育苗箱及田間施用矽酸爐渣對稻熱病與水稻收量之效應

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摘　要

本研究旨在探討矽酸爐渣施用於育苗箱及田間對水稻稻熱病及收量之效應。矽酸爐渣之施用量，分爲每箱施用20、40、60、80及100克6變級，直接施於田間者爲3噸／公頃。試驗結果顯示，施用矽酸爐渣顯著降低葉稻熱病之發病率，直接施用於田間比施用於育苗箱者葉稻熱病發病率較低。然而，對穗稻熱病無顯著之防治效應。就收量而言，矽酸爐渣施用於育苗箱之處理與對照處理間無顯著差異。而直接施於田間處理與對照處理間有顯著差異，收量差異達34％。

關鍵詞：育苗箱施用、矽酸爐渣、稻熱病、收量。

前　言

稻熱病之防治方法，主要包括稻種消毒，栽培抗病品種，適當施用肥料及適期施藥等。對稻熱病的預防，一般認爲以栽培抗病性品種爲主要方法，然而其對稻熱病發病抑制之貢獻率約65％左右。因此，肥培管理技術對品種抵抗性之影響，亦不容忽視[1]。

稻株的營養狀況，對於稻熱病的病勢進展影響頗爲顯著。一般而言，多施用氮素肥料可增加發病程度。至於矽酸爐渣對稻熱病之抵抗性問題，早在1917年Onodera就已報導；稻株含有高量的矽及矽化表皮細胞，稻熱病發生較輕微[16]。其後有許多研究者指出增加矽施用量可增強稻株對稻熱病之抵抗性[3,4,7,8,11,13,15,20,21]。甚至有學者指出在不同條件下，同一品種之矽含量與其對稻熱病之抵抗性有相關性存在[9]。在本省，1980年黃氏等報告指出，矽酸爐渣直接施用於田間可抑制稻熱病發病程度[1]。

矽酸爐渣除扮演肥效之功能外，對增強作物病害之抵抗性，亦具相當的效果。而過去之研究，僅探討直接施於田間之效應，而未探討其施用於育苗箱之作用，本研究係對其施用於育苗箱效應初步之探究結果，供今後進一步研究之參考。

材料與方法

本試驗於七十八年第一期作在新竹縣峨嵋鄉中盛村進行。供試品種爲台農67號及新竹64號。育苗箱施用矽酸爐渣爲0、20、40、60、80、100克／箱6變級，田間施用爲3噸／公頃1變級，共7變級。採裂

區設計，品種爲主區，矽酸爐渣施用量爲副區，四重複，小區面積爲9㎡。矽酸爐渣之主要成分可溶性矽酸20％以上，鹼性物質含氧化鈣、氧化鎂30％以上。

插秧日期爲3月8日，育苗箱在播種前施用矽酸爐渣，一般田間施用爲3月下旬，田間管理依慣行方法施行。調查項目包括葉、穗稻熱病發病率、農藝性狀、收量等。葉稻熱病發病率在5月17日調查，穗稻熱病在7月12日調查，每小區均逢機抽樣調查20株。調查資料均採用變方分析及鄧肯氏多變域測驗法分析。

結　　果

一、矽酸爐渣對稻熱病之效應

矽酸爐渣對稻熱病之效應，如表1所示，品種對葉稻熱病發病效應無顯著差異。矽酸爐渣施用與否對葉稻熱病之效應有顯著差異；田間施用3噸／公頃矽酸爐渣區葉稻熱病發病率爲12.0％，對照無施用區發病率爲31.5％，顯著降低發病率達19.5％，施用矽酸爐渣於育苗箱葉稻熱病降低9-10.6％。矽酸爐渣施用於田間與施用於育苗箱之間有顯著差異；田間施用者比施於育苗箱者降低達8.9-10.9％。矽酸爐渣施用對穗稻熱病罹病率無顯著的影響。

表1. 育苗箱及田間施用矽酸爐渣對稻熱病之效應

Table 1. Effects of field and nursery-tray application of silicate slag on rice blast disease.

Application rate	Disease severity of leaf blast (%)			Disease incidence of panicle blast (%)		
	TN 67	HS 64	Mean	TN 67	HS 64	Mean
0	31.4	31.6	31.5^{a}	31.1	21.9	26.5^{a}
20g/Tray	22.6	22.4	22.5^{b}	18.6	12.8	15.7^{a}
40g/Tray	22.3	22.1	22.2^{b}	14.6	36.7	25.7^{a}
60g/Tray	27.6	22.4	25.0^{ab}	22.2	26.8	24.5^{a}
80g/Tray	20.8	20.9	20.9^{b}	35.3	20.8	28.1^{a}
100g/Tray	27.7	23.8	25.8^{ab}	30.2	15.2	22.7^{a}
3t/ha	13.2	10.8	12.0^{c}	16.3	16.5	16.4^{a}

1)發病率後所附英文字母相同者，表示鄧肯氏多變域測驗法檢定在5%顯著水準無差異。
Means followed by the same letter for each column are not significantly different at the 0.05 level by Duncan's multiple range test.

二、矽酸爐渣對農藝性狀及稻穀收量之效應

由表2得知，處理間農藝性狀有顯著差異。但是，矽酸爐渣施用與否對株高及穗數無顯著之效應，而對分蘗數則有顯著影響；田間施用矽酸爐渣區平均分蘗數爲15.3支，對照不施用區爲13.4支，田間施用區比不施用區多出2支，處理間收量有顯著差異，不同量矽酸爐渣施用於育苗箱之各處理間，收量無顯著差異，而與對照不施用亦無差異。矽酸爐渣直接施用於田間區與對照區差異顯著，兩品種平均

表2. 育苗箱及田間施用矽酸爐渣對農藝性狀與稻穀收量之影響

Table 2. Effects of field and nursery-tray application of silicate slag on characteristics of rice.

Application rate	Tillering stage						Maturation stage						Yield (kg/ha)		
	Plant height (cm)			Tiller number			Plant height (cm)			Panicle number					
	TN 67	HS 64	Mean	TN 67	HS 64	Mean	TN 67	HS 64	Mean	TN 67	HS 64	Mean	TN 67	HS 64	Mean
0	62.9	61.1	62.0 ab	13.2	13.6	13.4 b	84.0	84.2	84.1 ab	14.3	14.2	14.2 ab	3,407	3,061	3,234 b
20g/Tray	64.9	60.3	62.6 ab	14.4	14.1	14.2 ab	81.6	82.4	82.0 b	13.6	13.5	13.5 b	3,506	3,135	3,321 b
40g/Tray	58.8	64.0	61.4 abc	14.3	14.2	14.3 ab	80.6	84.8	82.7 b	14.5	14.3	14.4 ab	3,555	3,827	3,691 ab
60g/Tray	61.7	57.7	59.7 b	15.5	13.1	14.3 ab	82.7	79.1	80.9 b	15.4	14.1	14.7 a	4,098	3,259	3,679 ab
80g/Tray	61.4	62.3	61.9 ab	13.8	14.3	14.1 ab	82.8	81.2	82.0 b	13.7	15.3	14.5 ab	3,456	3,407	3,432 b
100g/Tray	58.4	59.4	59.0 bc	14.2	13.3	13.8 b	80.6	81.2	80.9 b	13.8	14.4	14.2 ab	3,284	3,209	3,247 b
3t/ha	69.0	64.5	66.7 a	16.4	14.2	15.3 a	90.4	85.3	87.9 a	15.4	14.7	15.1 a	4,765	3,901	4,333 a

1)平均數後所附英文字母相同者，表示鄧肯氏多變域測驗法檢定在5%顯著水準無差異。

Means followed by the same letter for each column are not significantly different at the 0.05 level by Duncan's multiple range test.

施用矽酸爐渣3噸／公頃之處理爲4,333公斤，對照區爲3,234公斤，差異1,099公斤，增收率高達34％。而矽酸爐渣直接施用處理區，台農67號爲4,765公斤，對照區爲3,407公斤，差異1,358公斤，增收率高達40％，新竹64號矽酸爐渣直接施用處理區爲3,901公斤，對照區爲3,061公斤，差異840公斤，增收率爲27.4％。

討　論

病害發生之猖獗與否，除品種、感病性及氣候因素之影響外，植物營養亦爲重要之影響因素。肥料爲植物營養之重要來源，其種類、施用量、施用方法與病害發生程度均有密切的關係。

肥料三要素對稻熱病發生之影響，以氮素影響最顯著，而鉀及磷肥之影響較少。氮肥施用多時，水稻組織軟弱，表皮之矽化細胞數減少，細胞内之氮素增加，水稻對稻熱病菌侵入及進展之抵抗力降低[17,18]。磷肥之影響因條件而變動，不如氮素般之單純[13]；在氮肥施用量高之條件下增施磷肥增加發病程度，在缺磷之土壤，大量施用磷肥可降低發病到某一程度[14]。鉀在氮肥適量之時可抑制發病，多量時往往有多發之情形。尤其在缺乏鎂之土壤，多施用鉀時，稻熱病多發。稻株鉀與氮含量比率不均衡時會增加可溶性氮[5]。由上所述，可見三要素對稻熱病之影響因其他因子之互動而有不同。

矽酸對葉稻熱病之抗病機制爲水稻表皮細胞吸收矽酸，產生大量矽化細胞，對病原菌胞子發芽貫穿有阻止作用[7,12,20]，其次爲細胞内矽酸增加伴同氮素吸收量降低所產生之抑制作用[2,6,10,11,22,23]。可見肥料對稻熱病之影響相當複雜，但是矽酸對稻熱病具抵抗性則爲不爭之事實。至於矽酸爐渣施用量，據1971年石田氏[3]報告，施用量在150、300、600kg/10a間，防治稻熱病指數效果隨用量之增加而增加。然而，施用量對防治之效應，國内尚未有定論，此一問題，當爲今後探討之重點。

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Effects of Nursery-tray and Field Application of Silicate Slag on Blast Disease and Yield of Rice

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Summary

The efficacy of nursery-tray and field application of silicate slag for the control of leaf and panicle blast of rice were studied during the first crop season of 1989.

Silicate slag was applied at rates of 20, 40, 60, 80 and 100g/tray and 3t/ha in the field. A significant decrease in disease severity of leaf blast was observed in the plots by application of silicate slag. Application of silicate slag directly in the field at 3t/ha rate was more effective than the applications in the nursery-tray. Application of silicate slag had no effect on disease incidence of panicle blast of rice. All rates of silicate slag increased yields of rice. The increase in rice yields ranged from 1.4% to 20.3% for Tainung 67 and from 2.4% to 25% for Hsinchu 64 by nursery-tray application. However, increase of 39.9% for Tainung 67 and 27.4% for Hsinchu 64 was observed by field applications.