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Impact of Variable Planting Densities on Yield, Yield Components and Economics of Direct Wet Seeded Rice Production

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Abstract

A field trial was carried out to evaluate the effect of different seed rates on the production of direct wet-seeded rice. The coarse rice variety IR-6 was sown at seed rate of 40, 60, 80, 100, 120, 140, 160 and 180 kg ha⁻¹. The results revealed that paddy yield, harvest index, net income and benefit-cost ratio was maximum at medium seed rate of 120 kg ha⁻¹. A decrease in plant height at maturity, numbers of tillers per plant, number of panicles per plant, normal kernel (%) and progressive increase in sterility (%) and straw yield was observed with increase in seed rate from 40 to 180 kg ha⁻¹. All the growth, yield and kernel quality attributes were economical and profitable at seed rate of 120 kg ha⁻¹.

Introduction

Rice (*Oryza sativa* L.) is the second most important food crop of the world as well as Pakistan. It is the principal food crop of about one and half of the world population and especially in those areas of the world where population densities are highest (Ironan, 1972). During 1996-97 rice was cultivated on 790 thousand hectares area in Pakistan and produced 4.305 million tones of rough rice with an average yield of 1912 kg ha⁻¹ (Khan, 1997). Although a break through have been achieved in raising the yield of rice crop through transplanted rice culture but due to costly labour, compaction of soil structure due to puddling and failure of nursery due to various factors e.g unfavourable weather conditions, nutrient deficiencies, toxicities, and lack of plant protection measures, the farmers are reluctant to adopt transplanted rice culture. Added to this, the unpredictable and aberrant floods and droughts have created instability in rice production and therefore heavy input rice culture is taken as a risky enterprise particularly poor farmers of traditional rice growing areas. Nursery raising in transplanted rice means engaging the field for nearly a month earlier to transplanting and it requires additional expenditure and intensive care unlike direct seeded rice culture. Further more any abnormality in nursery raising adversely affects not only the productivity of the rice crop alone rather the productivity of the entire rice-based cropping system. Transplanting require greater labour force, while agricultural labour is becoming costlier and their availability in peak period of transplanting becomes one of the most limiting factors for covering the vast area delineated for planting with in the stipulated time. Rice seedling become overage resulting in reduced tillering and poor grain production. In the present era of energy crises, majority of rice growing countries are striving hard to make shift from transplanted culture to direct seeded culture. Most of the field experiments and on-farm researches have established that accurate seed rate, adaptation of timely sowing, efficient weed control and water management under direct seeded conditions, assured as high yield as transplanted rice (Choudhary *et al.*, 1966; Singh and

Bhattacharyya, 1987 and Baloch, 1994).

An attempt was therefore, made to evaluate the effect of different seed rates on the economic yield and other yield contributing characters in direct wet-seeded rice.

Materials and Methods

The research work was carried out at Agronomic Research Area, Faculty of Agriculture, Gomal University, D.I.Khan, during the year 1997. The experiment was laid out in Randomized Complete Block Design with three replications and eight treatments. The net plot size was 5x3 m (15 m²). The experimental treatments comprised of seed rates 40, 60, 80, 100, 120, 140, 160 and 180 kg ha⁻¹. The test variety was IRRI-6. A recommended dose of 120:100:60 kg NPK ha⁻¹ was applied to all plots as Urea, Triple Super phosphate (TSP) and Sulphate of potash (SOP). Irrigation was applied when ever required.

The data were analyzed by using analysis of variance technique (Steel and Torrie, 1980) and Duncan's Multiple Range Test was used to check the differences among the treatment means.

Results and Discussion

Different seed rates significantly affected plant height, tillers per plant, and numbers of panicles per plant. Maximum plant height at maturity more number of tillers and panicles per plant were observed in T1 with minimum seed rate, while these observations were minimum in T8 with maximum seed rate. In other words a progressive decrease in above described parameters was observed with increase in seed rate. The probable reason for maximum plant height and more number of tillers and panicles per plant at low seed rates might be due to the reduced competition among crop plants for nutrients, moisture, light, Carbon dioxide, Oxygen, space for survival and suitable physiological and environmental conditions for growth and development. Similar results were also reported by Cruz and Claro (1983).

Table 1: Yield and yield components of rice variety IR-6 as affected by variable planting densities in direct seeded rice.

Treatments	Plant height (cm)	Tillers/plant (No.)	Panicles/plant (No.)	Spikelets/Panicle (No.)	Normal Kernel (%)	Sterility (%)	1000 grain weight (g)	Yield (t ha ⁻¹) Paddy	Straw
T1	95.60 a	17.63 a	16.35 a	10.35d	86.19a	13.81e	22.54abc	2.33c	10.11b
T2	91.63 ab	16.48 ab	15.30 ab	11.10c	85.10b	14.90d	23.51ab	2.94bc	12.06b
T3	90.43 ab	15.03 bc	14.19 bc	11.55bc	84.95b	15.05d	24.89a	3.38ab	13.04b
T4	87.57 bc	14.02 cd	13.25 bc	12.00ab	84.26b	15.74d	22.54abc	3.69ab	17.23a
T5	86.60 bcd	13.50 cd	12.72 cd	12.20a	83.21b	16.79c	23.53ab	4.10a	16.61a
T6	48.22 cd	12.52 de	11.63 de	11.51bc	82.23d	17.77b	22.46abc	3.49ab	17.93a
T7	82.77 cd	11.07 ef	09.65 ef	10.42d	80.93e	19.07a	21.54bc	3.42ab	17.13a
T8	81.35 d	10.17 f	08.30 f	09.18e	80.69e	19.30a	20.49c	2.78bc	17.93a

Means having common letter are not significantly different at 1 % level of significance.

Table 2: Economic analysis of rice variety IRRI-6 as affected by variable planting densities in direct seeded rice.

Treatments.	Cost of Seed Rs./ha	Total Cost Rs./ha	Gross Income Rs./ha	Net Income Rs./ha	B.C.R.
T1	80	7347	15431	8084	2.10
T2	160	7427	19210	11783	2.59
T3	240	7507	21717	14270	2.89
T4	320	7587	25394	17887	3.35
T5	400	7647	26712	19065	3.49
T6	480	7747	24155	16808	3.12
T7	560	7827	23506	15679	3.00
T8	640	7907	20605	12698	2.61

Price of IRRI-6 = Rs.5000 per 1000 kg.; Price of Ronstar = Rs. 375 per 800 ml.; Labour cost = Rs. 70 per day per man.

The results regarding the number of spikelets per panicle, normal kernel (%) and sterility (%) are presented in Table 1. The mean values show that more number of spikelets per panicle were recorded at medium seed rate, while with increase in seed rate, a progressive decrease in spikelets per panicle was found. The reason might be due to severe competition among crop plants for nutrients, moisture, carbon dioxide, space and leaf Area Index (LAI) beyond optimum. Similar indications were also reported by Kabaki and Kon (1991). Maximum normal kernel (%) and minimum sterility (%) was found at minimum seed rate. Minimum normal kernel and maximum sterility (%) was observed at highest seed rate. With increase in seed rate, normal kernel (%) was decreased and sterility (%) was increased progressively. These variations at low seed rate might be attributed to the higher moisture availability at final kernel development stage and less competition among crop plants. Similar results were also reported by Gravois and Helms (1992).

It is revealed from the data given in Table 1 that maximum grain weight was recorded in T3, while paddy yield was found highest at medium seed rate. It was due to good crop stand, more normal kernels, more spikelets per panicle and adequate translocation of solutes to the grains which resulted highest economic yield (Singh *et al.*, 1990; Nigum *et al.*, 1988). The straw yield was minimum at lowest seed rate and maximum at highest seed rate. The more straw yield in high seed rate treatments probably due to more tillers per unit area. These findings coincide with Cruz and Claro (1983).

The Table 2 concerning the economic analysis of different seed rates indicated that maximum benefit-cost ratio of 3.49 was recorded in T5. Therefore, 120 kg seed ha⁻¹ seems to be the most suitable, economical and profitable for the growers of Dera Ismail Khan.

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