EFFECT OF SOIL TREATMENT ON THE EMERGENCE AND GROWTH OF WEEDS AND RICE[1]

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Although good control of weeds in rice can be available through the use of herbicides, chemical control of weeds is still considered expensive at the present circumstances. There is also a growing concern that continuous application of herbicides in rice may create a serious residue problem in the future. It is desirable, therefore, that weeds in rice can be controlled by a relatively cheap and safe method. Soil treatment appears promising as a physical method of controlling weeds in transplanted rice.

Raising seedlings for rice transplanter is quite difficult in the first crop when temperature is low. Rice seeds and seedlings are easily attacked by soil pathogens under cold environmental conditions, resulting in the seed decay and wilting of seedlings. Application of fungicides is not only expensive but provides only partial solution to the problem. Soil treatment of the nursery bed may give a better protection for rice seeds and young seedlings from the attack of soil pathogens. This paper reports the emergence and growth of weeds and rice as affected by the physical treatment of soil.

MATERIALS AND METHODS

The experiment was conducted on the clay pots in the screenhouse of the Chiayi Agricultural Experiment Station in the first crop of 1972. Soil samples taken from rice field were thoroughly burned with wood fire until the color of the soil became red. The burned and unburned soil samples were put into clay pots with surface area of 250 cm^2. Part of the soil samples was also sent to the soil testing laboratory of the Tainan District Agricultural Improvement Station for making soil analysis. The results of soil analysis were presented in Table 1.

Table 1. Results of the soil analysis.

Treatment	Texture	pH	Organic matter (%)	Available P_2O_5 (kg/ha)	Available K_2O (kg/ha)
Burned Soil	Sandy loam	6.7	0.07	772	430
Unburned Soil (CK)	Sandy loam	5.4	1.82	830	67

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Seeds of an indica rice variety, Taichung shen 2 and three major weeds in rice field namely, *Echinochloa crusgalli*, *Monochoria vaginalis*, and *Cyperus difformis* were planted in each clay pot. The number of seeds planted in each pot was 100 for both rice and *Echinochloa crusgalli* whereas 200 seeds were grown for both *Monochoria vaginalis* and *Cyperus difformis*. The seeds were planted on January 10, 1972. The experiment was arranged in a randomized complete block design with two replications. The percentage of germination was recorded for rice and weeds. Temperature during the period of germination is shown in Table 2. The growth of rice and weeds was expressed by the plant height and number of tillers per plant taken at 70 days after seeding.

Table 2. Climatic data during the period of seed germination.

Period	Temperature °C			Period	Temperature °C		
	Max.	Min.	Mean		Max.	Min.	Mean
Jan. 11 — 15	18.7	10.5	14.6	Feb. 1 — 5	25.6	17.6	21.6
16 — 20	20.9	11.2	16.1	6 — 10	18.1	11.6	14.9
21 — 25	25.6	15.4	20.5	11 — 15	19.2	12.3	15.8
26 — 31	23.0	14.0	18.5	16 — 20	25.4	16.2	20.8

RESULTS AND DISCUSSION

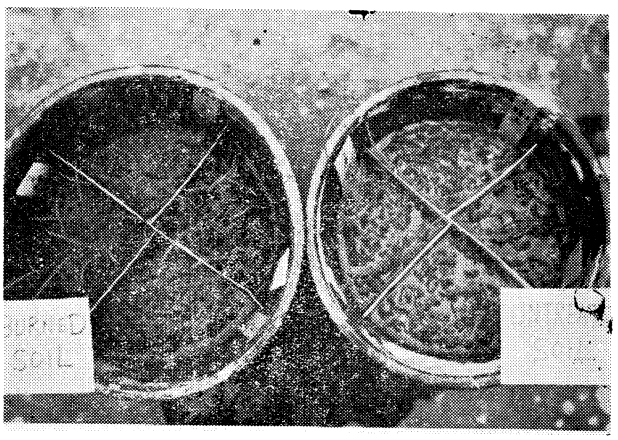
Germination of Weeds and Rice

The number of days required for seeds of weeds and rice to germinate and the percentage of germination for weeds and rice are presented in Talbe 3. It was observed that the germination on the unburned soil took 9, 14, and 21 days for *Echinochloa crusgalli*, *Cyperus difformis* and *Monochoria vaginalis*, respectively. The result shows that three major weeds of rice differ considerably in their days to germination. Rice variety Taichung shen 2 germinated as early as *Echinochloa crusgalli*. The number of days to germination in the treatment of burned soil was the same as that in the untreated control for *Echinochloa crusgalli* and *Cyperus difformis*, indicating that the days to germination of these two weeds is not affected by the physical treatment of the soil. It was noted, however, that *Monochoria vaginalis* took 39 days to germinate on the burned soil while the germination took only 21 days on the unburned soil. This indicates that the germination of *Monochoria vaginalis* can be considerably delayed if it is grown on the soil that has been burned. The days to germination for rice was also not affected by the soil treatment.

Table 3. Germination of weeds and rice.

	Days to germination		Percentage of germination (%)	
	Burned soil	Unburned soil	Burned soil	Unburned soil
Echinochloa crusgalli	9	9	38.0	38.0
Monochoria vaginalis	39	21	0.5	16.0
Cyperus difformis	14	14	1.5	63.0
Rice	8	8	98.0	41.0

The percentage of germination in the burned soil was the same as that in the unburned soil for *Echinochloa crusgalli*, showing that the germination of this weed was not affected by the soil treatment. It was observed, however, that there was practically no germination of seeds for *Cyperus difformis* and *Monochoria vaginalis* on the burned soil while as much as 63 and 16% of these weeds germinated on the untreated soil (Table 3) . The Figure 1. also provides a clear picture of this situation. It can be seen in Figure 1. that spaces allotted for both *Cyperus difformis* and *Monochoria vaginalis* in the burned soil were almost free from weeds while quite a few weeds germinated in the untreated soil. This observation clearly demonstrates that soil which has been burned seems to contain substances with inhibitory effect to germination of certain weeds of rice. The result of soil analysis shows that the burned soil has higher pH value and available K_2O but contained very low organic matter when compared with those of the unburned soil. It is, however, not clear whether these changes in soil property are related to the inhibitory effect of the burned soil on the germination of weed seeds. Nevertheless, the finding that weed emergence was suppressed on the burned soil might be of great practical significance. It appears likely that considerable reduction in the population density of weeds, if not complete control of weeds, can be obtained in rice through the burning of soil or the application of burned soil in rice field. This approach may turn out to be a cheap and effective physical method of weed control in rice since *Monochoria vaginalis* and *Cyperus difformis* are usually the predominant weeds of rice (Chang, 1971) . In rice fields not



Burned soil Unburned soil

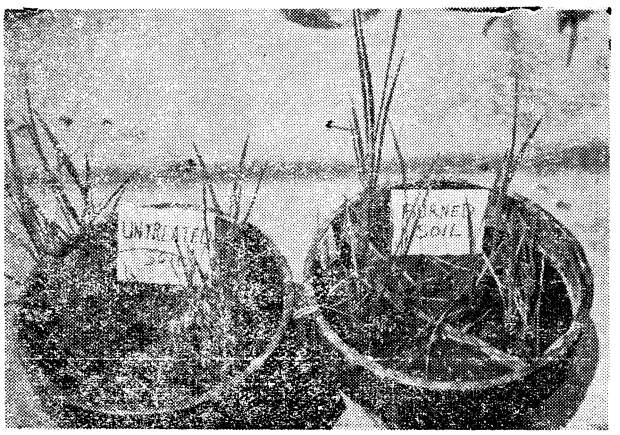
Figure 1. Germination of weeds and rice.

heavily infested with weeds, a satisfactory weed control should be possible with herbicides applied at lower rates, resulting in a considerable saving of the cost of chemical control (Chang and De Datta, 1972) . Further investigation on the usefulness of this method appears worthwhile.

The germination of rice variety Taichung shen 2 was quite normal on burned soil with percentage of germination reached as high as 98%. In the control treatment, however, only 41% of rice seeds germinated (Table 3) . The failure of most rice seeds to germinate on the unburned soil may be attributable to seed decay caused by soil pathogens. The symptom of seed rot can also be seen in Figure 1, where space allotted for rice in the unburned soil was almost covered with black mold. There was no evidence of seed decay in the burned soil presumably most of harmful soil organisms has been killed during the process of burning. Soil pathogens not only destroyed rice seeds but also killed most of rice seedlings before they became ready for transplanting. The temperature during the period of germination was generally low (Table 2) . Since seed decay rarely becomes a problem in the hot second crop, it appears that rice seeds are more susceptible to seed decay under cold environmental condition. The seed decay and wilting of seedlings pose a serious problem to nursery management for rice transplanter where rapid seed germination and uniform seedling growth are required for the smooth operation of the transplanting machine. Although seed decay and seedling wilting can be controlled to some extent by the application of fungicides such as Tachigaren (Chien and Hung, 1971) , the burning of nursery soil may offer a cheaper and better solution to this problem. Of course, possibilities of developing rice varieties with better ability to germinate and good resistance to soil organisms under unfavorable low temperature condtions should also be fully explored.

Growth of Weeds and Rice

The growth of weeds and rice was expressed by plant height and number of tillers per plant recorded at 70 days after seeding (Table 4) . Plant height and number of tillers per plant of *Echinochloa crusgalli* were quite similar in both burned and unburned soils, indicating that the growth of this weed was not affected by soil treatment during the early growing stage. The growth of *Monochoria vaginalis* and *Cyperus difformis* in the burned soil was poorer than that in the unburned soil since values of plant height and number of leaves per plant of these two weeds



Unburned soil Burned soil

Figure 2. Growth of weeds and rice.

in the burned soil was considerably smaller than those in the unburned soil. The plant height of rice variety Taichung shen 2 in the burned soil was also shorter than that in the unburned soil (Figure 2), although number of tillers per plant was the same in both soil treatments. Obviously, the growth of *Monochoria vaginalis*, *Cyperus difformis*, and rice variety, Taichung shen 2 can be affected by the burning of soil at least during the early growing stage. The exact reason for the burned soil to suppress the growth of certain weeds and rice is, however, not presently clear. It can be seen that the burned soil contained a verylow amount of organic matter (Table 1) and this might affect the growth of certain weeds and rice. Also, rice soil was found to became more compact after the burning which may render penetration and development of root in the soil increasingly difficult. Accordingly, less nutrients could be absorbed from the burned soil which might contribute to the poor growth of weeds and rice. This should be taken into consideration when the burned soil is to be used in the control of weeds in rice field and seedling disease in the nursery box of the rice transplanter.

Table 4. Growth of weeds and rice.

	Plant height (cm)		Number of Tillers per Plant	
	Burned soil	Unburned soil	Burned soil	Unburned soil
Echinochloa crusgalli	16.4	15.8	1.0	1.0
Monochoria vaginalis	1.0	4.2	1.5*	5.0*
Cyperus difformis	2.3	4.7	1.5*	2.2*
Rice	9.4	12.7	1.0	1.0

*Number of leaves per plant.

SUMMARY

Preliminary results on the emergence and growth of weeds and rice as affected by the burning of soil obtained at the Chiayi Agricultural Experiment Station in the first crop of 1972 are reported. The germination and early growth of *Echinochloa crusgalli* were not affected by the burning of the soil while *Monochoria vaginalis* and *Cyperus difformis* showed poor germination and growth on the burned soil. Rice variety Taichung shen 2 germinated poorly and developed severe seedling disease on the untreated soil but seed germination and seedling growth were apparently normal on the burned soil, although there was evidence of slight suppression on the seedling height.

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土壤處理對雜草及水稻萌芽與生長之影響

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摘　　要

本文係報告嘉義農業試驗分所在民國61年第 1期觀察土壤處理對若干什草及水稻萌芽及初期生長影響所得之初步結果。稗草之發芽及初期生長未受土壤處理之影響，惟鴨舌草及球花蒿草在燒土上之發芽及初期生長均較未處理者爲劣。水稻品種臺中秈 2號在未處理土壤上之發芽不良，且發生嚴重立枯病，惟在燒土上之發芽良好，秧苗生長雖稍受抑制，但尙稱正常。