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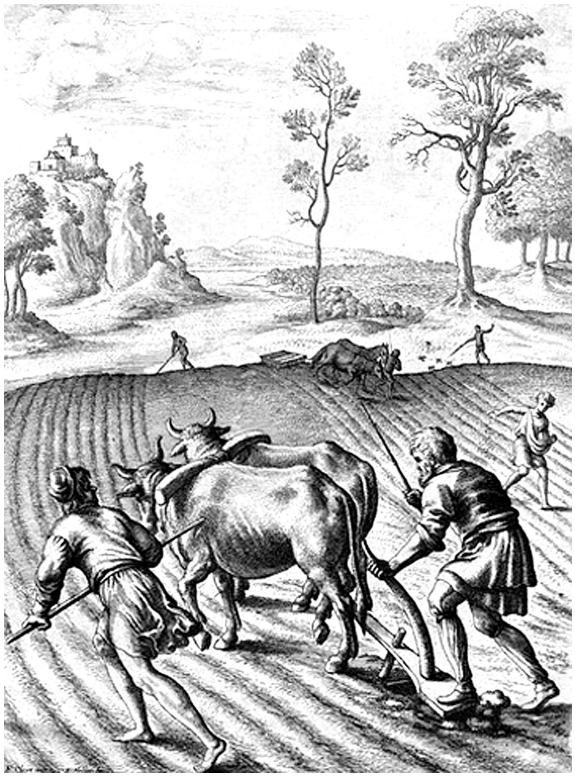

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Effect of Population Density of *Echinochloa crusgalli* and *Echinochloa colonum* on Rice

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Abstract: A pot experiment was conducted to study the effect of *Echinochloa crusgalli* and *Echinochloa colonum* on the growth and yield of rice (cv. IR50) during April to July 2002. The results showed that the effect of two weeds pot^{-1} produced 70.6% yield loss of rice grain and about 97% grain yield was reduced when 8 weeds competed against a single rice plant. The reduction of rice grain at this density was the results of 42.9% reduction of plant height, 92% reduction of LAI, 72.7% reduction of tillers plant^{-1}, 88.5% reduction of panicles/plant and 63.8% reduction of grains panicle^{-1}. Further increase of weed density produced the self-thinning effect of weeds and rice yield increased in comparison to 8 weeds pot^{-1}. It was concluded that *Echinochloa crusgalli* and *E. colonum* produced similar effects on grain yield and other plant characteristics of rice.

Key words: Barnyard grass, density effect, jungle rice, rice, weed

Introduction

Agriculture is a fight against weeds. Weeds are always present on every hectare of crop in the world. Especially, the prevailing climate and edaphic factors of Bangladesh are highly favourable for luxuriant growth of numerous species of weeds, which offer a keen competition with rice crop (Mamun, 1988). Weeds are important yield constraints in rice. In Bangladesh 40.28% rice yields are lost due to weed competition (Karim ***et al.***, 1998). Among the weed species *Echinochloa crusgalli* (barnyard grass) and *E. colonum* (jungle rice) are predominant grass weeds in rice (Ali and Sankaran, 1984; Ali, 1985). Although competition from these weeds reduce the yield of rice, mere present of few weeds on rice field may not be economic to control them. Decision on herbicide spraying also depends on the density of weeds. Therefore, it is important to know the extent of yield loss due to different density of *Echinochloa crusgalli* and *E. colonum*. The objective of the study was to find out the effect of different densities of the weeds on growth morphology and yield of upland rice.

Materials and Methods

The experiment was conducted in pots (30 cm diameter × 30 cm depth) during the period from March to July 2002, at Bangladesh Agricultural University, Mymensingh using complete randomized design with four replications. Pots were filled with clay loam soil and mixed with manures and fertilizers @ of 70 g cowdung kg^{-1} soil, 0.50 g TSP pot^{-1} and 0.45 g gypsum pot^{-1} (Karim, 2000). Fertilizers, TSP and gypsum were applied during the pot filling on 5 April, 2002 and urea was applied as top-dressing at 15 days after transplanting (DAT) and 30 DAT @ 0.72 and 0.70 g pot^{-1}, respectively. Two weed species i.e. ***Echinochloa crusgalli*** and ***Echinochloa colonum*** were grown in mixture of rice using four densities, 2, 4, 8 and 16 weeds pot^{-1} which were equivalent to 28, 56, 112 and 224 weed sm^{-2}, respectively. Monoculture of rice was also maintained for comparison of density effects. Rice and weed seeds were put in cloth bag and kept them under tap water for 24 h for sprouting. Four sprouted rice seeds were sown in the centre of the pot and sprouted weed seeds were sown surrounding the rice seedlings maintaining equal distance from each other. Pots were put in the net house. After 2 weeks of planting thinning was done keeping one healthy seedling of rice and the weed $hill^{-1}$. Unsown weeds were uprooted time to time to avoid extra competition. Data on plant height, number of tillers $hill^{-1}$ and leaf area $plant^{-1}$ were collected at 65 DAT. The number of panicles $plant^{-1}$, number of grains $panicle^{-1}$, 1000-seed weight and grain yield pot^{-1} were recorded after harvest. Straw yield was also recorded after final harvest. Collected data were analyzed statistically by using the statistical package IRRISTAT. The mean values were adjudged using DMRT. Correlation between weed density and grain yield of rice was studied.

Results and Discussion

Effect on growth morphology

Plant height

The tallest (76.5 cm) plants were produced in weed free condition and the height was reduced due to weed competition. The highest reduction (42.9%) of rice height was noticed when 8 weeds competed against a rice plant (Table 1). The density effect of 2 and 4 weeds pot^{-1} was similar. Again when the density of weeds increased from 8 to 16 weeds pot^{-1} the mean plant height was increased than that of 8 weeds pot^{-1}. This might be due to self-thinning of weed densities. That was due to intra weed competition the growth of weeds was suppressed and eventually the effect on rice height was nullified. Perera ***et al.*** (1992) and Sultana (2000) also noticed the similar reduction of rice height due to competition from ***E. crusgalli.***

Leaf area index (LAI)

The effect of weed density on rice height was reflected on the effect on LAI since, leaf area of crop might be related to the plant height of it. About 92% LAI of rice was reduced due to competition from 8 weeds against a single rice plant (Table 1). The density effect of weed species on rice LAI was more or less similar to that on plant height. Okafor and De Datta (1974) reported that reduction of rice grain yield due to competition from different weeds was due to reduced LAI and less light transmission. Both the weeds produced similar detrimental effects on rice LAI.

Table 1: Effects of weed density on plant height and leaf area index of rice

Density	Plant height (cm)				Leaf area index (LAI)			
(weed pot^{-1})	W_1	W_2	Density mean	Control (no weed)	W_1	W_2	Density mean	Control (no weed)
2	63.00a	55.00a	59.00a (22.87)*	76.5	0.33a	0.20a	0.26a (77.97)	1.18
4	57.80a	56.36a	57.05a (25.42)	76.5	0.29b	0.18a	0.23ab (80.51)	1.18
8	41.50b	45.80a	43.65b (42.94)	76.5	0.09c	0.11a	0.10c (91.53)	1.18
16	53.50a	54.30a	54.30a (29.01)	76.5	0.14c	0.21a	0.18b (84.75)	1.18
Weed mean	53.95A	52.85A		76.5B	0.21A	0.18A		1.18B

Table 2: Effects of weed density on the number of tillers and panicles plant^{-1}

Density	Number of tiller plant^{-1}				Number of panicle plant^{-1}			
(weed pot^{-1})	W_1	W_2	Density mean	Control (no weed)	W_1	W_2	Density mean	Control (no weed)
2	3.8ab	3.0a	3.4a (61.36)*	8.8	2.5a	1.3a	1.9ab (75.64)	7.8
4	4.0a	3.0a	3.5a (60.23)	8.8	2.5a	1.8a	2.15a (72.44)	7.8
8	2.5b	2.3a	2.4d (72.73)	8.8	1.0a	0.8a	0.9b (88.46)	7.8
16	3.3ab	2.5a	2.9ab (67.05)	8.8	0.8a	1.0a	0.9b (88.46)	7.8
Weed mean	3.4A	2.7B		8.8B	1.7A	1.23A		7.8B

Table 3: Effects of weed density on number of grains plant^{-1} and grain yield plant^{-1}

Density	Number of grains plant^{-1}				Grain yield plant^{-1} (g)			
(weed pot^{-1})	W_1	W_2	Density mean	Control (no weed)	W_1	W_2	Density mean	Control (no weed)
2	48.00a	67.00a	57.50a (15.46)*	49.80	1.54a	1.65a	1.60a (70.59)	5.44
4	16.00b	34.50b	25.25b (49.3)	49.80	0.35b	0.39b	0.37b (93.2)	5.44
8	8.00b	28.00b	18.00b (63.86)	49.80	0.10b	0.28b	0.19b (96.51)	5.44
16	18.70b	36.00b	27.35b (45.08)	49.80	0.20b	0.25b	0.23b (95.77)	5.44
Weed mean	22.68B	41.38A		49.80A	0.55A	0.64A		5.44B

Table 4: Effects of weed density on 1000-grain weight and straw yield plant^{-1}

Density	1000-grain weight (g)				Straw yield plant^{-1} (g)			
(weed pot^{-1})	W_1	W_2	Density mean	Control (no weed)	W_1	W_2	Density mean	Control (no weed)
2	17.14a	15.59a	16.37ab (8.39)	17.87	1.74a	1.39a	1.26a (87.29)*	9.91
4	16.79a	15.59a	16.19ab (9.4)	17.87	1.44ab	0.89a	1.16a (88.29)	9.91
8	18.19a	16.99a	17.59a (1.57)	17.87	0.55c	0.53a	0.54b (94.55)	9.91
16	14.77a	14.71a	14.74b (17.52)	17.87	0.65bc	1.08a	0.86ab (91.32)	9.91
Weed mean	16.72A	15.72A		17.87A	1.10A	0.97A		9.91B

*Figures in parentheses indicate the per cent reduction in comparison to control

Figures followed by same small letters are not significantly different at 5% level

W_1 = *Echinochloa crusgalli*, W2 = *Echinochloa colonum*

Number of tillers plant^{-1}

Maximum number of tillers plant^{-1} (8.8) was found in weed free pot, which was reduced by 72.7% due to competition from 8 weeds pot^{-1}. When 2 weeds pot^{-1} competed against single rice on an average 61.4% tiller production was reduced. Similar result was noticed due to the effects

of 4 weeds pot^{-1}. However, again when the density was too high e.g. 16 weeds pot^{-1} self-thinning occurred due to intra weed competition (Table 2). Sultana (2000) observed about 52% reduction of tillers due to competition from *E. crusgalli* and 43.8% reduction due to *E. colonum*. The findings are also in agreement with that of Azmi (1988) in Malaysia.

Number of panicles plant^{-1}

Reproductive growth is a reflection of vegetative growth. In this study the effect of weed density on the panicles plant^{-1} was similar to that on the number of tillers/plant or plant height. The highest number of panicles plant^{-1} (7.8) was noticed under weed free condition and the panicle production was reduced due to competition pressure of weed density (Table 2). About 80.46% panicles production was reduced when 8 and 16 weeds pot^{-1} competed against a rice plant. Sultana (2000) observed that when *E. crusgalli* at a density of 200 m^{-2} competed with Boro rice, it reduced about 59% of panicle production. Mamun *et al.* (1986) also found similar reduction of panicle plant^{-1} due to competition from weeds.

Number of grains panicle^{-1}

The effect of weed competition on the number of grains panicle^{-1} was different than that on the number of panicles plant^{-1} (Table 3). No significant difference was observed between weed free pot (49.8) and the pot with 2 weeds rice plant^{-1} (57.5). However, when the weed density was increased further i.e. from 4 to 16 weeds pot^{-1}, significant reduction in grain production was observed. The highest reduction 63.86% was noticed when 8 weeds competed against a single rice plant. Sultana (2000) found 40% reduction of grains panicle^{-1} due to competition from *E. crusgalli* and 28.7% reduction due to competition from *E. colonum* at a density of 200 weeds m^{-2}.

Effect on crop yields

Effect on grain yield

The rice crop produced 5.44 g rice grain plant^{-1} when grown without weed. Grain yield was reduced due to competition from the weeds (Table 3). The relationship between grain yield/plant and weed density was represented by a rectangular hyperbola (Fig. 1). Significant yield reduction was noticed due to competition from different densities of the weeds. The highest reduction (96.5%) was occurred when 8 weeds competed against a rice plant per pot (112 weeds m^{-2}). The lowest reduction (70.6%) was occurred when 2 weeds competed against a rice plant. The percent reduction increased progressively with the increase in weed density up to 8 weeds pot^{-1}. However, when the weed density increased further the magnitude of yield reduction was reduced; in other words the per pot yield was increased slightly. This increase of grain with the further increased of weed density might be due to self-thinning of weeds. The mean yields under 4, 8 and 16 weeds pot^{-1} were statistically similar. Two weeds, *E. crusgalli* and *E. colonum* produced similar effects on rice grain. In a study at Taiwan, it was reported that *E. crusgalli* caused 88% yield loss of transplanted rice. Well-branched root and higher root length

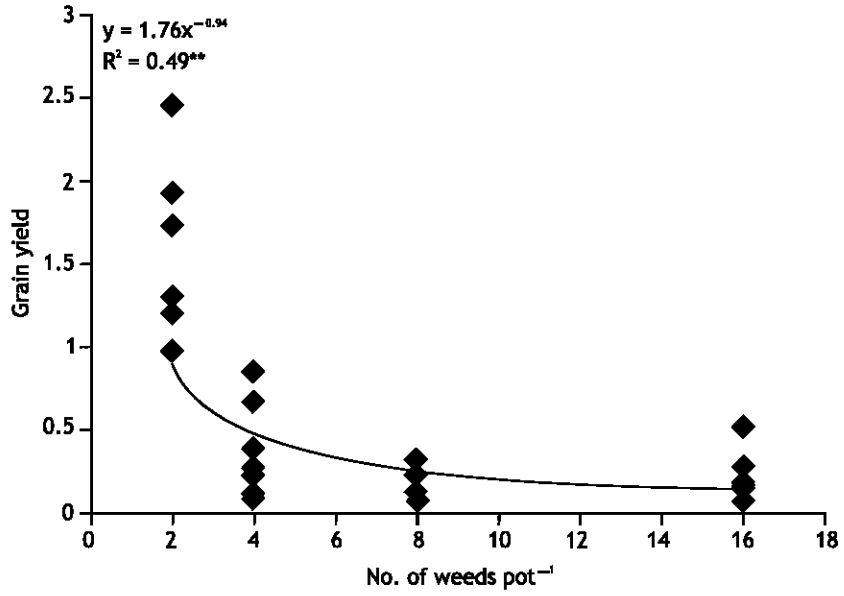

Fig. 1: Effect of weed density on grain yield (g plant^{-1}) of rice
** indicates the relationship is significant at 1% level

of the weed might be one of the important reasons for heavy bearing on rice yield (Haque ***et al.***, 1994).

Thousand grain weight

Thousand-grain weight is a genetical character of rice and. environmental factors influence in minimum level. No significant difference was found between weed free and weed competition (Table 4). However, Islam ***et al.*** (1980) reported that weight of 1000 grain varied significantly due to weed infestation but Rao and Moody (1992) reported that weed competition did not affect the seed weight of rice. Razia (2000) also found the similar non-significant effects of weed competition on 1000-grain weight.

Straw yield

The effect of weed competition on the plant height and number of tillers per plant were reflected on the straw yield per plant. Significant yield reduction was found due to weed competition (Table 4) yield reduction (about 95%) was occurred when 8 weed spot^{-1} competed against a single rice plant and the rate of reduction reduced when weed density was increased to 16 weeds pot^{-1}. Ahmed ***et al.*** (1986) reported that the weed competition produced significant reduction of straw yield with the increase in weed competition duration.

References

Ahmed, S., A.A. Mamun, M.A. Islam and S.M.A. Hossian, 1986. Critical period of weed competition in transplant Aus rice. Bangla. J. Agric., 11: 1-9.

Azmi, M., 1988. Weed competition in rice production. Proc. National Seminar and Workshop on Rice held at Malaysia, 1988. Field Weed Mant., pp: 141-152.

Ali, M.A. 1985. Crop-weed competition. In updated abstracts of papers of Ann. Conf. Ind. Soc. Weed Sci., pp: 78.

Ali, M.A. and S. Sankaran, 1984. Crop weed competition in direct seeded lowland and upland bunded rice. Ind. J. Weed Sci., 19: 90-96.

Haque, M.E., S.M.R. Karim and A.T.M., Samsuddoha, 1994. Comparative growth attributes of ***Echinochloa colona*** (L.) Link. grown in rice field. Bangla. J. Bot., 28: 159-167.

Islam, M.A., M.N.H. Khan and M.M. Rahman, 1980. Effects of cultural weed control practice on Aus rice. Bangladesh J. Agric. Sci., 7: 43-46.

Karim, S.M.R., T.M.T. Iqbal and N. Islam, 1998. Relative yields of crops and crop losses due to weed competition in Bangladesh. Pak. J. Sci. Ind. Res., 41: 318-324.

Karim, S.M.R., 2000. Competitive ability of three grass weeds grown in upland direct seeded aus rice in Bangladesh. Pak. J. Agric. Res., 16: 24-26.

Mamun, A.A., S. Ahmed and A.U. Sarker, 1986. Critical period of crop weed competition in direct seeded Aus rice. Bangladesh J. Agril. Sci., 13: 61-66.

Mamun, A.A., 1988. Farmers' concepts or weeds and weed control Jawar village in Kishorgonj. Agricultural Rural and Development in Bangladesh. JSARD Pub. No. 8. Japan Intl. Co-operation Agency, Dhaka, Bangladesh, pp: 74-90.

Okafor, L.T. and S.K. De Datta, 1974. Competition between weeds and upland rice in monsoon Asia. Weed Sci. Bull.,1: 39-45.

Perera, K.K., P.G. Ayres and H.P.M. Gunasena, 1992. Root growth and the relative importance of root and shoot competition in the interactions between rice (***Oryza sativa***) and ***Echinochloa crusgalli***. Weed Res., Sri Lanka, 32: 67-76.

Rao, A.N. and K. Moody, 1992. Competition between ***Echinochloa glabrescens*** and rice (***Oryza sativa***). Trop. Pest Mngt., 38: 25-29.

Sultana, R., 2000. Competitive ability of wet-seeded boro rice against ***Echinochloa crusgalli*** and ***Echinochloa colonum***. M.S. Thesis, BAU, Mymensingh, Bangladesh, pp: 36-50.