2007). Growth and productivity of rice (Oryza sativa L.) and water expense efficiency as influenced by different planting techniques. Environment and Ecology. 25(1): 235-238

Khattak, S. I.; K. Usman; Q.Khan and A. Qayyum (2006). Impact of various planting techniques on yield and yield components of rice. Indus Journal of Plant Sciences. 5(1): 753-756

Michael, A.M. (1978). Irrigation theory and practices. Vikas Publishing House PUTLTD New Delhi, Bombay.

Mishra, V. and R. Saha 92007). Effect of raised sunken bed system on inter-plot water harvesting and productivity of rice and French bean in Meghalaya. Indian J. of Agric. Sci. 77 (2): 73-78.

Park, S. T.; H. D. Yong; L. K. Young; K. S. Chul and O.Y. Jin (1998). Development of a corrugated furrow seeder and its effect on rice cultivation. RDA J. of Farm Manage. and Agric. Eng. 40(2): 124-129

Snedecor, G.W. and W.G. Cochran (1980). Statistical Methods. The 7th Edition, Iowa State Univ. Press, Ames, Iowa, USA.

Vethaiya, B.; J.K. Ladha; K.R. Gupta; R.K. Naresh, R.S. Mehla and S. Yadvinder (2003). Technology options for rice in the rice wheat system in South Asia. Improving the productivity and sustainability of rice wheat system: issues and impacts proceedings of an international symposium, USA, 22 October, 115-147.

انتاجية أعلى من الأرز بأقل كميات من مياه الرى باستحداث طرق زراعة مختلفة بمنطقة شمال الدلتا بمصر

محمــد ابــراهيم مليحــه[1] ، عــلاء زهيــر البــابلى[2] ، عبداللــه عبــدالنبى عبداللــه[3] و وليد محمد الخبى[3]

[1]معهد بحوث إدارة وطرق الرى ـ المركز القومى لبحوث المياه ـ مصر

[2]معهد بحوث الأراضى والمياه والبيئة ـ مركز البحوث الزراعية ـ الجيزه ـ مصر

[3]مركز البحوث والتدريب فى الأرز ـ معهد بحوث المحاصيل الحقلية ـ الجيزه ـ مصر

أجريت هذه الدراسة بمحطة البحوث الزراعية بسخا محافظة كفرالشيخ خلال موسمى 2006 و 2007 بهدف دراسة تأثير ثلاث طرق زراعة على انتاجية ثلاث أصناف من الارز وكفاءة وتوفير استخدام مياه الرى بمنطقة شمال الدلتا بمصر. حيث وزعت معاملات طرق الزراعة بالقطعة الرئسية فى حين وزعت اصناف الارز فى القطع المنشقة. كانت طرق الزراعة هى الشتل التقليدى والمتبع فى المنطقة و الشتل فى بطن الخطوط والشتل فى بطن المصاطب بينما كانت أصناف الارز هى سخا 101 و سخا 102 و جيزة 177 .

اوضحت النتائج الاتى:

1. أدت طريقة الزراعة فى بطن المصاطب الى زيادة معنوية فى ارتفاع النبات وعدد الفروع/جورة وعدد الداليات/جورة وطول الدالية قدرها 4.1% , 19.7% , 5.6% على التوالى ، بينما زاد كلا من وزن الدالية ومحصول الحبوب زيادة غير معنوية مقارنة بطريقة زراعة الشتل المتبعه بالمنطقة.
2. تفوق الصنف سخا 101 معنويا فى صفات عدد الفروع/الجورة و عدد الداليات /الجورة ووزن النورة ووزن الالف حبة ومحصول الحبوب فى حين تفوق الصنف سخا 177 فى صفات ارتفاع النبات ووزن الدالية فى طرق الزراعة الثلاثة المستخدمه.
3. بلغت كميات مياه الرى المضافة 1480 مم و1013 مم و 919 مم لطريقة الزراعة بالشتل والمتبعه فى المنطقة و طريقة الزراعة فى بطن الخطوط و المصاطب على التوالى. وبناء على ذلك يمكن توفير 31.6% و37.9% من مياه الرى باستخدام طريقة الزراعة فى بطن الخطوط والمصاطب على التوالى مقارنة بطريقة الشتل المتبعه فى المنطقة.
4. بلغت كميات مياه الرى المضافة 1181 مم و1116 مم و1116 مم للصنف سخا 101 وسخا 102 وجيزة177 على التوالى.
5. أدت طريقة الزراعة باستخدام المصاطب الى زيادة كفاءة استخدام مياه الرى لتصل الى 65.8 % ، 11.6% مقارنة بطريقة زراعة الشتل التقليدى والزراعة فى بطن الخطوط على التوالى.
6. ازدادت كفاءة استخدام مياه الرى فى حالة الصنف سخا 101 لتصل 7.3% ، 17.3% مقارنة بالصنف سخا 102 والصنف جيزة 177 على التوالى.

ومما سبق يتبين ان طريقة شتل الارز فى بطن المصاطب فى شمال دلتا مصر ادت الى زيادة انتاجية الارز بنسبة قدرها 3.7% وزيادة كفاءة استخدام مياه الرى بنسبة قدرها 65.8% مع توفير كمية من مياه الرى قدرها 37.9%.