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WEED MANAGEMENT THROUGH INCREASED PLANTING DENSITY IN TRANSPLANTED RICE

Naqib Ullah Khan[1], Gul Hassan[2], Sana Ullah Khan[1], Qayum Nawaz Khan[1], and Abdul Aziz Khakwani[3]

ABSTRACT

The experiments were conducted to evaluate the effect of different planting densities/geometries on weed control and paddy yield in rice. The three year studies revealed that the weed biomass and paddy yield were significantly ($P<0.01$) influenced by different plant populations. An inverse relationship was established between the cropping density and weed biomass. The minimum weed biomass was recorded in the spacing of 15x15 cm^2 (4,44,444 plants ha^{-1}). Whereas, the maximum weed biomass was observed in 30x30 cm^2 (1,11,111 plants ha^{-1}) during the three years. Significantly highest paddy yield of 7208 kg ha^{-1} was recorded in the plant spacing of 25x25 cm^2 (1,60,000 plants ha^{-1}) and was statistically at par with the plant spacing of 20x20 cm^2 (2,50,000 plants ha^{-1}) producing the paddy yield of 7192 kg ha^{-1}. The lowest paddy yield of 5667 kg ha^{-1} was obtained in plant spacing of 15x15 cm^2 with 4,44,444 plants ha^{-1} owing to severe attack of leaf folder and lodging. Hence, the 15 x 15 cm^2 spacing is suggested for better interspecific competition with weeds and higher economic returns.

Key Words: Weed Management, Planting Density, Rice

INTRODUCTION

Rice (*Oryza sativa* L.) is one of the major earning source of foreign exchange and occupies second position in providing the staple food for the country's population. Despite, advances in rice production, the average national yields of Pakistan are still lower as compared to many rice growing countries of the world. Many other factors are responsible for low yield, but it can be attributed mainly to severe weed infestation. In Punjab, the weed losses have been estimated to be 20-63 % depending up on the types of weeds and their infestation (Majid *et al.*, 1975).The yield losses depend mainly upon the weed densities and their diversity. Weeds compete with rice for light, nutrients, water, space, and Co_2 and consequently reduce the paddy yields. Losses due to weeds have been estimated at 10% of rice crop in India (DeDatta, 1980). Cultural weed control has also been considered the most desirable method of weed control. Inadequate cultural and management practices used by our farming community has made the weeds problem in rice rather worse (Marwat *et al.*, 1992). Like other crops weeds pose a serious problem in rice production. To avoid the weed competition due to earlier space capture farmers have to undergo the cumbersome practice of transplantation and maintaining flood in their fields throughout the

1 Plant Physiology Section, ARI, D.I.Khan.
2 Department of Weed Science, NWFP Agricultural University Peshawar.
3 Wheat Botany Section, ARI, D.I.Khan.

growing season. Herbicides are no doubt a very good alternative, but their injudicious use is already reflecting in the shape of environmental pollution and development of resistance among the weeds. Denser crop population can be used as a tool for weed management in rice and other field crops. Godel (1935) demonstrated that grain sorghum, when planted in 30.5 cm rows was more competitive with weeds rather 76.2 cm row spacing. In maize higher plant population has been found very effective in reducing the above ground biomass, tuber number, tuber weight, and height of yellow nutsedge and increased the corn yield (Ghafar and Watson, 1983). Mukhopadhyay and De (1979) reported that cultural methods and granular herbicides were found most effective for controlling the rice weeds. Narrow rows plants spacing and increased plant population practices can reduce weed density and growth in cotton as mentioned by Rogers *et al.* (1976) and Miller *et al.* (1983). Similarly, narrow rows with gradual increase in seed rate have reduced the weed infestation and enhanced the yield in soybeans (Ablett *et al.*, 1984; Teasdale and Frank 1983; Oliver 1978; Cooper 1974; Wax and Pendleton, 1974). Higher seeding rates and herbicides application proved most effective in controlling weeds and boosting wheat productivity (Ahmad *et al.*, 1996). Zimdahl (1980) noted that reduction in yield due to weed competition is usually sigmoidal rather than linear because very low weed densities do not usually result in yield reduction. Depending on crop variety and agro-climatic conditions, 9-63% losses have been reported in rice yield from weed competition in the Indian sub-continent (Ahmad *et al.*, 1977, Ghauri *et al.*, 1979, Bhargavi and Reddy, 1990, Zafar, 1989). To enhance the rice yield, there is a tremendous need of developing a package of weed management technology for the farming community. Keeping in view the importance of weed control in rice the present investigation was under taken to determine the effectiveness of plant population in suppressing the weeds and to see their effect on yield of transplanted rice.

Materials and Methods

The experiments were conducted at Agricultural Research Institute, D.I.Khan in three consecutive years viz; 1993, 1994 and 1995. Thirty days old nursery of cultivar KS-282 was transplanted on a well prepared soil during the second week of July in all the years. Basal dose of 90-90-60 NPK kg ha^{-1} was applied. All the P and K and half N was applied at planting time, while the remaining N was applied at tillering and panicle initiation stage. Uniform cultural practices and plant protection measures were adopted for raising a successful crop. The experiments were laid out in a RCB design with four treatments replicated four times. The rows and plants spacings were 15 cm, 20 cm, 25 cm and 30 cm. The data were recorded on weed biomass (g m^{-2}) and paddy yield (kg ha^{-1}) and analyzed by applying split plot design. The years were treated as main plots and the planting geometries as sub plots. Both ANOVA and LSD to establish the differences among the treatment means were performed by using the MSTATC computer program.

Results and Discussion

Highly significant differences ($P < 0.01$) were observed for weed biomass and paddy yield for years and plant spacings. However, the interactions between years and spacings were nonsignificant statistically for weed biomass and paddy yield. All the plant population densities markedly affected the weed infestation, weed biomass and paddy yield. During all the three years of studies, there was a preponderance of sedges and grassy weeds in the experiments. Among the sedges the dominant species observed were *Cyperus rotundus* and *C. difformis*, while *Echinochoa crus-galli*, *E. colonum* and *Cynodon dactylon* dominated among the grasses. No broad leaf weed was noticed in the trials.

Weed Biomass (g m^{-2}): The data recorded on weed biomass (g m^{-2}) revealed that weed biomass was significantly influenced by the different population densities/geometries during all the years of studies (Table 1). The lowest weed biomass (91.94 g m^{-2}) was observed in 1995, while the highest weed biomass (97.35 g m^{-2}) was recorded during 1993 followed by 1994. As far as planting densities are concerned, the significantly lowest weed biomass (15.43 g m^{-2}) was recorded in the spacing of 15 x 15 cm^2 with 4,44,444 plants ha^{-1} across all the years, which clearly indicates that an increase in population density decreases the weed infestation, resulting in least weed biomass. However, maximum weed biomass (213.20 g m^{-2}) was recorded in the widest spacing i.e 30 x30 cm^2 with 1,11,111 plants ha^{-1} and it was followed by spacing of 25 x 25 cm^2 (1,60,000 plants ha^{-1}). These results are in line with the findings of De Datta (1980), Marwat *et al.* (1992) and Mukhopadhyay and De (1979).

Paddy Yield (kg ha^{-1}): The data pertaining to paddy yield (Table 2) showed that different population densities responded significantly in producing paddy yield. Among the years, the highest paddy yield of 7288 kg ha^{-1} was recorded in 1995, which was followed by 1994. The lowest paddy yield (5814 kg ha^{-1}) was observed in 1993. The differences among the paddy yield of years were due to environmental conditions. For the plant spacings/geometries, the significantly highest paddy yield (7208 kg ha^{-1}) was deciphered in the plant spacing of 25 x25 cm^2 (1,60,000 plants ha^{-1}), but it was statistically at par with the crop having the plant spacing of 20 x 20 cm^2 (2,50,000 plants ha^{-1}) by producing the paddy yield of 7192 kg ha^{-1}. It was followed by the maximum spacing of 30 x 30 cm^2 (1,11,111 plants ha^{-1}). However, significantly lowest paddy yield of 5667 kg ha^{-1} was obtained in plant spacing (15 x 15 cm^2 with 4,44,444 plants ha^{-1}. The consistently lowest yield in the maximum plant population density is attributed to 15 % lodging, low tillering capacity and severe attack of leaf folder, nevertheless the minimum weed infestation and biomass was observed in the same treatment. These conclusions have a support from the earlier researchers like Bhargavi and Reddy (1990), Zafar (1989), De Datta (1980), Zimdahl (1980), Ghauri *et al.* (1979) and Ahmad et al. (1977). It is inferred from the above results that the treatments with 25 x 25 and 20 x 20 cm^2 spacing (1,60,000 and 2,50,000 plants ha^{-1}) followed by 30 x 30 cm^2 (1,11,111 plants ha^{-1}) gave statistically higher paddy yield as compared to the closest planting (4,44,444 plants ha^{-1}). The results further revealed that the too narrow plant spacing (15 x 15 cm^2) in transplanted rice should be avoided because it can render the crop prone to the attack of leaf folder and in addition liable to lodging.

Table 1. Effect of plant population of rice on weed biomass (g m^{-2}) during 1993, 1994 and 1995

Spacings (cm^2)	Plant Population ha^{-1}	Years			Spacing Means
		1993	1994	1995	
15 x 15	4,44,444	17.63	16.02	12.64	15.43 a[4]
20 x 20	2,50,000	63.27	61.26	58.19	60.91 c
25 x 25	1,60,000	90.90	89.33	86.55	89.26 b
30 x 30	1,11,111	216.60	212.50	210.40	213.20
Year means		97.35 a	94.78 b	91.94 c	-

[4] Means sharing a letter in common in the respective category do not differ by LSD test at 5% probability level.

Table 2. Effect of Plant population of rice on paddy yield (kg ha^{-1}) during 1993, 1994 and 1995

Spacing (cm^2)	Plant Population ha^{-1}	Years			Spacing Means
		1993	1994	1995	
15 x 15	4,44,444	4867	5660	6475	5667 c[a]
20 x 20	2,50,000	6425	7350	7800	7129 a
25 x 25	1,60,000	6300	7350	7975	7208 a
30 x 30	1,11,111	5663	6545	6900	6369 b
Year means		5814 c	6726 b	7288 a	-

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