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너도방동산이에 對한 水稻品種의 競合力

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Competitive Ability of Rice Varieties against *Cyperus serotinus*

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ABSTRACT

Competitive ability was determined for two different varieties, Josaengtongil (early maturing indica-japonica type) and Jinheung (medium maturing japonica type), against *Cyperus serotinus*(nut sedge). An increase of rice density increased competitive ability of rice to *C. serotinus*.

The results indicate that the use of tall and med ium maturing variety like Jinheung provides better competitive ability against *C. serotinus* than Josaengtongil, a semi-dwarf and early maturing type.

INTRODUCTION

Repeated application of the same herbicide to control the common annual weeds resulted in the predominance of perennial sedges which are more competitive and difficult to control(Ahn et al. 1975). The perennial weeds which are currently infesting a large area of Korea are *Cyperus serotinus*, *Eleocharis kuroguwai* and *Potamogeton distinctus* etc. *Cyperus serotinus* is a fast growing sedge and its rapid growth during the early stage makes this weed very competitive against rice, particularly more severe against semi-dwarf rice(Kim et al. 1977). Theoretically, weeds could be more damaging in shorter crop due to increased light competition. Many researchers (Smith 1968, Chang 1969, De Datta et al. 1969, Revees 1977) have pointed out that early maturing varieties, low planting density of rice, the use of semi-dwarf cultivars and early emergence of weeds generally increase yield loss.

Grain yield of rice can be influenced by four yield components; the number of panicles per unit area, the number of spikelets per panicle, filled grain ratio and 1,000-grain weight. Chisaka(1975) reported that the number of panicles is the yield component most severely reduced by both barnyardgrass and monochoria. Visperas et al.(1976) pointed out that perennial sedge, *Scirpus maritimus* grew faster and taller than rice, and thus rice suffered from shading. Further they added that shading would have been more severe if a 1 : 1 ratio of rice to the weed had existed. Kim et al. (1977) suggested that the use of a taller rice variety will provide better competition against *Cyperus serotinus*. Thus, understanding of varietal interaction with *C. serotinus* may be worth while in simulating effective control methods for perennial sedge.

This study was conducted to determine competiti ve ability of rice varieties against *C. serotinus*.

MATERIALS AND METHODS

This experiment was conducted on loam soil of the paddy fields at the Crop Experiment Station, during the summer crop season of 1976. Two rice varieties Josaengtongil (early maturing indica-japonica type) and Jinheung(medium maturing japonica type), were transplanted in the spacings of 15 by

15cm, 30 by 15cm, and 30 by 30cm, giving 44.2, 22.2 and 11.1 plants of rice densities per square meter, on the 3rd day of June, 1976, with 49days-old seedlings at 3 to 4 seedlings per hill. Immediately after transplanting of rice, approximately one leaf stage of *C. serotinus.* was planted at the intersection of two diagonal lines connecting four adjacient hills of rice plants in 1:0, 1/2:1, 1:1 and 2:1 ratios of rice plants to *C. serotinus*, indicating the fixed 22.2 seedlings of *C. serotinus* per square meter. Jinheung and Josaeng tongil received 100-50-60kg/ha and 150-100-120kg/ha of N, P_2O_5, and K_2O fertilizers, respectively. The paddy fields tested contained 2.3% of OM, 8.1 meq/100g of CEC with a pH of 5.4. Treatments were replicated three times in a radomized complete block design. Length of culm and panicle were determined at maturing stage. Degree of lodging and LAI were determined just after heading. Weeds were sampled at the maturing stage and rice was harvested 45 days after heading, and measurements were statistically analyzed.

RESULTS AND DISCUSSION

Lodging and LAI. 2space lodging increased markedly with a decrease in rice density, from 2.0 in a 2:1 to 7.3 in a 1/2:1 ratio of Josaengtongil to *C. serotinus*, and from 3.3 in a 2:1 to 6.7 in a 1/2:1 ratios of Jinheung to *C. serotinus*, (more severely with Josaengtongil) (Table 1). Under a 2:1 ratio of rice to weed, early maturing short variety, Josaengtongil showed less lodging than Jinheung. However, under a 1/2:1 ratio of rice to the weed, Jinheung resulted in more resistance to *C. serotinus*. This difference indicates that under a high rice density, Josaengtongil which has rapid growth at the early stage is more competitive against this sedge, leaving less space for weeds, while under a low rice density, Jinheung which is tall and medium maturity has a little advantage in competition with *C. serotinus*. The higher LAI of 4.7 in Josaengtongil and 4.2 in Jinheung were obtained under a 2:1 ratio of rice to weed, as compared with 3.5 in Josaengtongil and 2.0 in Jinheung under a 1/2:1 ratio of rice to the weed (Table 1). These results suggest that it may be advisable to increase rice density to acquire an appropriate LAI in the presence of *C. serotinus*, in both varieties.

Weed dry weight. 2space in Josaengtongil, 22.2 seedlings of *C. serotinus* per square meter planted

Table 1. Effect of rice and weed spacings on Cyperus serotinus dry weight.

Variety	Plant spacing		Rice		Weed			
	Rice (cm)	Weed No./m²	Lodging (0-10)	LAI	C. serotinus No./m²	Dry wt. g/m²(A)	Total Dry wt. g/m² (B)	A/B ratio
Josaengtongil	30 by 15	0	0	5.0	3	8.1c	18.7c	43.3
	15 by 15	22.2	2.0	4.7	311	185.3b	215.0b	86.2
	30 by 15	22.2	3.0	4.4	441	232.4b	250.5b	92.8
	30 by 30	22.2	7.3	3.5	541	338.1c	427.7a	79.1
Jinheung	30 by 15	0	0	3.1	0	0c	38.1c	0
	15 by 15	22.2	3.3	4.2	27.5	176.7b	228.8b	77.2
	30 by 15	22.2	4.3	2.7	433	211.6b	267.4b	79.1
	30 by 30	22.2	6.7	2.0	576	423.6a	489.7a	86.5

[a]The ratio of rice to the weed ; Rice : Weed
15 by 15cm(2) : 22.2(1)
30 by 15cm(1) : 22.2(1)
30 by 15cm(1) : 0 (0)
30 by 30cm(1/2): 22.2(1)

[b]Lodging; 0:no lodging, 10: completely lodging

[c]In the column, means followed by the same letter are not significantly different at 5% level using Duncan'smultiple range test.

immediately after rice transplanting multiplied to 311 plants in a 2:1 and 541 plants in a 1/2:1 ratio of rice and the weed, while in Jinheung, 275 plants in a 2:1 and 576 plants in a 1/2:1 ratio of rice to the weed(Table 1). The number of *C. serotinus*, like the degree of lodging, increased significantly with a decrease of rice density, under which sedge was subjected to more light and available nutrients. An increase of weed number directly contributed to an increase of weed dry weight. *C. serotinus* dry weight increased significantly with a decrease of rice density, from 185.3g/m^2 to 338.1g/m^2 in Josaengtongil and from 176.7g/m^2 to 423.6g/m^2 to 423.6g/m^2 in Jinheung, in a 2:1 and a 1/2:1 ratio of rice to the weed respectively. There was statistical difference in weed dry weight between a 2:1 and a 1/2:1 ratios of rice to the weed, but no statistical difference between a 2:1 and a 1 : 1 ratio of rice to the weed, in both rice varieties. Under the lowest rice density, the highest dry weight of *C. serotinus* in Jinheung attributed to its longer growth duration although a tall variety had some advantege in competition with a tall weed.

Grain yield and yield components. In both varieties, length of culm and panicle showed no sighificant difference among treatments.Both varieties headed in time without statistical difference among treatments (Table 2). Grain yeld in both Josaengtongil and Jinheung decreased significantly with a decrease of rice density, from a 2 : 1 to a 1/2 : 1 ratio of rice to the weed(Table 2). Compared with a sedge

Table. 2. Effect of rice and weed spacings on the grain yield and yield components of rice.

Variety	Plant spacing[a]		Heading	Length[b]		Yield components[c] 1000				Yield(kg/10a)[d]	
	Rice (cm)	Weed no·/m^2		Cu.(cm)	Pa.(cm)	Panicle no·/m^2	spikelet no.	Ripening ratio(%)	Grain weight (mg)	Brown rice	Index (%)
Josaeng-tongil	30 by 15	0	Aug. 7	52.3	21.8	347 (100)	94 (100)	60.8 (100)	23.4 (100)	493a	100
	15 by 15	22.2	Aug. 7	53.0	20.5	414 (119)	68 (72)	37.8 (62)	22.5 (86)	319b	65
	30 by 15	22.2	Aug. 7	54.8	21.6	294 (85)	79 (84)	36.3 (60)	22.0 (94)	237c	48
	30 by 30	22.2	Aug. 7	57.4	21.1	161 (46)	82 (87)	42.4 (70)	21.5 (92)	129d	26
Jinheung	30 by 15	0	Aug.16	80.1	21.8	283 (100)	87 (100)	57.5 (100)	24.1 (100)	438a	100
	15 by 15	22.2	Aug.15	78.8	20.1	340 (120)	63 (72)	41.2 (72)	24.7 (103)	363b	83
	30 by 15	22.2	Aug.15	80.7	22.0	210 (74)	75 (86)	50.1 (87)	24.5 (102)	241c	55
	30 by 30	22.2	Aug.16	82.7	22.1	144 (51)	88 (101)	51.6 (90)	23.3 (97)	182c	42

[a]The ratio of rice to weed;

Rice		Weed
2(15 by 15cm)	:	1(22.2 plants/m^2)
1(30 by 15cm)	:	1(22.2 plants/m^2)
1(30 by 15cm)	:	0 (0)
1/2(30 by 30cm)	:	1(22.2 plant2/m^2)

[b]Cu:Culm, Pa:Panicle

[c]( ):100 Weed over weed free treatment

[d]In the column, means followeed by the same letter are not significantly different at 5% level using Duncan's multiple range test.

free plot, grain yield of Josaengtongil was reduced by 35% and 74% in a 2 : 1 and a 1/2 : 1 ratio of rice to the weed, respectively, while Jinheung was reduced 17% and 45% in a 2 : 1 and a 1/2:1 ratio of rice to the weed, respectively. This clearly indicates that a dense rice planting and the use of a tall variety like Jinheung much better minimize rice yield reduction in the presence of *C. serotinus*. As

shown in Table 2, under a dense rice planting, panicle number in both varieties is the yield component most severely reduced by *C. serotinus*. Chisaka (1975) reported the similar result that the number of panicles is the most susceptible yield component affected by barnyardgrass and monochoria, followed by spikelet number per panicle and the percentage of filled grain by barnyardgrass, indicating that competition with barnyardgrass continues seriously to the later stage of rice growth for both nutrients and light. Similarly, greater reduction of the filled grain ratio and spikelet number by *C. serotinus* suggests that *C. serotinus* continues to compete for nutrients and light with rice till the late stage. Regardless of rice density used, Josaeng-tongil, early maturing and short type, had a higher yield reduction than Jinheung, medium and tall type. Many researchers (Smith 1968, Chang 1969, De Datta et al. 1969, Chisaka 1975) reported the similar results that intermediate stature rice varieties had an advantage over semi-dwarf types, in competition with a tall sedge, A highly sighificant negative correlation was obtained between grain yield and *C. serotinus* dry weight ($r=-0.971$ for Josaengtongil, $r=-0.855$ for Jinheung), showing Josaengtongil more sensitive to *C. serotinus* (Figure 1).

Based on results and observation, it is obvious that the use of a tall variety like Jinheung provides better competition against *C.serotinus* and a dense rice planting exerts better competitive ablity of rice crop capable of establishing a canopy sufficient to exploit nutrients and light, allowing less space and opportunity for weeds. Thus, it is recommendable that the use of an intermediate stature rice variety with a medium maturity and the control of rice density will result in a greater benefit to minimize infestation of sedge like *C. serotinus* which has a rapid growth and a high stature. The results obtained play some important role in simulating the interg-rated control method by means of using an ecological control approach.

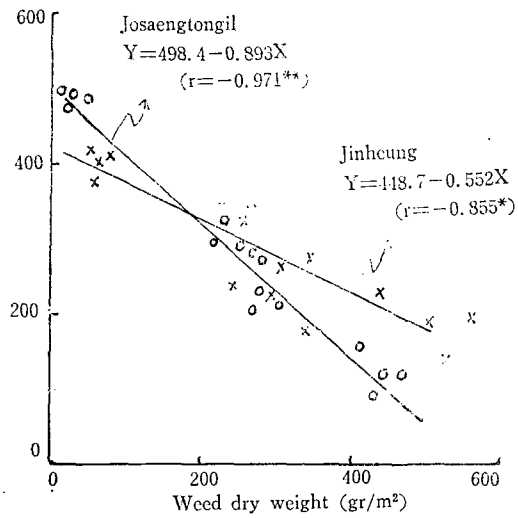

Fig. 1: Regression coefficiency equation between rice yield and weed dry weight.

SUMMARY

Competitive ability was determined for two different varieties, Josaengtongil(early maturing indica-japonica type) and Jinheung(medium maturing japonica type), against Cyperus serotinus(nut sedge). An increase of rice density increased competitive ability of rice to *C. serotinus*. LAI decreased with a decrease of rice density, from 4.7 in a 2:1 to 3.5 in a 1/2:1 ratio of Josaengtongil to *C. serotinus*, and from 4.2 in a 2:1 to 2.0 in a 1/2:1 ratio of Jinheung to *C. serotinus*. However,degree of lodging increased with a decrease of rice density, from 2.0 in a 2:1 to 7.3 in a 1/2:1 ratio of Josaengtongil to *C. serotinus*, and from 3.3 in a 2:1 to 6.7 ratio of Jinheung to the weed, (more severely with Josaengtongil), Dry weight of *C. serotinus* increased significantly with a decrease of rice density, from 185.3g/m² to 338.1 g/m² in Josaengtongil and from 176.7 g/m² to 423.6 g/m² in Jinheung, in a 2:1 and in a 1/2:1 ratios of rice to the weed, respectively. Under a sparse rice density, panicle number per unit area in both Josaengtongil and Jinheung was the yield component most severely reduced by *C. serotinus*. Rice yield was significantly reduced with a decrease in rice density. With the lowest rice density, 1/2:1 ratio of rice to the weed, yield reduction of Josaengtongil and Jinheung was 74% and 45% respectively, the greatest reduction with Josaengtongil. The results indicate that the use of tall and medium maturing variety like Jinheung

provides better competitive abillity against *C. serotinus* than Josaengtongil, a semi-dwarf and early maturing type.

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摘 要

1. 多年生雜草 너도방동산이에 對한 水稻品種 振興과 早生統一의 栽植거리를 달리하여 水稻品種의 競合力을 檢定하여 얻어진 結果를 要約하면 다음과 같다 葉面積指數는 水稻密度가 減少될수록 작아지는데 早生統一은 水稻와 너도방동산이의 密度比가 2 : 1에서는 4.7이고 $\frac{1}{2}$:1에서는 3.5로 작아졌으며, 振興은 2 : 1 에서 4.2이고 $\frac{1}{2}$:1에서 2.0으로 작아졌다.

2. 倒伏은 水稻密度가 減少될수록 增加되었으며 早生統一은 水稻와 너도방동산이의 密度比가 2 : 1에서 2.0이 $\frac{1}{2}$:1에서는 7.0으로 振興에서는 2 : 1에서 3.3이 $\frac{1}{2}$:1에서는 6.7로 各各 增加되었다.

3. 雜草의 乾物重은 水稻와 雜草와의 密度比가 작아질 수록 增加를 보였으며 早生統一은 2 : 1에서 185.3mg/m²이 $\frac{1}{2}$:1에서는 338.1mg/m²이 되었고, 振興은 2 : 1에서 176.7 mg/m²이 $\frac{1}{2}$:1에서 423.6 mg/m²으로 各各 增加되었다.

4. 水稻와 雜草의 密度比가 작아질수록 葉面積指數는 減少, 倒伏은 增加, 雜草의 數, 乾物重이 크게 增加되므로 水稻의 收量은 크게 減少되었는데 $\frac{1}{2}$:1의 密度比에서 早生統一은 74%, 振興은 58%의 收量減少를 보였다.

5. 水稻와 雜草의 密度比가 가장 낮은 $\frac{1}{2}$:1인 處理區에서 收量減少에 가장 크게 影響을 미친 것은 收量構成要素中 二品種 供히 單位面積當의 穗數였으며 早生統一이 더 크게 影響을 받았다.