Pak. J. Agri. Sci., Vol. 41(3-4). 2004

AGRO-ECONOMIC EFFICIENCY OF DIFFERENT DIRECT SOWN TECHNIQUES IN FINE RICE (*ORYZA SATIVA* L.)

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Field experiment was conducted to see the effect of direct sowing methods on agro-economic efficiency of fine rice. Different techniques of direct seeding were applied while transplanting was used as recommended method. Data on agronomic parameters and economics of fine rice were recorded. Results revealed that direct sowing through drill at optimum soil moisture conditions proved to be best for obtaining maximum grain yield (3.15 t ha^{-1}) and net return of Rs. 20354.50 and 21554.55 in year 2000 and 2001, respectively. Transplanting of rice also gave maximum grain yield but in terms of net return it could not compete with direct seeding as it involved lot of expenditures on raising and transplanting of nursery.
Key words: Direct seeding, seeding method, fine rice.

INTRODUCTION

Rice (*Oryza sativa* L.) is a major food of the world and more than half of the population subsists on it. It is the main livelihood of rural population living in sub-tropical and tropical Asia, and hundreds of millions people living in Africa and Latin America. It contains a number of energy rich compounds such as carbohydrates, fat, protein and reasonable amount of iron, calcium, thiamine, riboflavin and niacin (Juliano, 1993).

In Pakistan, next to wheat, rice is the second important food crop. Its share in Pakistan's export is 5.4% (Anon., 2004). In Pakistan rice is grown on an area of 2226 thousand hectares with an average yield of 2012 kg ha^{-1} (Anon., 2004) which is much lower than many other rice growing countries of the world like Australia, Korea, Japan, U.S.A. China, Turkey, France and Mexico where yields are 10269, 6997, 6219, 6354, 6059, 5283, 5650 and 4738 kg ha^{-1}, respectively (Anon., 1998). Among many factors responsible for low yield in Pakistan, defective planting techniques are considered to be the major ones. The common method of rice cultivation in Punjab is transplanting the nursery which is very laborious and time consuming job. The high cost of farm labour invariably delays transplanting and often leads to the use of aged seedling (Santhi *et al.*, 1998). Direct seeding is another method of rice cultivation that requires only two man hours to sow the same area (Hashimoto *et al.*, 1996). However, according to Adair *et al* (1992) rice cultivation by transplanting is generally considered superior to direct seeding. By contrast, in countries like U.S.A. and Australia direct seeding of rice is extensively practiced with profitable results (Mabbayad and Obord, 1971) as it avoids all the penalties entailed in transplanting.

Other advantages of direct seeding over transplanting include good stand establishment, higher grain yield, stable growth, reduced lodging, less drought risks and flooding damage (Pandey *et al.*,1995). The present study was, therefore, designed to determine the comparable effect of direct seeding techniques on the agro-economics traits of fine rice.

MATERIALS AND METHODS

Experiment was conducted at the research area of Agronomy Department, University of Agriculture, Faisalabad during 2000 and 2001. The experiment was laid out in a randomized complete block design with four replications and a net plot size of 2 x 3 m. Rice variety "Super Basmati" was used as a test crop. Among the sowing techniques transplanting of rice nursery was applied as recommended method while in case of direct sowing techniques crop was directly sown by five different methods viz., broadcasting in standing water, broadcasting in puddled conditions, drilling at optimum soil moisture conditions (wattar), broadcasting at optimum soil moisture and drilling on dry soil. Nursery for transplanting was sown on 25th of May and transplanting was done after one month at a distance of 20 x 20 cm with manual labour while in case of direct sowing crop was directly sown on 25th of June with the help of single row hand drill in 20 cm spaced rows except broadcast by using a seed rate of 80 kg ha^{-1} For weed control Pretilachlor (Rifit) @ 2.5 L ha^{-1} was applied two days after sowing. All agronomic practices except those under study were kept normal and uniform for all the treatments. Data on yield parameters i.e. plant height, panicle bearing tillers, spikelets per panicle, 1000-grain weight and grain yield were recorded. Economic analysis was carried out on the basis of variable cost and prevailing prices (Chaudhry *et al.*, 1995). Data collected were statistically analysed using Fisher's Analysis of Variance technique and treatments mean were compared by LSD at 0.05 probability (Steel and Torrie, 1984).

Table 1. Effect of planting methods on growth and yield of direct sown rice (two-year average data).

Treatments Planting methods (M)	Plant height (cm)	Number of panicle bearing tillers m^{-2}	Number of spikelets $panicle^{-1}$	1000-grain weight (g)	Grain yield ($t\ ha^{-1}$)
M_1 = Transplanting (recommended)	112.60 a	433.12 ab	149.37 a	19.96	3.28 a
M_2 = Direct seeding by broadcast in standing water	95.72 b	455.12 a	131.87 b	19.74	3.06 b
M_3 = Direct seeding by broadcast in puddled conditions	89.39 c	464.87 a	129.79b	19.95	3.12 b
M_4 = Direct seeding by drill at optimum soil moisture conditions	95.97 b	413.75 b	131.07 b	19.99	3.15 ab
M_5 = Direct seeding by broadcast at optimum soil moisture conditions	95.01 b	411.37 b	126.46 b	19.53	2.71 c
M_6 = Direct seeding by drill on dry soil.	89.40 c	402.12 b	125.22 b	19.88	2.61 c
LSD (5%)	5.50	36.63	9.30	NS	0.14

Means in a column having different letters differ significantly at $P \leq 0.5$
NS = Non-significant

Table 2. Effect of planting method on economic analysis of direct seeded fine rice during 2000 and 2001.

2000

Treatments Planting methods (M)	Total variable cost ($Rs.\ ha^{-1}$)	Gross income ($Rs.\ ha^{-1}$)	Total expenditure ($Rs.\ ha^{-1}$)	Net income ($Rs.\ ha^{-1}$)
M_1 = Transplanting (recommended)	3800.00	36965.50	17673.50	19292.00
M_2 = Direct seeding by broadcast in standing water	2200.00	34677.50	15033.30	19644.20
M_3 = Direct seeding by broadcast in puddled conditions	2900.00	35302.50	15283.50	20019.00
M_4 = Direct seeding by drill at optimum soil moisture conditions	2180.00	35457.50	15103.00	20354.50
M_5 = Direct seeding by broadcast at optimum soil moisture conditions	2100.00	30940.50	14563.50	16377.00
M_6 = Direct seeding by drill on dry soil.	1980.00	30115.50	14353.30	15762.20

2001

Treatments Planting methods (M)	Total variable cost ($Rs.\ ha^{-1}$)	Gross income ($Rs.\ ha^{-1}$)	Total expenditure ($Rs.\ ha^{-1}$)	Net income ($Rs.\ ha^{-1}$)
M_1 = Transplanting (recommended)	3950.00	38467.50	18179.25	20288.25
M_2 = Direct seeding by broadcast in standing water	2280.00	36423.75	15609.20	20814.55
M_3 = Direct seeding by broadcast in puddled conditions	3080.00	36963.75	16669.20	20294.55
M_4 = Direct seeding by drill at optimum soil moisture conditions	2260.00	37233.75	15679.20	21554.55
M_5 = Direct seeding by broadcast at optimum soil moisture conditions	2180.00	33011.25	15189.20	17822.05
M_6 = Direct seeding by drill on dry soil.	2060.00	31740.00	14949.20	16790.80

Source: 1. Economic Survey of Pakistan 2000-01
2. Research Handbook of Economic Analysis of Experimental Data, University of Agriculture, Faisalabad.

RESULTS AND DISCUSSION

Plant height at maturity

Plant height was affected significantly by different planting methods (Table 1). Significantly the greater plant height of 112.60 cm was recorded for M_1 (transplanting) against the lowest in M_3 (89.39 cm). Next best treatments regarding plant height after M_1 were M_2, M_4 and M_6 which were statistically at par with one another.

The greater plant height recorded in transplanted rice was probably due to comparatively longer growing period. As seedlings were already established before transplanting in the field and these plants maintained their edge throughout the growing season which resulted in greater plant height. These results are in line with those reported by Wade and Johnston (1975) who stated that photoperiod sensitivity and marked reduction in growth period due to delayed seedling growth might account for decrease in plant height.

Panicle bearing tillers m^{-2}

The effect on panicle bearing tillers m^{-2} was non-significant. However, on the basis of two-year average data on panicle bearing tillers varied from 375.50 to 410.25 m^{-2} (Table 1). These results are not in consonance with those of Singh *et al.* (1981) who conducted field trials on rice grown under various sowing methods i.e., broadcasting, drilling, germinated seed sowing and seedling transplanting. Transplanting gave maximum number of fertile tillers m^{-2} as compared to other planting methods.

Number of spikelets panicle^{-1}

The different planting methods had significant effect on spikelets panicle^{-1} (Table 1). Crop raised through transplanting (M_1) produced significantly greater number (149.37) of spikelets panicle^{-1} than all other methods in the experiments which were statistically at par with one another.

The greater number of spikelets panicle^{-1} in transplanted rice might be attributed to the better development of panicles as a result of well established plants and better resource utilization. Greater number of spikelets panicle^{-1} in transplanted rice as compared to direct sowing was also reported by Singh *et al.* (1981) and Kim *et al.* (1991).

1000-grain weight

The data regarding the effect of different planting methods on 1000-grain weight given in Table 1 indicated that year as well as main effects on 1000 grain weight were non-significant. However, on the basis of two-year average data 1000-grain weight varied from 19.53 to 19.99 g. Results are not in line with Jana *et al.* (1981) who reported that 1000-grain weight was significantly higher in transplanted rice as compared to the other methods of sowing.

Grain yield

Perusal of data given in Table 1 revealed that there was a significant effect of different planting methods on grain yield. Transplanting (M_1) produced significantly higher grain yield (3.28 t ha^{-1}) than M_2. M_3 M_5 and M_6 but was statistically at par with M_4(direct seeding by drill at optimum soil moisture conditions) The difference among M_2, M_3 and M_4 was, however, non-significant.

Higher paddy yield obtained in M_1 was attributed to more number of spikelets per panicles and higher 1000-grain weight which might be due to longer period of growth and development of plant and more translocation of photosynthates in transplanted rice which ultimately resulted in more yield per plot. These results are in line with Jana *et al.* (1981) and Maqsood (1998) who reported that paddy yield was the highest in transplanted rice.

Economic analysis

A perusal of the Table 2 indicated that crop seeded directly by drill at optimum soil moisture conditions (M_4) gave maximum net return of Rs. 20354 ha^{-1} in 2000 and Rs. 21554 ha^{-1} in 2001 against the minimum of Rs. 15762 ha^{-1} and Rs. 16790 ha^{-1} in M_6 during 2000 and 2001, respectively.

Higher net field benefits harvested in M_4 were attributed to higher grain yield in the treatment. Although M_1 gave maximum grain yield of 3.28 t ha^{-1} (not significantly higher than M_4) but it also involved a lot of expenditure on the raising of nursery and its transplanting whereas these penalties were avoided in case of M_4 which ultimately resulted in maximum net return than all other treatments in the experiment. Similar findings were reported by Prasad *et al.* (1999) who reported that line sowing gave maximum yield and net income ha^{-1} when seeded @ 80 kg ha^{-1}.

CONCLUSIONS

From results of the experiment it can be concluded that fine rice (Super Basmati) should preferably be directly sown through drill at optimum soil moisture condition (M_4) to get maximum grain yield and net field benefits under agro-ecological conditions at Faisalabad, Pakistan.

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