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DETERMINATION OF GROWTH AND DEVELOPMENT OF BARNYARDGRASS (*Echinochloa crus-galli* L. Beauv) UNDER DIFFERENT ALLELOPATHIC EFFECT OF RICE VARIETY

R. KHATUN, S.M.R. KARIM, M.S. ISLAM* AND F. ZAMAN

Department of Agronomy, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh.

*Corresponding author & address: Md. Shafiqul Islam, E-mail: shafiqagron@bau.edu.bd
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ABSTRACT

Khatun R, Karim SMR, Islam MS, Zaman F (2014) Determination of growth and development of barnyardgrass (*Echinochloa crus-galli* L. Beauv) under different allelopathic effect of rice variety. *Int. J. Sustain. Crop Prod.* 9(1), 11-15.

An experiment was carried out at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during the period from 29 March, 2011 to 17 May, 2011 to determine the growth and development of barnyardgrass (*Echinochloa crus-galli* L. Beauv.) under different allelopathic effect of rice variety. Two planting systems *viz.* (a) Monoculture of barnyardgrass (b) Rice-branyardgrassmixculture; two level of nitrogen *viz.* (a) Optimum nitrogen dose (70 kg/ha) (b) No nitrogenand five varieties of rice *viz.* V_1 = BR 3 (Biplob), V_2 = BR 21 (Niamat), V_3 = BR 24 (Rahmat), V_4 = BRRI dhan27 and V_5 = BRRI dhan47 were included as experimental treatment. The experiment was laid out in a randomized complete block design with three replications. In fields barnyardgrass was grown mixed with allelopathic rice and decreased its the allelopathic effect of rice on the growth and development of barnyardgrass (*Echinochloa crus-galli* L. Beauv.) number of tillers plant^{-1}, total dry weight (g) significantly except height due to the competitive nature of barnyardgrass. This reduction might be due to allelopathic effect of rice on barnyardgrass. Level of nitrogen had significant effect of plant height, number of tillers plant^{-1} and seedling emergence at all sampling dates, except height at 50 DAS. The value of each of these parameters was the highest at the optimum level of nitrogen (35 g plot^{-1}) and the lowest at the lowest level of nitrogen (0 kg ha^{-1}). At any level of nitrogen, plant height, numbers of tillers plant^{-1} of barnyardgrass at any growth stage were shorter in mix-culture than in monoculture. This means that at any level of nitrogen, rice plants exerted its allelopathic effect on barnyardgrass of any growth stage in field. In field conditions, except height number of tillers plant^{-1}, total dry weight plant^{-1} of barnyardgrass at all sampling dates and seedling emergence (at 2 and 7 DAS) of barnyardgrass decreased significantly when it was grown mixed with rice. This reduction might be due to allelopathic effect of rice on barnyardgrass. Level of nitrogen had significant effect on number of tillers plant^{-1}, seedling emergence of barnyardgrass at any sampling dates of barnyardgrass at 50 DAS. The highest value was observed at optimum level of nitrogen (80 kg N ha^{-1}) and the lowest at lowest level of nitrogen (0 kg N ha^{-1}). Interaction effect of system of planting and level of nitrogen was significant in respect of parameters related to growth and development of barnyardgrass, but plant height was not significant. Seeding emergence number of tillers plant^{-1} of barnyardgrass was significantly lower in mixculture than those in monoculture.

Key words: *barnyardgrass, allelopathy, rice*

INTRODUCTION

Rice (*Oryza sativa* L.) is one of the principle food crops in the world.In Bangladesh, rice is the staple food and it provides about 70% of an average per capita total calorie intake. Weeds are the most significant biological constraint to rice production (Kato-Noguchi and Ino, 2001). Individual barnyardgrass plant was reported to produce with an average of 100,000 seeds per plant (Norris 1992). The chemical compound which is responsible for the allelopathic activity are commonly known as allelochemicals and are present in many higher plants as well as in many plant organs (Duke *et al.* 2000). Under certain conditions these compounds are released into the environment, either as exudates form living plants or by decomposition of plant residues in sufficient quantities to affects neighbouring plants (Rice 1984; Dayan *et al.* 2000; Einhellig 2004). The subjectof allelopathy currently receives much attention from scientists worldwide. It may provide alternatives to synthetic herbicides for weed management.

Weeds in rice can be controlled mechanically, chemically or biologically. Mechanically weed control is very expensive, especially due to shortage of field labour. Therefore, mechanical control of weeds in rice becomes out of reach to our resource poor farmers. Chemical control on the other hand leads to environmental pollution. The toxic effects from chemical applied to the crop field may deteriorate our soil, water and air environment which makes chemical control of rice weeds non-feasible to our country. Biological control usingcompetitive and allelopathic cultivars is therefore, the best option for Bangladesh, which is easy and affordable to our resource poor farmers.

Most allelochemicals are released during germination and early growth. In particular, the allelopathic effect of rice on paddy weeds had a higher growth inhibition on the root than the shoot.Scientists in the world recently developed some rice varieties which has allelopathic effect on *E. crusgalli.* In Egypt, Hassan *et al.* (1995) identified approximately 1000 rice varieties during 1993-96, that expressed allelopathic effects after plants reached the 3-leaf stage, and such varieties inhibited root development and emergence of the first or second leaf of *E. crusgalli.*

Growing allelopathic rice may lead to reduction of weeding cost to a great extent. Moreover, due to reduction in herbicidal dose in controlling weeds in crop fields, it helps to reduce environmental pollution.To avoid the harmful effects of synthetic herbicides the researchers of Bangladesh now trying to find out some alternative weed management strategies. The objectives of this study were to determine the growth and development of barnyardgrass (*Echinochloa crus-galli* L. Beauv.) under different allelopathic effect of rice variety.

MATERIALS AND METHODS

An experiment was conducted at the Agronomy Field Laboratory, Bangladesh Agricultural University, Mymensingh during the period from 29 March, 2012 to 17 May, 2012 to determine the growth and development of barnyardgrass (*Echinochloa crus-galli* L. Beauv.) under different allelopathic effect of rice variety. The experiment included three factors (A) two planting systems *viz.* (a) Monoculture of barnyardgrass (b) Rice-branyardgrassmixculture ; (B) two level of nitrogen *viz*. (a) Optimum nitrogen dose (70 kg/ha) (b) No nitrogenand (C) five varieties of rice *viz.* V_1 = BR 3 (Biplob), V_2 = BR 21 (Niamat), V_3 = BR 24 (Rahmat), V_4 = BRRI dhan27 and V_5 = BRRI dhan47. The experiment was laid out in a randomized complete block design with three replications.The unit plot size was 2.5 m × 2 m with 1.5 m space between the blocks and 50 cm space between the unit plots. The treatments were (Line sowing) assigned to the unit plots.

The following 5 rice varieties were used in the study with their description –

Sl. No.	Variety	Type of variety	Growing season	Origin	Culm height (cm)	Maturity (days)	Yield (t ha^{-1})
1	BR 3	Modern	*Aus*	Bangladesh	95	170	6.50
2	BR 21	Modern	*Aus*	Bangladesh	100	110	3.00
3	BR 24	Modern	*Aus*	Bangladesh	105	105	3.50
4	BRRI dhan27	Modern	*Aus*	Bangladesh	140	115	4.00
5	BRRI dhan47	Modern	*Aus*	Bangladesh	105	150	6.10

Source: BRRI, Gazipur

The 5 selected rice varieties were collected from Bangladesh Rice Research Institute (BRRI), Joydebpur, Gazipur and the Barnyardgrass weed were collected from the market. Both of the seeds were treated with Vitavax-200, at the rate of 4 g kg^{-1} of seed. The germination of the collected seeds was more than 80%. The experimental land was first opened with a power tiller. The land was then puddle thoroughly by ploughing and cross ploughing with a country plough and subsequently levellled by laddering. The weeds and stubble were removed from the field. Fertilizers TSP, MoP, gypsum and zinc sulphatewere applied as basal dose to the plots @ 90, 70, 60 and 10 kg ha^{-1}, respectively, at the time of final land preparation. Urea was applied according to the treatment. The first top-dressing was done 20 DAS and the second top-dressing was done 48 DAS. Seeds of selected rice varieties were sown on 29 March, 2011 @ 20g/plot then indicator weed seed (barnyardgrass) were sown @ 2 kg/ha at the time of rice seed sowing. Weed seedlings other than *E. crusgalli* were removed from each experimental plot time to time to avoid extra competition. No irrigation was done since natural precipitation provided with sufficient soil moisture for crop growth. Data on the growth and development of barnyardgrass i.e.weed seed emergence (at 2, 7 DAS), plant height, number of tillersplant^{-1} and total dry matters were recorded. Percent reduction in weed dry matter due to allelopathic rice varieties in comparison to control was determined as per following formula:

$$\% \text{ reduction} = \frac{C-T}{C} \times 100$$

Where, C = Control treatment (without rice) and T = Treated treatment

Collected data were analyzed statistically using MSTAT-C programme and the means were compared by Duncan's Multiple Range Test (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Effect of system of planting

In barnyard grass, it has been seen that system of planting produce significant effect on number of tillers plant^{-1} and total dry weight except height because due to the competitive nature of barnyard grass they increased their height instead of reduced in mixture (Table 1). Number of tillers plant^{-1} and total dry weight plant^{-1} were significantly lower in rice-barnyard grass mixture than in monoculture barnyard grass it might be due to allelopathic effect of rice on barnyard grass.Seeding emergence of barnyardgrass was influenced by system of planting at two DAS and seven DAS. It was significantly lower (50.0% at two DAS and (60.0%) seven DAS) in mixture that in monoculture (Table 2). This means that rice plants had significant allelopathic effect on seedling emergence of barnyardgrass.

Table 1. Plant height, number of tillers plant^{-1} and total dry mater of barnyard grass as affected by the allelopathic effects of five rice varieties

Variety	Plant height (cm)			No. of tillers plant^{-1}			Dry weight (g) plant^{-1}			
	Mono culture	Mix culture	% Reduction	Mono culture	Mix culture	% Reduction	Mono culture	Mix culture	% Reduction	Average Percent Inhibition (API)
BR 3	42.8b	44.88b	(-)4.63458	4.4b	3.68b	16.36364	6.55b	2.344	64.21374	25.31427
BR 21	47.8a	48.324a	(-)1.08435	5.8a	4.0ab	31.03448	10.82a	2.322	78.53974	36.16329
BR 24	38.2e	43.44bc	(-)12.0626	3.8c	4.04ab	5.940594	3.67e	2.34	36.23978	10.03925
BRRI dhan27	40.2d	43.84bc	(-)8.30292	3.6c	4.40a	18.18182	4.62d	2.51	45.671	18.51663
BRRI dhan47	41.6c	42.04c	1.046622	4.6b	4.32a	6.086957	4.93c	2.332	52.69777	19.94378
S(x)	0.08	0.05	0	0.18	0.08		0.43	0.05		
Level of sig.	**	**		**	**		**	NS		
CV (%)	1.34	2.46		3.19	4.77		1.72	4.62		

In a column figures with same letter or without letter do not differ significantly whereas figures with dissimilar letter differ significantly as per DMRT
** = Significant at 1% level of probability
NS = Not significant

Table 2. Allelopathic effects of five varieties of rice on the seedling emergence of barnyard grass

Variety	Seedling emergence			Seedling emergence			Average
	At 2 DAS			At 7 DAS			
	Mix culture	Mono culture	% Reduction	Mix culture	Mono culture	% Reduction	
BR 3	3	4b	25	4a	5b	20	22.5
BR 21	2	4b	50	2b	5b	60	55
BR 24	3	5a	40	4a	6a	33.33	36.67
BRRI dhan27	3	3c	0	4a	4c	0	0
BRRI dhan47	4	4b	0	4a	5b	20	10
S(x)	0.28	0.17		0.24	0.13		
Level of sig.	NS	**		**	**		
CV (%)	19.8	5.48		6.92	1.9		

In a column figures with same letter or without letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT)
** = Significant at 1% level of probability
NS = Not significant
DAS = Days after sowing

Effect of nitrogen dose

Level of nitrogen had significant effect on plant height, number of tiller plant^{-1} and seedling emergence of barnyard grass at any sampling date. The value of plant height, number of tiller plant^{-1}, seedling emergence of barnyardgrass were highest at optimum doses of nitrogen (70 kg/ha) and lowest at no application of nitrogen treatment (Table 3). At optimum level there was an increase in plant height from 36 cm to 41.9 cm. In general, plant height increased with the optimum dose of nitrogen at any growth stage of barnyardgrass. The number of tillers plant^{-1} increased with the increase in dose of nitrogen, the highest number of tillers plant^{-1} being produced at optimum dose and the lowest at no nitrogen. There is an increase in seedling emergence at optimum nitrogen dose than no nitrogen dose. As for example there was no seeding appear in no nitrogen dose in BR 21 variety whereas 3 seedlings emerged at optimum nitrogen dose.

Table 3. Interaction effect of system of planting and nitrogen doses on plant height, number of tillers plant^{-1} and seedling emergence of barnyard grass

Variety	Nitrogen dose	Plant height (cm)	Number of tillers plant^{-1}	Seedlings emergence	
				At 2 DAS	At 7 DAS
BR 3 (mono culture)	No nitrogen dose	36.00m	3.10f	1e	1e
	Optimum nitrogen dose	41.90de	4.40bc	4b	5b
BR 3 (mix culture)	No nitrogen dose	32.00i	2.10g	1e	0f
	Optimum nitrogen dose	43.99c	3.60de	3c	4c
BR 21 (mono culture)	No nitrogen dose	28.00j	3.80d	2d	1e
	Optimum nitrogen dose	46.89b	5.80a	5a	6a
BR 21 (mix culture)	No nitrogen dose	26.00k	2.10g	0f	0f
	Optimum nitrogen dose	48.32a	4.00cd	3c	2d
BR 24 (mono culture)	No nitrogen dose	21.00lm	2.00g	1e	0f
	Optimum nitrogen dose	28.20g	3.80d	4b	6a
BR 24 (mix culture)	No nitrogen dose	22.00l	3.00f	0f	0f
	Optimum nitrogen dose	43.30cd	4.04cd	2d	4c
BRRI dhan27 (mono culture)	No nitrogen dose	3.10n	2.00g	0f	0f
	Optimum nitrogen dose	40.10f	3.60de	3c	4b
BRRI dhan27 (mix culture)	No nitrogen dose	21.00lm	3.10f	1e	0f
	Optimum nitrogen dose	43.84c	4.40bc	3c	5b
BRRI dhan47 (mono culture)	No nitrogen dose	20.00m	3.20ef	0f	0f
	Optimum nitrogen dose	41.60e	4.60b	4b	5c
BRRI dhan47 (mix culture)	No nitrogen dose	31.00i	3.30ef	1e	0f
	Optimum nitrogen dose	42.00de	4.32bc	4b	4c
S(x)		2.634986	0.221541	0.362012	0.529523
Cv(%)		7.862813	6.30633	17.23866	22.5329
Level of Significe		**	**	**	**

In a column figures with same letter or without letter do not differ significantly whereas figures with dissimilar letter differ significantly (as per DMRT)
** = Significant at 1% level of probability,
NS = Not significant,
DAS = Days After Sowing

Effect of interaction of system of planting and level of nitrogen

Interaction effects of system of planting and level of nitrogen on plant height, number of tillers plant^{-1} and seedling emergence were significant at all sampling dates except total dry weight. Plant height increased its height instead of reduce its height in mixture at any level of nitrogen but the rate of increased height was the highest in optimum nitrogen dose; it means that at this growth stage nitrogen had promoting effect of allelopathy of rice on barnyadrgrass. The number of tillers plant^{-1} was less in rice-barnyardgrass mixculture than that in monoculture of barnyardgrass at any level of nitrogen. The seedling emergency was reduced in mixture at optimum level of nitrogen and but the rate of reduction was the highest in no nitrogen.

CONCLUSION

From the results of the present study it may be concluded that for controlling barnyard grass allelopathic rice should be selected for the successful rice production especially in low input agricultural systems where herbicide is not a good option. BR 21 rice variety exerted highest allelopathic effects on barnyard grass and reduced its growth and development. Which (BR 21 rice variety) might be used in future plant breeding program for high yielding for the development of more allelopathic and high yielding capacity which might be helpful to reduce the cost weeding and use of herbicide.

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