SEED INJURY IN PADDY DUE TO OVERDOSAGE OF FUNGICIDES

ABDUL GHAFOOR KAUSAR AND M. IQBAL CHOHAN*

Seed injury in paddy due to overdosage of eight fungicides was investigated in dry and wet nurseries. In general, germination of paddy seed of four varieties was lower and seed injury due to overdosage of fungicides was more pronounced in wet than in dry nursery. Granosan M, Granosan NI and I & D caused pronounced seed injury in dry and wet nurseries, and almost completely eliminated germination at 32 times, whereas Granosan M and Granosan NI did so even at 8 and 16 times their recommended rates. Arasan and Spergon were the safest and caused no seed injury even at 32 times their recommended rate in dry nursery, but caused some seed injury in wet nursery at 16 and 32 times the recommended rate. Ceresan, Agrosan GN and Dieldrex were intermediate in this respect.

INTRODUCTION

Seed dressing fungicides for paddy have been the subject of extensive investigations and the results of these studies have been reviewed (Leukel, 1936, 1948; Nawaz and Kausar, 1967). The harmful effect of the fungi occurring on paddy seeds and the fungicides to counteract their harmful effect have also been studied in Pakistan (Bajwa & Kausar, 1965, 1969; Nawaz & Kausar, 1967). However, the effect of overdosage of fungicides on the germination of paddy seed, seed injury and their relationship with the amout of overdosage do not appear to have received adequate attention.

The effect of application of certain groups of fungicides at rates higher than recommended on the germination of paddy seed in wet nurseries has recently been reported (Kausar *et al.*, 1970). In general, dressing of paddy seed with fungicides at recommended rates enhanced the germination of seed, but Granosan NI, Granosan M and I & D caused serious seed injury and reduced germination at four and eight times their recommended rates. However, Dieldrex, Agrosan GN, Ceresan and Arasan did not cause seed injury even at eight times their recommended rate.

The present study is a continuation of the investigation of Kausar *et al.* (1970) and reports the results of experiments designed to study the injury of paddy seed, in dry and wet nurseries, by different groups of fungicides applied at rates higher than studied previously.

*Department of Plant Pathology, Faculty of Agriculture, West Pakistan Agricultural University, Lyallpur.

MATERIALS AND METHODS

The effect of treating paddy seed of four varieties with eight fungicides at four rates of their application on the germination of the seed in dry and wet nurseries was studied in the field at Lyallpur in quadruplicated split plot experiments. Rates of application of the fungicides and the varieties formed the larger main plots and the sub-plots respectively. Within the sub-plots of the varieties, plots of the fungicidal treatments formed the next smaller sub-plots. Each sub-plot consisted of a 4 feet long row of each treatment, one foot apart from the other row, and was planted with 625 paddy seed of the varieties under trial.

Treatment of the paddy seed with fungicides and an untreated check comprised the treatments. The fungicides included in the test and the recommended rates of their application per 45 lbs paddy seed were as follows: Granosan M, 1/2 oz; Granosan NI, 1/2 oz; Dieldrex, 2 oz; Agrosan GN, 2 oz; Arasan, 1½ oz; I & D, 2 oz; Dieldrex, 2 oz; and Spergon, 2 oz. The first four fungicides are organic mercurials, the fifth is a thiram, the sixth and seventh are combinations of a fungicide and an insecticide, and the eighth is a quinone (chloranil). The fungicides were applied at the recommended, 8, 16 and 32 times their recommended rates. The four varieties of paddy included in the test were Basmati 370, Jhona 349, Palman 246 and Sathra 278.

The dry nursery comprised paddy seed sown in prepared moist nursery bed which was watered occasionally to keep the soil sufficiently moist. The wet nursery comprised seeding of presprouted paddy seed in puddled nursery bed with a thin sheet of water on the surface, which was kept flooded. The irrigation water was not allowed to stagnate and was replaced by fresh water every morning during the first week and occasionally later on.

The number of paddy seeds germinated was subjected to analysis of variance for the test of significance and interpretation of results.

EXPERIMENTAL RESULTS

(i) Dry nursery

F values for varieties, fungicides, and rates of their application were significant. Similarly, F values for the interaction of fungicides and varieties, fungicides and their rates of application, and second order interaction of fungicides, rates and varieties were significant. However, the interaction of rates of application and varieties was non-significant.

Significant F value for varieties indicated that there was significant difference in the germination of the seed of the varieties used in the experiment. Significant F value for rates of application of the fungicides showed that seed emergence was significantly reduced by the application of the fungicides at rates

higher than recommended. Paddy seed emrgence per plot for average of the four varieties and fungicides (Table 1) showed that there was significant reduction in the germination of paddy seed with an increase in the rate of application of the fungicides. However, significant interaction of the fungicides and the rates of their application indicated that some fungicides behaved differently from others in causing seed injury due to overdosage.

TABLE 1. *Paddy seed emergence for different rates of application of fungicides in dry nursery.*

Rate of application	Plant emergence per plot*	Per cent emergence
Recommended rate	488.4$_a$	78.1$_a$**
Eight times recommended rate	374.8$_b$	59.9$_b$
Sixteen times recommended rate	328.6$_c$	52.6$_c$
Thirty-two times recommended rate	259.3$_d$	41.5$_d$
Least significant difference		
At 5 per cent level	20.7	3.3
At 1 per cent level	27.3	4.4

*On the basis of 625 seeds sown per plot.

**Figures having the same letter in a column do not differ significantly at 5 per cent level.

The eight fungicides under trial fell in three groups in this respect (Table 2). Granosan M, Granosan NI and I & D fell in the first group and caused pronounced seed injury. The germination of paddy seed treated at 8, 16 and 32 times their rates of application was reduced significantly. Germination was almost completely eliminated when paddy seed was treated with these three fungicides at 32 times their recommended rate, and with Granosan M and Granosan NI at 16 times their recommended rate. The germination of paddy seed was negligible (5.4 and 10.4 per cent) when treated with Granosan M and Granosan NI at eight times their recommended rate, and was poor (17.4 and 27.7 per cent respectively) when treated with I and D at 16 and 8 times the recommended rate.

Arasan and Spergon belonged to the second group and caused no seed injury even when applied at 8, 16 and 32 times their recommended rate. These two fungicides are, therefore, the safest for seed dressing of paddy. Ceresan, Agrosan GN and Dieldrex belonged to the third group, and were intermediate between the above two groups. These fungicides did not significantly reduce germination of the seed at 8 times their recommended rate, but reduced the germination significantly at 16 and 32 times their recommended rate. The

germination of the paddy seed was 53, 32 and 33 per cent respectively when treated with Ceresan, Agrosan GN and Dieldrex at 32 times their recommended rate as compared with 89.6 per cent of the untreated check.

TABLE 2. *Emergence of paddy seed treated with eight fungicides at four rates of application in dry nursery.*

Fungicides	Per cent emergence of paddy seed treated at four rates				
	Recommended	Eight times recommended	Sixteen times recommended	Thirty-two times recommended	Average
Garnosan M.	65.3$_a$	5.4$_a$	0.6$_a$	0.1$_a$	17.9$_a$*
Granosan N.I.	63.3$_a$	10.4$_a$	0.6$_a$	0.0$_a$	18.6$_a$
Ceresan	82.2$_c$	78.3$_c$	64.9$_c$	53.3$_d$	69.5$_c$
Agrosa GN.	79.8$_b$	83.7$_c$	71.4$_d$	31.7$_b$	66.6$_c$
Arasan	86.9$_c$	83.2$_c$	87.5$_c$	87.3$_c$	86.2$_d$
I & D.	82.3$_c$	27.7$_b$	17.4$_b$	2.2$_a$	32.4$_b$
Dieldrex	89.5$_c$	84.5$_c$	64.3$_c$	32.7$_b$	67.7$_c$
Spergon	82.8$_c$	83.6$_c$	82.1$_e$	80.2$_c$	82.4$_d$
Check	82.7$_c$	83.9$_c$	48.7$_f$	85.9$_c$	83.3$_d$
Least significant difference:					
At 5 per cent	7.1	7.1	7.1	7.1	3.6
At 1 per cent	9.3	9.3	9.3	9.3	4.8

*Figures having the same letter in a column do not differ significantly at 5 per cent level.

Significant interaction of varieties and fungicides indicated differential response of certain varieties to the higher rates of application of fungicides. However, this requires further study.

(ii) Wet nursery

F values for fungicides and their rates of application were significant. Similarly, F values for interaction of fungicides and varieties, fungicides and rates of application, and the second order interaction of varieties, fungicides their rates of application were significant. However, F value for varieties and that for interaction of rates and varieties were non-significant.

Significant F value for rates of application of the fungicides indicated that fungicides applied at rates higher than recommended significantly reduced germination of treated paddy seed. Paddy seed emergence per plot for averages of the varieties and fungicides for different rates of application of the fungicides

(Table 3) indicated that application of fungicides at 8, 16 and 32 times the recommended rates significantly and gradually decreased germination of paddy seed. As the interaction of varieties and rates was non-significant, the response

TABLE 3. *Paddy seed emergence for different rates of application of fungicides in wet nursery.*

Rate of application	Plant emergence per plot*	Per cent emergence
Recommended rate	326.8_a	52.3_a
Eight times recommended rate	224.4_b	35.9_b
Sixteen times recommended rate	168.9_c	27.0_c
Thirty-two times recommended rate	117.7_d	18.8_d
Least significant difference:		
At 5 per cent level	20.7	3.3
At 1 per cent level	27.3	4.4

*On the basis of 625 seeds sown per plot.

**Figures having the same letter in a column do not differ significantly at 5 per cent level.

of varieties to higher rates of application of fungicides was similar. Thus, of the four varieties used in the experiment, none was more tolerant to these higher rates of applications of the fungicides than the others. However, a significant interaction of fungicides and rates of application indicated that certain fungicides applied at rates higher than recommended behaved differently from others in causing seed injury. This is brought out clearly in Table 4, summarising the emergence of paddy seed treated with eight fungicides at four rates of application, using an average of four varieties.

The eight fungicides under trial fell in more or less three groups as in the case of dry nursery. Granosan M, Granosan NI and I and D caused pronounced seed injury. Germination of paddy seed was almost completely eliminated by treatment with these three fungicides at 32 times their recommended rate and with Granosan M and Granosan NI at 8 and 16 times their recommended rate. The germination of paddy seed was poor (12.7 and 25.2 per cent respectively) when treated with I & D at 16 and 8 times the recommended rate. Of the fungicides under trial, Arasan and Spergon were the safest and caused the least seed injury as compared with other fungicides. However, in wet nurseries even these two fungicides applied at 16 and 32 times the recommended rates reduced germination of the treated paddy seed, which was significant statistically. Ceresan, Agrosan GN & Dieldrex were intermediate in this respect. These fungicides

reduced germination significantly at 16 and 32 times their recommended rates. The germination of paddy seed ranged between 3.8 to 13.0 at 32 times the recommended rates and between 20.0 to 27.8 at 16 times their recommended

TABLE 4. *Emergence of paddy seed treated with eight fungicides at four rates of application in wet nursery.*

Fungicides.	Per cent emergence of paddy seed treated at four rates				
	Recommended	Eight times recommended	Sixteen times recommended	Thirty-two times recommended	Average
Granosan M.	34.0$_b$	0.6$_a$	0.2$_a$	0.0$_a$	8.7$_a$*
Granosan N. I.	26.0$_a$	2.9$_a$	0.1$_a$	0.1$_a$	7.3$_a$
Ceresan	64.2$_d$	41.8$_c$	25.0$_c$	12.9$_b$	36.0$_c$
Agrosan GN	58.9$_c$	49.0$_d$	26.8$_c$	3.8$_a$	34.7$_c$
Arasan	54.7$_c$	49.2$_d$	49.5$_e$	43.7$_c$	49.3$_g$
I & D	59.9$_c$	25.2$_b$	12.7$_b$	0.6$_a$	27.1$_b$
Dieldrex	61.8$_c$	51.3$_d$	27.8$_c$	8.5$_b$	37.3$_c$
Spergon	55.4$_c$	46.4$_c$	43.1$_d$	41.0$_c$	46.5$_f$
Check	56.9$_c$	55.5$_d$	58.0$_f$	59.0$_d$	57.4$_e$
Least significance different					
At 5 per cent	6.3	6.3	6.3	6.3	3.2
At 1 per cent	8.3	8.3	8.3	8.3	4.2

*Figures having the same letter in a column do not differ significantly at 5 per cent level.

rates. Of these three fungicides, Ceresan and Agrosan GN reduced the germination significantly at 8 times their recommended rates, which was 41.8 at 49.0 per cent respectively.

In general, the germination of the untreated and treated paddy seed of four varieties used in the experiments was lower and the seed injury due to overdosage were more pronounced in wet than in the dry nursery.

DISCUSSION

Eight fungicides investigated for their seed injury in the present study comprised three groups, whereas seven out of these eight fungicides studied in a previous investigation (Kausar *et al.*, 1970) belonged to two groups. The third group in the present study has emerged on account of higher rates (16 and 32 times) of application of fungicides used in the present study, than in the previous study wherein the effect of application of fungicides at 2, 4 and 8 times their recommended rates was investigated.

Granosan M, Granosan NI and I & D belonged to the same group in the two investigations. These fungicides caused pronounced seed injury and almost completely eliminated germination at 32 times, whereas Granosan M and Granosan NI did so even at 8 and 16 times their recommended rates. I and D was comparatively less deleterious than Granosan M and Granosan NI at 8 and 16 times their recommended rate.

Arasan, Dieldrex, Agrosan GN and Ceresan belonged to the second group in the pevious study and did not cause seed injury at eight times their recommended rates. However, out of these fungicides, only Arasan did not cause seed injury at 32 times in the dry nursery in the present study. Other fungicides reduced the germination of paddy seed significantly at 16 and 32 times the recommended in dry and wet nurseries. The eighth fungicide Spergon also caused no seed injury at 8, 16 and 32 times their recommended rates in the dry nursery.

The germination of seed of four paddy varieties used in this study was lower in the wet nursery than in the dry nursery and the seed injury due to overdosage was more pronounced in wet than in the dry nursery. Even Arasan and Spergon which proved to be the safest of the eight fungicides investigated caused some injury in the wet nursery at 16 and 32 times their recommended rates. The plumule of the prosprouted seed planted in wet nurseries is fragile and apparently finds more difficulty in establishing itself than the seed planted as such in dry nurseries. It also appears to be more susceptible to higher rates of fungicides. More precaution is therefore necessary in the selection of a safer fungicide, and in the thorough application of the fungicide selected, at its correct rate of application, for sowings in wet nursery than in the dry nursery.

LITERATURE CITED

Bajwa, M. N., and A. G. Kausar. 1965. Fungi occurring on paddy seeds and their control. *Pak. Jour. Agr. Sci.* **2** : 7-20.

Bajwa, M. N., and A.G. Kausar. 1969. Fungi occurring on paddy seed in the Punjab. *Pak. Jour. Agr. Sci.* **6** : 125-132.

Kausar, A. G., M. I. Chohan, M. Hussain and Q. U. Ansari. 1970. Trial of seed dressing fungicides for paddy in wet nurseries. *Pak. Jour. Agr. Sci.* **7** : 101-107.

Leukel, R. W. 1936. The present status of seed treatment with special reference to cereals. *Bot. Rev.* **2** : 498-527.

Leukel, R.W. 1948. Recent developments in seed tretment. *Bot. Rev.* **14** : 235-269.

Nawaz, S.M., and A. G. Kausar. 1967. Seed dressing and spray fungicides for the control of paddy blight. *Pak. Jour. Agr. Sci.* **4** ; 324-333.