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Effect of Seedling Age and Density on Growth and Yield of Rice in Saline Soil

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Abstract

Two field experiments were carried out in saline soil receiving fertilizers NPK @ 130-75-75 kg ha $^{-1}$, respectively, to see the effect of seedling age and number of seedling hill^{-1} on rice growth and yield. Rice seedlings of 25-, 35- and 55-day-old were transplanted in puddled field. Results revealed that seedlings of 25- to 35-day-old produced significantly higher number of tillers and productive tillers hill^{-1}, paddy and straw yields compared with 55-day-old seedlings. In the second experiment, transplanting of two and three seedlings hill $^{-1}$ of 35-day-old gave more promising results compared with one and four seedlings. Two seedlings hill^{-1} caused maximum increase in plant height, straw and paddy yield while more number of tillers and productive tillers were recorded with three seedlings hill^{-1}.

Introduction

Better crop stand establishment is one of the key pre-requisite for achieving desired level of rice production. Presently, rice occupies an areas of 2.2 million ha in Pakistan (Zia *et al.*, 1998). Among the factors responsible for low yield of rice, salinity has a special relevance to Pakistan and is a well recognized as a major concern because it accounts for 40 to 70 per cent yield reduction (Muhammad *et al.*, 1991; Aslam *et al.*, 1995). Qayyum and Malik (1985) reported an annual loss of about fourteen billion rupees due to soil salinity in Pakistan. This situation demands for reclaiming such degraded soils for economic crop production to meet ever-increasing challenge of food supply.

The proper cure of salt affected soils is of course its reclamation that involves the use of chemical amendments. Certain factors like insufficient supply of good quality irrigation water, shallow ground water table, low permeability of soils, high cost of amendments and use of problem ground water, are limiting the success of tackling this problem (Muhammad *et al.*, 1990). Therefore, we have to learn to live with salinity and manage such soils for sustainable and profitable agriculture.

Seedling age and plant population in rice are the important factors affecting growth and yield of rice (Hossain and Haque, 1988; Raju *et al.*, 1989; Mannan and Siddique, 1991; Bassi *et al.*, 1994). Rice plant being photosensitive may respond well to variation in day length and intensity of light in different periods. Studies also showed a positive relationship between plant population and yield of rice (Singh, 1982; Chaudhry and Iqbal, 1986). Keeping the above discussion in view, the present study was under taken with the following objectives I) determine the most appropriate seedling age of rice for transplanting in saline soil ii) determine the number of seedlings per hill to maintain optimum population of rice in saline environment.

Materials and Methods

Two field experiments were conducted on rice crop a Haveli Reclamation Research Farm Shorkot Cantt., during 1996-97. The soil was saline in nature having shallow water table; EC_e, 9.4 dS m $^{-1}$; pH_s 7.7 and SAR, 11.3 (mmo L $^{-1}$)^{½}.

In the first experiment, seedlings of rice variety Basmati 385 of three different ages (i.e. 25-, 35- and 55-day-old were transplanted in the puddled field with two seedling per hill. Fertilizers: NPK were applied @ 130-75-75 kg ha respectively. Whole dose of P, K and half of N was applie at the time of puddling while remaining half nitrogen wa applied at the time of panicle initiation.

In the second experiment, thirty five-day-old seedlings rice (Var. Basmati-385) were transplanted at the rate one, two, three and four seedlings per hill in puddled so Fertilizers rate and method of application were the same mentioned in experiment No.1.

Both the experiments were laid out in randomized comple block design with four replications. Canal water was us for irrigation. The following growth and yield paramet were recorded at different stages: a) plant height b) numb of tillers hill $^{-1}$ c) number of productive tillers hill $^{-1}$ panicle length e) number of kernels panicle $^{-1}$ f) 100 kernels weight g) straw yield h) paddy yield. The data collected was analyzed statistically and means w compared by using LSD-Test according to Steel and Tor

Results

Effect of Seedling Age on Growth and Yield of Rice Saline Soil: Results revealed that maximum plant he (124.7 cm) was found in 35-day-old seedlings but it statistically alike to those produced by 25- and 55-day seedlings (Table 1). As regards the number of tillers per and number of productive tillers per hill (Table 1), 25-d old seedlings stood superior in performance attaining 2

Table 1: Growth and yield characteristics of Basmati-385 as affected by seedling age under saline conditions. (Average of four replicates)

Treatments	Plant height (cm)	No. of tillers hill^{-1}	No. of productive tillers hill^{-1}	1000-kernel weight (g)	Paddy Yield (kg ha^{-1})	Straw yield (kg ha^{-1})
25 day old seedlings	121.3 NS	20.40 a	18.75 a	20.67 NS	4525 a	11280 a
35 day old seedlings	124.7	18.75 a	17.23 a	20.30	4475 a	9675 ab
55 day old seedlings	122.8	13.45 b	12.25 b	20.28	3650 b	8850 b

Table 2: Growth and yield characteristics of Basmati-385 as affected by number of seedlings hill^{-1} under saline conditions. (Average of four replicates)

Treatment	Plant height (cm)	No. of tillers tillers hill^{-1}	No. of productive tillers hill^{-1}	1000-kernel weight (g)	Paddy Yield (kg ha^{-1})	Straw yield (kg ha^{-1})
One seedling hill^{-1}	119.1 ab	11.20 b	9.95 c	21.85 NS	3825 c	8268 b
Two seedlings hill^{-1}	120.3 a	18.55 a	16.38 b	21.17	4550 a	9300 a
Three seedlings hill^{-1}	117.7 b	18.92 a	18.63 a	22.0	4400 ab	9100 a
Four seedlings hill^{-1}	118.0 ab	16.58 a	15.13 b	22.42	4175 b	9200 a

Means sharing similar letters do not differ significantly at p=0.05

and 18.75 tillers per hill, respectively, and differed significantly with 55-day-old seedlings which produced lowest number of tillers per hill. Number of tillers of 35-day-old seedlings was statistically similar with those produced by 25-day-old seedlings. Data showed that though maximum 1000-kernel weight (20.67 g) was found in 25-day-old seedlings but it was statistically similar to those produced by 35- and 55-day-old seedlings.

Data (Table 1) showed that seedling age had significant effect on paddy yield and maximum yield (4525 kg ha^{-1}) was observed in case of 25-day-old seedlings while 35- and 55-day-old seedlings ranked second and third producing average yields of 4475 and 3650 kg ha^{-1}, respectively. Paddy yield of 25- and 35-day old seedlings was statistically at par with each other but differed significantly with 55-day-old seedlings. Similarly, significantly higher straw yield (11280 kg ha^{-1}) was produced by 25-day-old seedlings followed by 35- and 55-day-old seedlings.

Effect of Number of Seedlings per Hill on Growth and Yield of Rice in Saline Soil: Varying number of seedlings per hill had significant effect on rice yield and its contributing parameters. The difference between per hill seedlings of rice variety Basmati-385 for plant height was significant (Table 2). Maximum plant height of 120.3 cm was observed in case of transplanting two seedlings per hill while minimum plant height was recorded with transplanting of three seedlings per hill. Number of seedlings had significantly affected the number of tillers per hill and productive tillers and highest tillers were recorded with three seedlings per hill (18.9 and 18.6, respectively). Minimum tillers were found in case of one seedling per hill and differed significantly with all other treatments. Effect of per hill seedlings on 1000-kernel weight was statistically non significant. Maximum value (22.42 g) was recorded in four seedlings per hill.

Data revealed that paddy yield was significantly affected by number of seedlings per hill (Table 2). Treatment: two seedlings per hill gave maximum paddy yield of 4550 kg ha^{-1} and differed significantly with one and four number of seedlings per hill but non significantly with the yield of three seedlings. Minimum paddy yield was recorded in case of one seedling per hill. Similarly, two seedlings per hill produced maximum straw yield (9300 kg ha^{-1}) but it remained statistically similar to three and four seedlings per hill and different from one seedling per hill.

Discussion

Most rice crops are produced from flooded, anaerobic soils that are chemically highly reduced (Ponnamperuma, 1984.) Such conditions are fatal to the majority of species especially in saline soils, and rice is the only major crop plant that can survive or even thrive in these soils. Soil salinity affects plant growth and yield by upsetting water and nutritional balance of the plants due to the deterioration of physical and chemical properties of soil as well as by the toxic effect of individual ions (Yeo and Flowers, 1984). Biological approaches may play vital role in reclaiming such soils as well as in increasing yields.

Seedling age affects growth and yield of rice and in our study 25 to 35 day old seedlings significantly affected number of tillers and productive tillers hill^{-1}, paddy and straw yield. Our results are in accordance with the findings of many workers. Raju *et al.* (1989) found that transplanting 30-, 45- or 60-day-old seedlings gave yields of 4.85, 4.40 and 4.19 tones, respectively. They further observed higher values of number of panicles m^{-2}, number of filled grains panicle^{-1} and 1000-grain weight with 30-day-old seedlings. Hossain and Haque (1988) reported that basal tillers were greater with 30-day-old than 60-day-old seedlings. Higher number of tillers, panicles and grain yield were observed when young seedlings were planted compared with more aged seedlings (Mannan and Siddique, 1991; Bassi *et al.*, 1994; Kim and Lee, 1989).

Results revealed that effect of seedling number hill^{-1} was

also significant on growth and yields of rice. Our results are also similar to the findings of Hossain and Haque (1988) who reported highest grain yield with 2 seedlings hill^{-1} but the number of basal tillers increased with increasing seedling number. Many other workers also confirmed the effects of seedling number on growth and yields of rice (Singh and Singh, 1992; Banerjee *et al.*, 1992).

Optimum seedling age and plant populations are important factors to be considered for increasing paddy yields. Genetic differences among genotypes in the ability of seedlings to establish after transplanting might cause differences in growth and yield (Bassi *et al.*, 1994). Being a photo-period sensitive crop, too low or high temperature adversely affects the spike fertility in rice. So rice may respond to variation in day length and intensity of light in different periods (Mannan and Siddique, 1991). Positive response to more population density per unit area could be due to better seedling establishment and dilution effects at root level causing less entry of saline ions into the shoot. However, low response to four seedlings hill^{-1} may be due to more competition for nutrients.

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