

Effect of Rice Cultural Practices on Emergence of *Echinochloa crus-galli* and *Monochoria vaginalis**

Kim, J.S.¹ and J.C. Chun²

피와 물달개비의 발생에 미치는 벼栽培樣式的影響*

金鐘奭¹ · 全載哲²

ABSTRACT

Seed occurrence patterns of *Echinochloa crus-galli* (L) P. Beauv. and *Monochoria vaginalis* (Burm. f.) Presl. were investigated in irrigated and rainfed rice cultures. There was not much difference in seed population of *E. crus-galli* between irrigated and rainfed fields, but *M. vaginalis* occurred in about 1.6-fold greater number in rainfed fields. In seed distribution patterns under the two conditions, about 50% and 30% of *E. crus-galli* and *M. vaginalis*, respectively, were found in the uppermost 5cm layer. Under both conditions *M. vaginalis* was distributed to a depth of 25cm, but distribution of *E. crus-galli* was only 15cm deep. Early rice transplanting brought about greater emergence of the two weeds than optimal or late transplanting. Emergence of the weeds was significantly greater in single cropping system of rice than in double cropping systems of rice followed by barley and/or strawberry.

Key words : Seed population, Rice cultural practice, *Echinochloa crus-galli*, *Monochoria vaginalis*

INTRODUCTION

Rice cultural practice in Korea has been changed from hand-transplanting in 1970s to machine-transplanting by the late 1980s and in turn to direct-seeding since the early 1990s. Moreover, double-cropping system becomes more prevalent. This trend results from strong demand for establishing labor-saving rice cultural practice and uti-

lizing effectively the limited land. Consequently weed occurrence in rice field has varied with the cultural practice accepted. Intensive use of annual herbicides has given rise to heavy infestation of perennial weeds in machine-transplanting rice field¹⁾. The weed problem, however, gradually returns again to annual weeds in direct-seeded rice⁴⁾.

The present study, therefore, was undertaken to determine difference in seed population of *E.*

¹ Department of Life Resources Science, Woosuk University, Wanju 565-800, Korea

² Department of Agricultural Chemistry, Chonbuk National University, Chonju 561-756, Korea

* 本論文은 第15次 아시아-太平洋雜草學會(1995. 7. 24 - 7. 28. 日本 筑波)에서 發表하였음.

<1996. 4. 25 접수>

crus-galli and *M. vaginalis* between irrigated and rainfed paddy soils and to investigate emergence pattern of the weeds due to different transplanting dates and cropping systems.

MATERIALS AND METHODS

Seed Population

Seed reserve and vertical distribution of *E. crus-galli* and *M. vaginalis* were determined in two different paddy conditions. Soil types of irrigated and rainfed paddy fields were clay and sandy clay loam, respectively, while such other soil characteristics as pH and organic matter content were not quite different between the two soils. Water condition of the two fields has kept without change for more than 10 years. In each condition 5 locations were randomly selected to determine seed population, and ten soil cores, 15-cm diameter and 15-cm deep, were taken after harvest in 1993. The cores were bulked and the soil was thoroughly mixed. Sub samples of 100g were taken from each bulked sample. There were two sub samples for each field. To investigate the vertical distribution of seeds, ten soil cores, 8-cm diameter and 30-cm deep, were taken and sectioned every 5-cm. The same horizons from each sample were bulked to give five replicates of the six horizons.

The sub samples were air-dried and thoroughly pulverized. Weed seeds were separated by placing each sub sample in 60-mesh brass sieve and washing it under a running stream of tap water to remove all silt, clay and fine sands. The remaining material was washed into 1-L beaker filled with water. After settling the floating matter was decanted into a 6- by 8-cm fine mesh nylon bag. This step was repeated until no material floated. The samples were dried and seeds were counted with the aid of a binocular microscope.

Seeds were first incubated for 30 days in a laboratory germinator operated at 12-h day/12-h

night temperature regimes of 30/25°C and the number of germinated seed was recorded. Viability of the remaining seeds was then determined using 2,3,5-triphenyltetrazolium chloride(TTC) according to the method of Eagly and Chandler²¹. Total numbers of viable seed consisted of the sum of the germinated seeds with the non-germinated seed stained pink to red with TTC.

Emergence Pattern

Effects of transplanting dates and cropping systems on emergence pattern of *E. crus-galli* and *M. vaginalis* were investigated in the above irrigated rice field. Rice transplanting dates employed were May 12, May 26, and June 9 as early, optimal, and late transplanting timing, respectively. Cropping systems used were rice only, rice followed by barley, and rice followed by strawberry. The cultural practices were conducted in 1992 and 1993. Four fields were selected and a quadrangle area of 0.5- by 0.5-m was established in four locations from each field. During the rice growing period standing water was maintained at a depth of 5-cm. Emerging weeds at the marked quadrangle were counted at 2-week intervals. No herbicide was applied and frequent hand weeding outside the marked quadrangles was done during the experimental period.

RESULTS AND DISCUSSION

Seed Bank

Seed reserves of *E. crus-galli* and *M. vaginalis* varied with water management condition in rice field. There was not much difference in seed population of *E. crus-galli* between irrigated and rainfed fields, but *M. vaginalis* occurred in about 1.6-fold greater number rainfed field than in irrigated field(Fig. 1). In both conditions *M. vaginalis* was about 4- to 5-fold greater in number of seeds than *E. crus-galli*.

Vertical distribution of the two weeds in soil was similar between irrigated and rainfed fields, but the distribution pattern varied with the weed

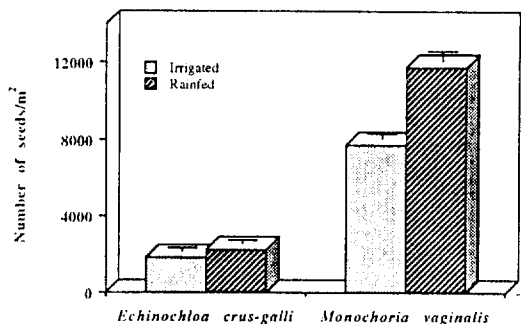
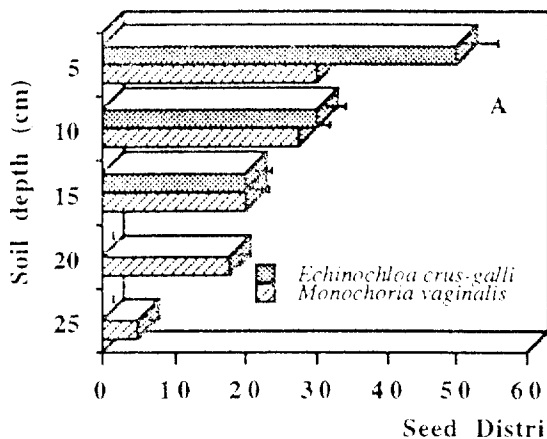


Fig. 1. Weed seed population as affected by water condition in rice field.



species involved (Fig. 2). About 50% and 30% seeds of *E. crus-galli* and *M. vaginalis*, respectively, were found in the uppermost 5-cm layer. On the other hand, seed occurrence of *E. crus-galli* was restricted at the depth of 15-cm, while *M. vaginalis* was found at 25-cm deep. Most of *E. crus-galli* seeds were present in plowing layer. This finding suggests that *E. crus-galli* emerges within a short period of cropping season, while occurrence of *M. vaginalis* may be erratic during a relatively longer period.

Effect of Transplantig Date

Transplanting date of rice affected emergence

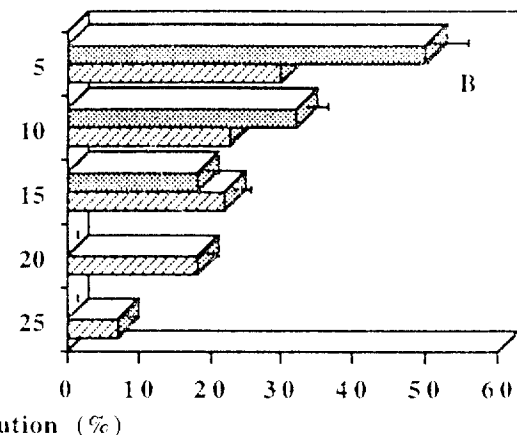


Fig. 2. Distribution of weed seeds at different soil depths in irrigated (A) and rainfed (B) fields.

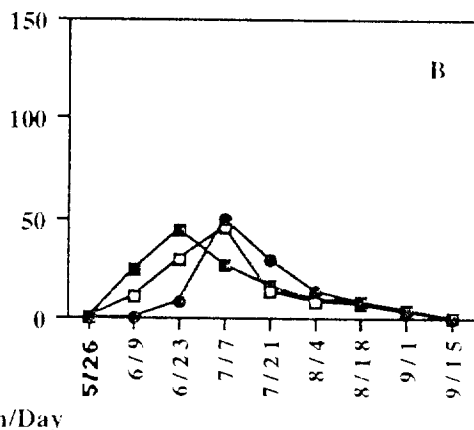
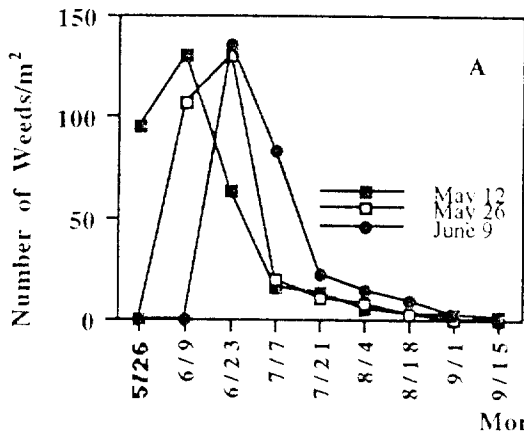


Fig. 3. Emergence pattern of *Echinochloa crus-galli* (A) and *Monochoria vaginalis* (B) as affected by rice transplanting date.

pattern of *E. crus-galli* and *M. vaginalis* (Fig. 3). *E. crus-galli* emerged for 4 weeks after transplanting (WAT) was about 69% of the total emergence when rice was transplanted at 2 weeks earlier than the optimal or conventional transplanting date. As the transplanting date was delayed, however, the number of occurrence for 4 WAT increased to about 86% and 83% at the optimal and late transplanting, respectively. In *M. vaginalis* more than 85% emergence of the total number was obtained for 10, 8, and 8 WAT at early, optimal, and late transplanting date, respectively. This indicated that occurrence period after transplanting with *M. vaginalis* was longer than with *E. crus-galli*.

As the transplanting date was delayed, total number of emergence throughout the cropping season decreased in both the weeds. *E. crus-galli* emerged at the optimal and late transplanting dates decreased by about 16% and 20%, respectively, as compared with early transplanting date. A similar trend was also found in *M. vaginalis*, but decrease in emergence due to the delayed transplanting was about 11% and 14%, respectively. Increase in emergence at early transplanting was attributed to increase in the overall cropping period.

Effect of Cropping System

In the experimental field dominant weed species were mostly annual weeds. In 1992 community dominance was 0.72 and the value did not greatly change in the following year (Table 1). For the two years the importance value ranged from 40 to 41% on *E. crus-galli* and from 33 to 36% on *M. vaginalis*. The minor weeds such as *Eleocharis acicularis* showed less than 8% of importance value. Dominant occurrence of annual weeds in recent is considered to result from intensive use of sulfonylurea herbicides which are effective to perennial sedges, but ineffective

to grasses.

Emergence of *E. crus-galli* and *M. vaginalis* varied with cropping system employed. Both the weeds emerged significantly greater number in rice monoculture than in double cropping systems (Fig. 4). However, emergence of *E. crus-galli* was about 2.4-fold greater than *M. vaginalis*, regardless of the cropping patterns employed. Decrease in emergence of the weeds in double cropping systems was due to increased land disturbance by crop rotation. A similar trend was reported by Guh et al.³⁾

Table 1. Community dominance and importance value of major weeds in paddy rice field studies.

Year	Community dominance	Major weed	Importance value(%)
1992	0.72	<i>Echinochloa crus-galli</i>	41
		<i>Monochoria vaginalis</i>	33
		<i>Eleocharis acicularis</i>	8
		<i>Aneilema japonica</i>	4
		<i>Ludwigia prostrata</i>	4
		<i>Cyperus difformis</i>	3
		<i>Leersia japonica</i>	2
1993	0.67	<i>Echinochloa crus-galli</i>	40
		<i>Monochoria vaginalis</i>	36
		<i>Eleocharis acicularis</i>	7
		<i>Aneilema japonica</i>	5
		<i>Ludwigia prostrata</i>	5
		<i>Sagittaria pygmaea</i>	3
		<i>Rotala indica</i>	3

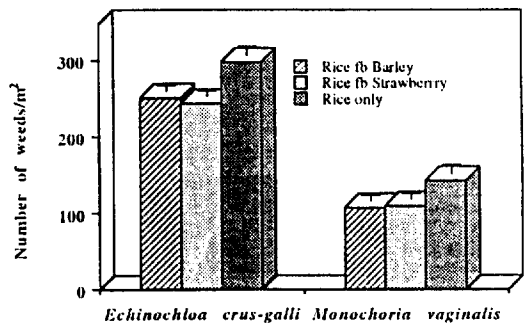


Fig. 4. Weed emergence in paddy field as affected by cropping system.

摘 要

논에서의 물 관리 條件, 移秧時期 및 作付體系에 따른 피와 물달개비의 發生樣相을 比較하였다. 灌溉畚과 天水畚 條件에서의 논 土壤 중 피 種子 貯藏量은 큰 差異를 나타내지 않았으나, 물달개비 種子量은 天水畚 條件에서 約 1.6倍 정도 많았다. 두 條件에서의 種子 分布 樣相은 表層 5cm 層位에 피는 全體 種子量의 50%가, 물달개비는 30%가 分布되었다. 물달개비는 두 條件에서 地表下 25cm까지 分布되었으나, 피는 地表下 15cm까지만 分布되었다. 早期移秧時에는 適期 및 晚期移秧時에 비하여 두 草種의 發生量이 많았다. 벼 栽培後 보리나 밭기와 같은 二毛作 栽培 條件에서의 피나 물달개비의 發生보다는 벼만의 一毛作 栽培 條件에서 發生量이 현저하게 높았다.

ACKNOWLEDGMENT

This work was supported by a grant No.

LITERATURE CITED

1. Choi, C.D., S.C. Kim, and D.Y. Hwang. 1989. Effect of repeated use of same herbicide on weed growth in lowland rice. *Kor. J. Weed Sci.* 9 : 39-45.
2. Egle, G.H. and J.M. Chandler. 1978. Germination and viability of weed seeds after 2.5 years in a 50-year buried seed study. *Weed Sci.* 26 : 230-239.
3. Guh, J.O., S.L. Kwon, and S.M. Heu. 1983. Differential weed competition of two rice cultivars under various cropping patterns. *Kor. J. Weed Sci.* 3 : 57-68.
4. Ryang, H.S. and J.S. Kim. 1992. The status, problems and countermeasure of direct rice seeding in Honam Province - On weed control. *Kor. J. Weed Sci.* 12 : 271-291.