

## EVALUATION OF SOME PLANTING AND HARVESTING METHODS OF RICE

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### Abstract

Field experiments were carried out at Meet El-Deyba Rice Mechanization Center during the successive seasons of 1997 and 1998. The study aimed to investigate the productivity of rice cultivar Sakha 101 as influenced by seven different methods of planting and three methods of harvesting. Randomized complete block design with four replications was used to measure growth and yield components. To study the grain yield, straw yield and harvest index strip plot design with four replicates was used. The first strips were occupied by seven methods of planting namely, manual broadcasting, mechanical broadcasting, dibbling (20x20 cm), manual transplanting (20x20 cm), mechanical transplanting (12x30 cm), drilling in wet soil and drilling in dry soil. The sub plots were devoted to three methods of harvesting namely, combined harvesting, semi-mechanical harvesting (manual harvesting and mechanical threshing) and traditional harvesting (manual harvesting and traditional threshing). The main results of this investigation could be summarized as follows :

Highly significant differences were observed for the effects of planting methods on number of tillers/m<sup>2</sup>, number of panicles/m<sup>2</sup>, number of grains/panicle, panicle weight, 1000-grain weight, grain yield/m<sup>2</sup> as well as grain and straw yields (t/fed.). Mechanical transplanting gave the highest values of the above-mentioned traits, while, manual broadcasting and drilling in dry soil produced the lowest values. Meanwhile, methods of planting did not exert significant effects on plant height in both seasons. Mechanical harvesting resulted in the highest grain yield followed by semi-mechanical harvesting, while traditional harvesting produced the lowest grain yield. The highest yield of straw was obtained from traditional harvesting and the lowest by mechanical harvesting. The interaction of planting and harvesting methods significantly affected grain yield (t/fed.) in both seasons. The highest grain yield was produced when transplanting and harvesting were mechanically done.

### INTRODUCTION

In spite of the fact that Egypt has a high average of rice grain yield, the need to raise its productivity per unit area is a matter of importance and challenge. Improvement of rice production could be achieved through different ways. Planting and har-

vesting methods are amongst.

Planting methods play an important role in rice production. Transplanting rice manually is a highly demanding operation requiring intensive labour for few days in a season. Direct seeding methods whether drilling or broadcasting need a high power for good land levelling and a sophisticated weed control program.

El-Keredy (1982) and El-Keredy *et al.* (1984), reported that mechanical transplanting was more favorable than other methods of planting.

Shalan and Badawy (1985) reported that higher grain yields were obtained from mechanical drilling, as well as manual (regular) and mechanical transplanting.

Assey *et al.* (1992) observed that transplanting methods surpassed other ones (broadcasting, dibbling and hand drilling) in plant height, number of tillers/m<sup>2</sup>, grain and straw yields/fed.

Hegazy *et al.* (1992) also reported the superiority of transplanting method over (dibbling, seed drill and broadcasting methods).

Attia *et al.* (1994) reported that transplanting method had a significant effect on grain yield/fed with the highest grain yield obtained from plants arranged in regular rows. Meanwhile, irregular transplanting came in the second rank.

El-Kalla *et al.* (1994) reported that planting methods had significant effects on all the studied traits. Dibbling method surpassed the other planting methods in grain yield/fed and was followed by the regular transplanting or drilling methods while, broadcasting came in the last rank.

El-Serafy *et al.* (1995) found that broadcasting was more efficient than other direct seeding methods and better than transplanting since it gave the highest grain yield and its components.

Harvesting of rice crop is the most labour consuming field operation. Efficient harvesting is a main factor that reduces grain losses and costs.

Sahrigi and El-Haddad (1982) indicated that mechanical harvesting gave the highest yield.

El-Shal and Morad (1993), Marey (1997), Abd El-Hamied (1998) and Arnaout *et al.* (1998) found that mechanical harvesting surpassed semi-mechanical or traditional harvesting in grain and straw yields, and was lowest in grain losses.

The present investigation was directed mainly to study the productivity of the new rice cultivar Sakha 101 as affected by seven different planting methods and three harvesting methods.

## MATERIALS AND METHODS

In 1997 and 1998, two field experiments were conducted at Meet El-Deyba, Rice Mechanization Center, Kafr El-Sheikh, Agricultural Mechanization Research Institute, Egypt. The experiments were laid out in strip-plot design with 4 replicates. The methods of planting (manual broadcasting, mechanical broadcasting, dibbling, manual transplanting, mechanical transplanting and drilling in wet and dry soils) were distributed randomly among the first strip plots. Each plot was 42 x 1.2 m wide. At harvest each plot was divided to three sub plots to which the three harvesting methods, viz (combine harvesting, semi-mechanical and traditional harvesting methods) were randomly arranged. The previous crop was clover in both seasons. The other culture practices were conducted as recommended. At harvest, samples of one square meter were harvested from each planting method and the following data were obtained :

1. Plant height (cm)
2. Panicle length (cm)
3. Number of tillers/m<sup>2</sup>
4. Number of panicles/m<sup>2</sup>
5. Number of filled grains/panicle
6. Panicle weight (g)
7. 1000-grain weight (g)

Rice plants in each sub-plot were harvested and grain and straw yields were determined, then converted to estimate yield/feddan. Grain yield was adjusted to 14% moisture content. The data were subjected to suitable statistical analysis of variance for each season. Differences among treatment means were compared using the Duncan multiple range test at 5% levels of significance (Gomez and Gomez, 1984). Data for

pre-harvest traits were analyzed as randomized complete blocks and yield data as split-plot design.

## RESULTS AND DISCUSSION

### 1. Planting methods effect :

Significant differences were observed among planting methods in panicle length , number of tillers/m<sup>2</sup>, number of panicles/m<sup>2</sup>, number of filled grains/panicle, panicle weight, and 1000-grain weight. While, it did not exert significant effect on plant height in both seasons. Mechanical transplanting produced the highest number of tillers/m<sup>2</sup> (464 & 484), number of panicles/m<sup>2</sup> (430 & 415), number of filled grains/panicle (120 & 125), panicle weight (3.38 & 3.48 g), 1000-grain weight (28.3 & 28.0 g) as well as grain yield (4.34 & 4.70 t/fed.) and straw yield (4.90 & 5.40 t/fed.) in 1997 and 1998, respectively (Tables 1 & 2). The lowest value of number of grains/panicle (102 & 104), panicle weight (2.71 & 2.75 g), 1000-grain weight (26.4 & 27.0 g) and grain yield (3.35 & 3.41 t/fed.) were produced by manual broadcasting. Mechanical broadcasting gave the lowest number of panicles/m<sup>2</sup> (375 & 369) and number of tillers/m<sup>2</sup> (399 & 414). Concerning panicle length, the tallest panicles (22.5 & 22.5 cm) were given by mechanical transplanting while, the shortest panicles (19.0 & 20.3 cm) were given by drilling in dry soil during 1997 and 1998, respectively, Tables (1 & 2). These data are in agreement with those reported by El-Keredy (1982 & 1984), Shaalan and Badawy (1985), Assey *et al.* (1992), Attia *et al.* (1994), El-Kalla *et al.* (1994).

### 2. Harvesting method effect :

The evaluated harvesting methods exerted highly significant effects on grain yield/fed. in both seasons, (Table 3). Mechanical harvesting yielded the highest grain yield (4.00 & 4.10 t/fed.). Semi-mechanical harvesting came second and yielded (3.70 & 3.90 t/fed.). On the other hand, the lowest values of grain yield (3.35 & 3.41 t/fed.) were obtained when the traditional harvesting was used during 1997 and 1998 seasons, respectively (Table 3). The highest grain yield recorded by the mechanical harvesting may be attributed to low grain losses percentage. These data are in harmony with those reported by El-Shal and Morad (1993), Marey (1997), Abdel-Hamid (1998) and Arnaout *et al.* (1998).

Table 1. Rice grain yield and yield contributing characters averaged for seven planting methods during 1997 season

| Main effects             | Plant height (cm) | Panicle length (cm) | No. of tillers/m <sup>2</sup> | No. of panicles/m <sup>2</sup> | No. of filled grains/panicle | Panicle weight (g) | 1000-grain weight (g) | Grain yield (t/fed.) | Straw yield (t/fed.) |
|--------------------------|-------------------|---------------------|-------------------------------|--------------------------------|------------------------------|--------------------|-----------------------|----------------------|----------------------|
| Planting methods         |                   |                     |                               |                                |                              |                    |                       |                      |                      |
| Manual broadcasting      | 90.5              | 18.5 d              | 441 c                         | 382 c                          | 102 d                        | 2.71 e             | 26.4 c                | 3.35 e               | 4.09 b               |
| Mechanical broadcasting  | 90.5              | 19.8 bc             | 399 e                         | 375 c                          | 105 bcd                      | 2.85 d             | 27.1 b                | 3.43 d               | 4.12 b               |
| Dibbling                 | 89.5              | 20.5 b              | 449 bc                        | 409 b                          | 107 bc                       | 2.95 c             | 27.5 b                | 3.61 c               | 4.30 b               |
| Manual transplanting     | 89.0              | 20.8 b              | 451 bc                        | 424 a                          | 109 b                        | 3.02 b             | 27.7 b                | 4.10 b               | 4.71 a               |
| Mechanical transplanting | 89.5              | 22.5 a              | 474 a                         | 430 a                          | 120 a                        | 3.38 a             | 28.3 a                | 4.34 a               | 4.90 a               |
| Drilling in wet soil     | 89.5              | 20.0 bc             | 459 b                         | 408 b                          | 103 cd                       | 2.79 d             | 27.3 b                | 3.52 c               | 4.23 b               |
| Drilling in dry soil     | 89.8              | 19.0 cd             | 425 d                         | 385 c                          | 102 d                        | 2.74 e             | 27.1 b                | 3.50 c               | 4.23 b               |
| F. test                  | NS                | **                  | **                            | **                             | **                           | **                 | **                    | **                   | **                   |

\* Values followed by the same letter(s) are not significantly difference .

Table 2. Rice grain yield and yield contributing characters averaged for seven planting methods during 1998 season

| Main effects             | Plant height (cm) | Panicle length (cm) | No. of tillers/m <sup>2</sup> | No. of panicles/m <sup>2</sup> | No. of filled grains/panicle | Panicle weight (g) | 1000-grain weight (g) | Grain yield (t/fed.) | Straw yield (t/fed.) |
|--------------------------|-------------------|---------------------|-------------------------------|--------------------------------|------------------------------|--------------------|-----------------------|----------------------|----------------------|
| Planting methods         |                   |                     |                               |                                |                              |                    |                       |                      |                      |
| Manual broadcasting      | 91.0              | 21.5 c              | 433 d                         | 390 b                          | 104 d                        | 2.75 e             | 27.0 c                | 3.41 e               | 4.31 d               |
| Mechanical broadcasting  | 90.5              | 22.3 ab             | 414 e                         | 369 c                          | 108 cd                       | 2.89 d             | 27.0 c                | 3.50 d               | 4.24 d               |
| Dibbling                 | 90.0              | 22.5 a              | 457 c                         | 386 b                          | 114 b                        | 3.11 c             | 27.0 c                | 3.90 c               | 4.52 c               |
| Manual transplanting     | 88.8              | 21.8 bc             | 465 b                         | 410 a                          | 118 b                        | 3.28 b             | 28.0 a                | 4.20 b               | 4.93 b               |
| Mechanical transplanting | 89.8              | 22.5 a              | 484 a                         | 415 a                          | 125 a                        | 3.48 a             | 28.0 a                | 4.70 a               | 5.40 a               |
| Drilling in wet soil     | 90.0              | 21.8 bc             | 463 b                         | 407 a                          | 109 c                        | 2.97 d             | 27.2 b                | 3.80 c               | 4.90 b               |
| Drilling in dry soil     | 90.8              | 20.3 d              | 431 d                         | 382 b                          | 104 d                        | 2.80 e             | 27.0 c                | 3.70 c               | 4.28 d               |
| F. test                  | NS                | **                  | **                            | **                             | **                           | **                 | **                    | **                   | **                   |

\* Values followed by the same letter(s) are not significantly difference .

Harvesting methods had a highly significant effect on straw yield (t/fed.) in both seasons of this investigation. The highest values (4.45 & 4.80 t/fed.) were obtained with the traditional harvesting method, while the lowest values of straw yield (4.25 & 4.52 t/fed.) were obtained by mechanical harvesting in the two seasons, respectively, (Table 3).

Table 3. Rice grain yield and straw yield (t/fed.) for three harvesting methods during 1997 and 1998 seasons

| Main effects<br>Harvesting methods | Grain yield<br>t/fed. |        | Straw yield<br>t/fed. |        |
|------------------------------------|-----------------------|--------|-----------------------|--------|
|                                    | 1997                  | 1998   | 1997                  | 1998   |
| Mechanical harvesting              | 4.00 a                | 4.10 a | 4.25 c                | 4.52 c |
| Semi-mechanical harvesting         | 3.70 b                | 3.90 b | 4.40 b                | 4.64 b |
| Traditional harvesting             | 3.40 c                | 3.60 c | 4.45 a                | 4.80 a |
| F. test                            | **                    | *      | **                    | **     |

### 3. Interaction effect :

The interaction of planting and harvesting methods significantly affected grain yield/fed. in both seasons. The highest values of grain yield (4.6 & 4.9 t/fed.) were produced when both mechanical transplanting and mechanical harvesting were used during 1997 and 1998, respectively, Table (4). The lowest values of grain yield (3.1 & 3.2 t/fed.) were obtained when both manual broadcasting and traditional harvesting methods were used (Table 2). These data are in agreement with those reported by Sahrigi and El-Haddad (1982).

Table 4. Grain yield (t/fed.) as affected by the interaction between planting and harvesting methods during 1997 and 1998 seasons

| Planting methods         | Harvesting methods       |       |                               |       |                           |       |
|--------------------------|--------------------------|-------|-------------------------------|-------|---------------------------|-------|
|                          | Mechanical<br>harvesting |       | Semi-mechanical<br>harvesting |       | Traditional<br>harvesting |       |
|                          | 1997                     | 1998  | 1997                          | 1998  | 1997                      | 1998  |
| Manual broadcasting      | 3.6 d                    | 3.7 e | 3.4 d                         | 3.4 f | 3.1 d                     | 3.2 e |
| Mechanical broadcasting  | 3.7 cd                   | 3.8 d | 3.4 d                         | 3.5 e | 3.1 d                     | 3.2 e |
| Dibbling method          | 3.9 c                    | 4.1 c | 3.6 c                         | 3.9 c | 3.3 c                     | 3.6 c |
| Manual transplanting     | 4.3 b                    | 4.5 b | 4.0 b                         | 4.2 b | 3.8 b                     | 3.9 b |
| Mechanical transplanting | 4.6 a                    | 4.9 a | 4.3 a                         | 4.7 a | 4.0 a                     | 4.5 a |
| Drilling in wet soil     | 3.8 cd                   | 4.1 c | 3.5 cd                        | 3.6 c | 3.2 cd                    | 3.6 c |
| Drilling in dry soil     | 3.8 cd                   | 3.8 d | 3.4 cd                        | 3.3 d | 3.2 cd                    | 3.3 d |

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## تقييم بعض طرق زراعة وحصاد الأرز

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أجريت هذه الدراسة فى المزرعة البحثية لمركز ميكنة الأرز بميت الديبة - كفر الشيخ - معهد بحوث الهندسة الزراعية - مركز البحوث الزراعية بالتعاون مع مركز البحوث والتدريب فى الأرز - سخا - كفر الشيخ خلال موسمى ١٩٩٧ ، ١٩٩٨ لتقييم طرق زراعة وحصاد الأرز للوصول إلى أفضل طريقة لزراعة الأرز (سخا ١.١) من حيث الإنتاجية وطريقة الحصاد التى تقلل الفاقد وتعظم إنتاجية الفدان . وقد اشتملت الدراسة على عاملين تحت الدراسة وهما كالاتى :

أ - طريقة الزراعة ، وتشمل سبعة طرق هى :

- |                           |                                    |
|---------------------------|------------------------------------|
| ١- البدار اليدوى          | ٢- البدار الآلى                    |
| ٣- النقرة (٢٠×٢٠ سم)      | ٤- الشتل اليدوى المنتظم (٢٠×٢٠ سم) |
| ٥- الشتل الآلى (٢٠×١٢ سم) | ٦- التسطير الآلى                   |
| ٧- التسطير الجاف          |                                    |

ب- طرق الحصاد ، وتشمل ثلاث طرق وهى :

- ١- الحصاد الآلى باستخدام الكومباين موديل يانمار يابانى الصنع
- ٢- الحصاد نصف آلى باستخدام الحصاد اليدوى والدراس ألياً
- ٣- الحصاد التقليدى باستخدام الحصاد اليدوى والدراس تقليدى

وقد إستُخدم لتنفيذ هذه الدراسة تصميم القطاعات الكاملة العشوائية فى مراحل النمو الخضرى وتصميم الشرائح المتعامدة عند الحصاد لتقدير محصول الحبوب والقش/فدان ، حيث احتوت الشرائح الأفقية على طرق الزراعة والشرائح المتعامدة على طرق الحصاد .

ويمكن تلخيص النتائج المتحصل عليها على النحو التالى :

تأثير طرق الزراعة :

- تفوقت طريقة الشتل الآلى على باقى الطرق فى طول الدالية ، عدد الأشرطة/م<sup>٢</sup> ، عدد الداليات/م<sup>٢</sup> ، عدد حبوب الدالية ، وزن الدالية ، وزن الحبة ، محصول الحبوب/فدان ، محصول القش/فدان . بينما حققت طريقة البدار اليدوى أقل قيمة لعدد حبوب الدالية ، وزن الدالية ، وزن الألف حبة ومحصول الحبوب/فدان ، كما جاءت طريقة البدار الآلى فى المؤخرة فى عدد الداليات وعدد الأشرطة محققة أقل قيمة وسجلت طريقة التسطير الجاف أقل قيمة لطول الدالية . لم يحدث

أى اختلاف فى طول النيات عند الحصاد فى كلا الموسمين باختلاف طرق الزراعة .

#### تأثير طريقة الحصاد :

- أعطى الحصاد الآلى أعلى قيمة وأقل فاقد للحبوب يليه الحصاد النصف آلى فى المرتبة الثانية وجاء الحصاد اليدوى فى المرتبة الأخيرة ، حيث أعطى أقل كمية من محصول الحبوب (طن/فدان) وأعلى فاقد .

- بالنسبة لحصول القش/فدان ، سجلت طرق الحصاد تأثيراً معنوياً على محصول القش/فدان فى كلا الموسمين ، حيث أعطى الحصاد اليدوى أعلى محصول قش/فدان وتلاه الحصاد النصف آلى ثم الحصاد الآلى الذى جاء فى المؤخرة معطياً أقل كمية محصول قش/فدان .

#### تأثير التفاعل بين طرق الزراعة والحصاد :

تأثر محصول الحبوب/فدان تأثيراً معنوياً نتيجة التفاعل بين طرق الزراعة والحصاد فى كلا الموسمين ، حيث جاءت أعلى كمية محصول من الحبوب/فدان عند استخدام طريقة الحصاد الآلى مع طريقة الشتل الآلى . وجاءت أقل كمية محصول حبوب/فدان حين استخدمت طريقة الحصاد اليدوى مع كل من البدار اليدوى والبدار الآلى . أما محصول القش/فدان فلم يتأثر نتيجة التفاعل بين طرق الزراعة والحصاد فى كلا الموسمين .