COMPETITIVE BEHAVIOR OF WEED FLORA IN WETLAND RICE ECOSYSTEM AS INFLUENCED BY NUTRIENT MANAGEMENT AND SPACING

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Abstract: A field experiment was conducted at College of Agriculture, Vellayani, Thiruvananthapuram, Kerala to study the extent of crop-weed competition for nutrients and space as influenced by nutrient management and plant population in a wetland rice ecosystem. The treatments included four levels of nutrient management and three levels of crop spacing. The results indicated that by altering nutrient management and adjusting the plant population, the competitive ability of rice crop could be improved and weed management made more efficient and economic. During both the seasons, at 20 and 40 DAT, the weed density and dry weight were the lowest when NPK @ 90:45: 45 kg ha^{-1} was applied with 25 per cent N as organic while at 60 DAT the enhanced nutrient level of NPK @112.5:56:25:56.25 kg ha^{-1} applied with 25 per cent N as organic recorded the lowest weed density values. The general trend was that, though weed growth increased with increasing nutrient levels, partial organic substitution had a positive effect in suppressing weed growth. At all growth stages the weed growth parameters were minimum in closer spacing of 15 X 15 cm. An overall analysis of the weed growth and crop performance indicated that the enhanced nitrogen especially when it is applied in an integrated manner with organic substitution benefited the rice crop more than the weeds through altering the micro environment in favour of rice.

Keywords: Crop, Nutrients, Spacing, Rice

INTRODUCTION

Weeds compete with crops for one or more plant growth factors such as water, mineral nutrients, solar energy and space and the factors excluding water are found to be limiting in wetland situations. Crop plants vary greatly in their ability to compete with the associated weeds and the total effect of interference as reflected in the crop growth and yield, results mainly from competition for nutrients, moisture and sunlight (Rao, 2000). Changes in cultivation methods results in wide variation in species composition and diversity (Tomita *et al.*, 2003). Making rice more competitive by adjusting the plant population and altering nutrient management techniques is an effective eco-friendly technique for weed management (Pamplona *et al.*, 1990). A study of these factors, which aid in manipulating crop environment to the disadvantage of weeds so that they can be outgrown by crop plants should be highly appreciated (Gupta, 2009). The present study was undertaken to study the extent of crop-weed competition for nutrients and space as influenced by nutrient management and plant population

MATERIAL AND METHOD

The field experiments were conducted during the first and second crop seasons of 2010 in the wetlands of the Instructional farm attached to College of Agriculture, Vellayani located at 8.5^{o}N latitude and 76.9^{o}E longitude and at an altitude of 29 m above mean sea level (MSL). The rice variety used for the experiment was PTB 52 (Aiswarya) released from Rice Research Station, Pattambi. The experimental area was puddled twice and leveled. Weeds and stubbles were removed by hand picking. Five blocks with 12 treatment combinations each were laid out in strip plot design. The plots were separated with channels of 60 cm width and each block were separated with channels of 1 m width. The treatments included N_1 – NPK @ 90:45:45 kg ha^{-1} with 100 % N as chemical fertilizer (POP), N_2 – NPK @ 90:45:45 kg ha^{-1} with 75 % N as chemical fertilizer and 25 % N as organic, N_3 – NPK @ 112.5:56.25:56.25 kg ha^{-1} with 100 % N as chemical fertilizer, N_4 – NPK @ 112.5:56.25:56.25 kg ha^{-1} with 75 % N as chemical fertilizer and 25 % N as organic under three spacings (p_1- 15 X 15, p_2- 20 X 15, p_3- 20 X 20cm). All the treatments uniformly received FYM @ 5 t ha^{-1} as per package of practices recommendations for rice, Kerala Agricultural University.

RESULT AND DISCUSSION

Weed spectrum in the rice ecosystem

In the present investigation, the weed spectra observed in the experimental field was quite diverse with three specii of grasses, four specii of sedges, five specii of broad leaved weeds and two ferns. Among them the grass *Isachne miliacea* Roth ex Roem et Schult., the sedge *Cyperus iria* L., the broad leaved weed Lindernia grandiflora and the ferns *Marsilea quadrifoliata* Linn., and *Salvinia molesta* D.S. Mitch. were present throughout the crop growth period in both the years emphasizing its ubiquitous nature in the ecosystem under study.

Effect of nutrient management on weed density and weed dry weight

The weed density was found to be influenced significantly by the sources and levels of nutrients. The general trend was that during both seasons at 20 and 40 DAT, the density was the lowest when NPK

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@ 90:45: 45 kg ha^{-1} was applied with 25 per cent N as organic (n_2) (Table 1 & 2.) while at 60 DAT the enhanced nutrient level of NPK @112.5:56:25:56.25 kg ha^{-1} applied with 25 per cent N as organic (n_4) recorded the lowest value (Table 3.). The effect of nutrient management on weed dry weight was also statistically significant and followed the same trend as in weed density. The pooled data also confirmed this trend in weed infestation (Table 4)

Experiments conducted by Gallandt *et al.* (1999) revealed that soil fertility management could be used to manipulate weed dynamics, so that weed control could be improved, to favor the crop. The results of the present study showed that though the weed density in the wetland rice crop increased with increased levels of nutrients, the plots which received enhanced nutrient level with organic substitution was superior in suppressing the weed growth.

Effect of crop spacing on weed density and weed dry weight

The results revealed that crop spacing also had pronounced influence on weed growth in the rice field. During both years, the weed density was the lowest at all growth stages under the closer spacing of 15 X 15 cm (p_1) and the difference was statistically significant in most of the observations. The weed dry weight also followed a similar trend. Several scientists have also opined that when rice was grown at closer spacing the crop became more competitive and weed population was reduced (Ghosh and Singh, 1996, Gogoi, 1998., Bisht *et al.,*1999). Higher plant density of 44 plants m^{-2} resulted in significant reduction of dry matter accumulation by weeds over plant densities of 33 plants m^{-2} (Brar and Walia, 2001). However there are also contradictory reports that increased weed densities were observed when spacing was increased from 10 X 10 cm to 40 X 40 cm (Sankar, 1979) emphasizing the theory that the extent of weed – crop interference, which varies widely in both space and time depends on numerous factors such as crop and weed species, duration and intensity of weed growth, time of occurrence of weeds, nutrient and water status of soils and cropping practices.

Even though the dry weight of weeds was reduced by closer spacing, the variation between treatments tended to be less pronounced than in the case of weed density. A probable explanation is that under closer spacing, the sprouted weed seedlings could not harness enough resources for vigorous growth and dry matter accumulation. Jacob (2002) has also reported similar observations from his study on impact of plant population on the performance of Basmati rice.

Effect of interaction between nutrient management and crop spacing on weed density and weed dry weight

Though not always consistent, from the pooled analysis data it was evident that the combined effect of nutrient management and crop spacing on both weed density and weed dry weight was significant in the present experiment. The general trend was that the plots which received lower nutrient levels with organic substitution and when planted closely (n_2p_1) was superior in terms of weed suppression. This of course was a reflection of the individual effect of these factors on the weed growth parameters.

CONCLUSION

Thus the results of the present study showed that though the weed density in the wetland rice crop increased with increased levels of nutrients, the plots which received enhanced nutrient level with organic substitution was superior in suppressing the weed growth emphasizing that proper nutrient management was an indirect tool for better weed management. An overall analysis of the weed growth and crop performance indicated that the enhanced nitrogen especially when it is applied in an integrated manner with organic substitution was found to have benefited the crop more than the weeds. After critically analyzing the overall effect of nutrient management and crop spacing on weed growth and crop productivity, it can be concluded that by altering nutrient management and adjusting the plant population, the competitive ability of rice crop could be improved and weed management made more efficient and economic.

Table 1. Weed density (no. m^{-2}) in wetland rice ecosystem at 20 DAT as influenced by nutrient management and plant density

Treatments	First crop season			Second crop season		
	Grasses	Sedges	BLW	Grasses	Sedges	BLW
n_1	12.9	38.0	19.1	20.5	18.3	11.8
n_2	11.5	24.3	17.8	22.3	11.7	11.7
n_3	14.3	24.6	14.7	24.8	13.3	10.8
n_4	17.5	39.7	15.9	24.7	14.5	11.9
SEM(3,12)	0.0746	0.0993	0.0594	0.0954	0.0808	0.0396
C.D (0.05)	0.230	0.306	0.183	0.294	0.249	0.122
p_1	14.6	25.6	14.8	24.8	13.9	11.1
p_2	14.3	32.5	17.2	25.7	15.9	11.8

p_3	13.4	36.9	18.7	18.8	13.5	11.9
SEM (2,8)	0.0540	0.0914	0.0770	0.0785	0.0288	0.0310
C.D (0.05)	0.176	0.298	0.251	0.256	0.094	0.101
$n_1 p_1$	13.2	28.4	17.4	23.4	16.8	11.0
$n_1 p_2$	14.4	49.8	19.4	22.6	23.2	12.0
$n_1 p_3$	11.2	35.8	20.4	15.4	14.8	12.4
$n_2 p_1$	12.4	15.2	14.6	24.8	10.8	10.8
$n_2 p_2$	11.4	27.0	21.6	25.8	12.6	12.2
$n_2 p_3$	10.8	30.8	17.2	16.4	11.8	12.0
$n_3 p_1$	16.4	23.6	13.4	27.2	17.2	11.4
$n_3 p_2$	13.0	19.8	14.6	26.2	10.8	10.4
$n_3 p_3$	13.4	30.4	16.2	21.0	12.0	10.6
$n_4 p_1$	16.2	35.2	13.8	23.6	10.8	11.0
$n_4 p_2$	18.2	33.2	13.2	28.0	17.2	12.4
$n_4 p_3$	18.2	50.8	20.8	22.4	15.4	12.4
SEM (6.24)	0.1172	0.1617	0.1096	0.1504	0.1220	0.0846
C.D (0.05)	0.342	0.472	0.320	0.439	0.356	0.247

Table 2. Weed density (no. m^{-2}) in wetland rice ecosystem at 40 DAT as influenced by nutrient management and plant density

Treatments	First crop season			Second crop season		
	Grasses	Sedges	BLW	Grasses	Sedges	BLW
n_1	14.9	49.5	37.5	25.0	11.8	20.6
n_2	9.3	46.5	37.3	15.5	10.7	28.0
n_3	16.3	48.5	35.0	22.3	10.1	30.6
n_4	34.3	46.4	31.7	22.6	11.1	29.3
SEM(3,12)	6.6751	0.1502	0.0840	0.1289	0.1139	0.0643
C.D (0.05)	20.57	0.463	0.259	0.389	0.351	0.198
p_1	16.2	37.4	31.1	20.0	11.2	25.4
p_2	26.9	50.1	39.4	25.7	9.9	31.1
p_3	13.0	55.8	35.8	18.4	11.7	24.9
SEM (2,8)	5.7617	0.1300	0.126	0.1392	0.0282	0.0555
C.D (0.05)	NS	0.424	0.416	0.454	0.092	0.181
$n_1 p_1$	14.6	31.8	26.0	18.8	12.0	17.4
$n_1 p_2$	21.6	59.8	46.8	36.6	10.6	26.6
$n_1 p_3$	8.6	56.8	39.6	19.6	12.8	17.8
$n_2 p_1$	7.4	41.4	34.8	13.0	12.8	30.2
$n_2 p_2$	8.4	50.8	47.0	18.0	8.4	28.8
$n_2 p_3$	12.2	47.4	30.2	15.6	10.8	25.0
$n_3 p_1$	18.0	34.1	31.2	22.2	10.2	19.6
$n_3 p_2$	15.0	48.0	33.8	23.0	10.0	36.8
$n_3 p_3$	15.8	63.4	40.0	21.6	10.2	35.4
$n_4 p_1$	25.0	42.1	32.2	26.0	9.6	34.4
$n_4 p_2$	62.6	41.6	29.8	25.0	10.8	32.0
$n_4 p_3$	15.4	55.4	33.2	16.8	13.0	21.6
SEM (6.24)	11.2748	0.2138	0.2062	0.2097	0.1871	0.1929
C.D (0.05)	32.911	0.624	0.602	0.612	0.546	0.563

Table 3. Weed density (no. m^{-2}) in wetland rice ecosystem at 60 DAT as influenced by nutrient management and plant density

Treatments	First crop			Second crop		
	Grasses	Sedges	BLW	Grasses	Sedges	BLW
n_1	23.7	21.5	47.6	31.5	12.1	53.6
n_2	16.4	33.1	37.1	28.8	11.6	34.7
n_3	23.9	28.3	40.5	32.0	10.3	52.3
n_4	24.7	24.7	25.3	23.6	10.2	26.9

SEM(3,12)	0.0915	0.282	0.1165	0.0701	0.0750	0.0866
C.D (0.05)	0.282	0.879	0.359	0.216	0.231	0.267
p_1	21.8	22.7	28.2	27.2	10.8	33.3
p_2	24.3	31.2	46.1	29.5	10.6	47.0
p_3	20.5	26.8	38.6	30.3	11.8	45.3
SEM (2,8)	0.0806	0.3155	0.1223	0.0951	0.1487	0.1699
C.D (0.05)	0.263	1.029	0.399	0.310	0.485	0.554
$n_1 p_1$	27.4	18.6	39.0	25.6	12.2	45.6
$n_1 p_2$	29.0	24.0	54.8	32.0	11.0	70.0
$n_1 p_3$	14.6	22.0	49.0	36.8	13.0	45.2
$n_2 p_1$	17.6	24.8	23.6	26.8	10.4	27.6
$n_2 p_2$	15.6	38.2	47.0	28.6	11.0	40.0
$n_2 p_3$	16.0	36.4	40.6	31.0	13.4	36.4
$n_3 p_1$	21.6	28.2	27.2	31.4	10.3	36.8
$n_3 p_2$	25.6	32.2	56.6	29.6	10.0	50.8
$n_3 p_3$	24.4	24.4	37.6	35.0	10.6	69.2
$n_4 p_1$	20.6	19.1	22.8	24.8	10.2	23.2
$n_4 p_2$	26.8	30.4	26.0	27.6	10.4	27.2
$n_4 p_3$	26.8	24.5	27.0	18.4	10.0	30.4
SEM (6.24)	0.1706	0.5293	0.2336	0.2025	0.1781	0.2241
C.D (0.05)	0.498	1.545	0.682	0.591	0.520	0.654

Table 4. Total dry weight (g m^{-2}) of weeds in wetland rice ecosystem as influenced by nutrient management and plant density

Treatments	20 DAT			40 DAT			60 DAT		
	First crop	Second crop	Pooled	First crop	Second crop	Pooled	First crop	Second crop	Pooled
n_1	80.83	76.43	78.63	108.00	87.13	97.57	115.20	126.30	120.75
n_2	64.80	72.97	68.88	94.37	68.17	81.27	96.87	108.03	102.45
n_3	67.90	78.03	72.97	112.07	86.43	99.25	115.87	121.67	118.77
n_4	89.97	80.27	85.12	119.03	84.77	101.90	100.37	87.43	93.90
SEM(3,12)	0.001	0.0047	0.002	0.0471	0.001	0.024	0.001	0.001	0.001
C.D (0.05)	0.001	0.0103	0.005	0.1027	0.001	0.051	0.001	0.001	0.001
p_1	70.65	79.76	75.20	98.65	79.03	88.84	94.90	101.12	98.01
p_2	76.45	84.23	80.34	115.08	93.45	104.26	119.92	114.87	117.40
p_3	80.53	66.80	73.66	111.38	72.40	91.89	106.40	116.57	111.49
SEM(2,8)	0.001	0.0041	0.002	0.0408	0.001	0.020	0.001	0.001	0.001
C.D (0.05)	0.001	0.0094	0.005	0.0941	0.001	0.047	0.001	0.001	0.001
$n_1 p_1$	71.30	81.30	76.30	85.60	70.90	78.25	113.50	106.90	110.20
$n_1 p_2$	95.90	84.90	90.40	132.10	116.70	124.40	138.70	137.90	138.30
$n_1 p_3$	75.30	63.10	60.00	106.30	73.80	95.00	93.40	134.10	113.75
$n_2 p_1$	56.70	78.80	67.75	82.80	66.00	74.40	84.30	96.90	90.60
$n_2 p_2$	68.30	78.60	73.45	103.00	71.20	87.10	103.30	111.20	107.25
$n_2 p_3$	69.40	61.50	65.45	97.30	67.30	82.30	103.00	116.00	109.50
$n_3 p_1$	72.00	81.30	76.65	100.20	81.00	90.60	100.60	114.10	107.35
$n_3 p_2$	59.20	79.10	69.15	107.60	92.10	99.85	127.20	111.20	119.20
$n_3 p_3$	72.50	73.70	73.10	128.40	86.20	107.30	119.80	139.70	129.75
$n_4 p_1$	82.60	77.62	80.11	126.00	98.20	112.10	81.20	86.60	83.90
$n_4 p_2$	82.40	94.30	88.35	117.60	93.80	105.70	100.50	99.20	104.85
$n_4 p_3$	104.90	68.90	86.90	113.50	62.30	87.90	109.40	76.50	92.95
SEM(6,24)	0.001	0.0082	0.0040	0.0816	0.001	0.041	0.001	0.001	0.001
C.D (0.05)	0.001	0.0165	0.0080	0.1649	0.001	0.082	0.001	0.001	0.001

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