STUDIES ON SHEATH BLIGHT OF RICE IN THE LOW COUNTRY WET ZONE

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ABSTRACT

Sheath blight disease of rice caused by the fungus *Rhizoctonia solani* Kuhn, is becoming a major disease problem in the low country wet zone where environmental conditions are ideal for its spread. The disease has characteristic lesions and in severe cases could completely dry-up the leaves. Some farmers' practices aimed at other targets very often lead to higher sheath blight incidence. Some of these practices have been evaluated at the Regional Agricultural Research Centre, Bombuwela during the last few years and this paper reports the results of these investigations.

These experiments have indicated that sheath blight disease at high severity levels causes reduction in yield mainly due to empty earheads. High densities of sowing as well as nitrogen doses higher than the Department of Agriculture recommendation have resulted in higher disease incidence. There has been no effect on disease incidence due to incorporation of straw, whether infected or uninfected. Two fungicides, Pencycuron (Monceren) and Tri phenyl tin hydroxide (Duter) have effectively controlled the disease.

KEY WORDS : Nitrogen, *Rhizoctonia solani*, Rice, Rice straw, Sheath blight

INTRODUCTION

Sheath blight disease of rice, caused by the fungus *Rhizoctonia solani* Kuhn, is becoming a major disease problem in the low country wet zone of Sri Lanka where the environmental and climatic conditions were very favourable for its infection and spread. The disease is characterized by greyish green lesions which develop on the leaf sheath near the water surface. The lesions enlarge and coalesce with one another. Leaf blades may also show the lesions if they drop and touch other infected stem and sheaths. In severe cases the lesions reach up to the flag leaf sometimes completely drying and killing it thereby affecting yield.

Some farmer practices, including those recommended by the Department of Agriculture (DOA), have been observed to be pre-disposal factors in causing this disease. The practice by farmers of sowing a higher seed rate than the DOA recommendation has definitely increased its incidence. The DOA recommendation to incorporate straw as a potassium supplement may also have its effect specially when the straw happens to be infected with the pathogen. However, Rosale and Mew (1982) have shown that microbial decomposition of straw could reduce the survival of sheath blight causing fungus. The use of high doses of nitrogen by farmers is another practice that could encourage high disease incidence (Kannaiyan *et al.*, 1979), The causal organism, *R.solani* survives as *sclerotia* in the soil, in the plant debris and weeds. Therefore sanitary, hygenic and cultural measures may be adopted to minimize the onset of this disease condition.

Several experiments were conducted at the Regional Agricultural Research Centre, Bombuwela on sheath blight disease with the objective of evaluating these farmer practices and other control measures including the use of fungicides. This paper discusses the results of these investigations.

MATERIALS AND METHODS

Each trial was laid out in a randomized complete block design and treatments were replicated 3 or 4 times. The plot size was of 3m × 3m. Rice varieties Bw 100 and Bg 400-1 were used in the "Plant density" trial. The very susceptible variety Bg 94-1 was used in the others. "Effect on yield" trial with 3 varieties was transplanted while the others were broadcast sown. Inoculation was done with a 7-day old *R. solani* culture on rice grain. The technique of spreading evenly on the water surface was used. Recommended fertilizers were applied and pest and disease control measures were taken.

Following are the specific treatments and other measures taken under the respective investigations:

Effect of sheath blight disease on yield of rice

Field collections were made of panicles from infected tracts in farmers' fields by taking 1m×1m quadrats. Five quadrat samples were taken for each level of infection as rated in the Standard Evaluation Systems for Rice (IRRI, 1980). Samples from 3 varieties were taken. Yield measurements, panicle and spikelet counts were recorded. Yield per panicle was calculated as follows;

$$\text{Yield per panicle} = \frac{\text{Yield per sq. m}}{\text{No. of panicles per sq. m}}$$

In the field experiment, inoculation was done at weekly intervals commencing from the 3rd week after transplanting. The last inoculation was done on the 8th week after transplanting at the primordia initiation stage. Disease evaluation was made at harvest by rating the flag leaf infection. This was computed as

$$\text{\% flag leaf infection} = \frac{\text{No. of flag leaf infected tillers per sq. m}}{\text{Total No. of tillers per sq. m}} \times 100$$

Harvesting was done leaving a 30 cm border around each plot.

Effect of plant density on sheath blight disease incidence

The seed rates tested for Bg 400—1 were 50, 100 (DOA recommendation), 150 and 200 kg/ha while those for BW 100 were 37.5, 75 (DOA recommendation), 112.5 and 150 kg/ha. Disease evaluation was carried out as described in the previous section.

Influence of rice straw incorporation on sheath blight disease incidence

Straw incorporation for the current season was done by growing a uniform crop the previous season. This crop was grown till maturity and inoculation performed in all except one plot in each replicate. Harvesting was either done at surface level or at 60 cm above the soil surface. Straw was either applied on the surface or incorporated deep. In addition there was a burnt stubble treatment and a fungicide applied treatment. Treatment details are given in Table 5. Disease Index for this experiment and for other experiments described below was computed as follows;

$$\text{Disease Index} = \frac{1\,(H) + 2\,(L) + 3\,(M) + 4\,(S1) + 5\,(S2)}{\text{Total No. of tillers}}$$

where, H = No. of healthy tillers.

L = No. of lightly infected tillers.

M = No. of moderately infected tillers.

S1 = No. of severely infected tillers.

S2 = No. of very severely infected tillers with flag leaf completely dried.

Effect of nitrogen and potassium fertilizers on the spread of sheath blight disease

There were 9 treatments consisting of all combinations of 3 levels of nitrogen X 3 levels of potassium (Table 6).

Fungicidal control of sheath blight disease

Six fungicides were tested in the laboratory using the filter paper disc method (Mithrasena *et al.*, 1987) at concentrations ranging from 10—100 ppm. Non-effective chemicals were eliminated. Tri phenyl tin hydroxide and 25% Pencycuron with 50% Benomyl as the standard were selected for field evaluation. Two spray applications at (a) 24 hours after inoculation and (b) 2 weeks after inoculation, were tested. Disease evaluation was done using a disease index as described earlier.

RESULTS AND DISCUSSION

Effect of sheath blight disease on yield of rice

The results from naturally infected trial in farmers' fields are tabulated in Table 1 and graphically represented in Fig. 1. Yield per panicle has shown a statistically significant decline in all three varieties with the increase in disease severity. The percentage of filled grains per panicle showed significant differences only between the non-infected and the severely infected and beyond (Table. 1). There were no significant differences between treatments in their 1000 grain weights These results indicate that the yield losses observed in these varieties due to sheath blight is caused by non-fiilng of grain and not by any grain deformations. Further the regression lines (Fig. 1) show the degree of susceptibility by their slopes. Their positions indicate the levels of tolerance. The line having the least slope represents the most suitable variety for sheath blight prone areas. The time of inoculation for the highest incidence of disease which was also tested has shown the 7th and 8th week after transplanting to be the best time to get the highest flag leaf infection and therefore the highest yield reduction (Tables 2 and 3). Fig. 2 shows the positive relationship between yield loss and disease incidence as represented by flag leaf infection.

Effect of plant density on sheath blight disease incidence

The higher seed rates have not increased the yields since they have increased the disease incidence (Table 4). Yield differences however were not significant. Seed rate and disease incidence show a positive relationship. This relationship was significant for both varieties and both seasons.

Influence of rice straw incorporation on sheath blight disease incidence

The effect of straw incorporation on sheath blight incidence and grain yield is given in Table 5. The artificially inoculated previous season's crop gave a uniform infection. There was no significant increase in disease incidence when infected straw was incorporated. This may be due either to the inability of the straw to sustain viable fungal propagules or to the microbial activity during decomposition which leads to the destruction of *sclerotia*.

Effect of nitrogen and potassium fertilizers on the spread of sheath blight disease

Data in Table 6 have shown that disease incidence increased with the increase in nitrogen levels. The effect of the higher incidence of sheath blight is also seen in reduced yields at higher nitrogen doses. The effect of potassium is not clear and needs further investigation.

Fungicidal control of sheath blight disease

The laboratory experiment was carried out only for the purpose of eliminating the non-effective chemicals. In this experiment Tri phenyl tin hydroxide at 10 ppm showed an inhibition zone while Pencycuron 25% showed the same at 30 ppm. None of the other tested chemicals including Benomyl 50% showed any reaction. Results presented in Table 7 indicate that both Pencycuron 25% and Tri phenyl tin hydroxide give a better control than the standard chemical, 50% Benomyl. Application of fungicide 24 hours after inoculation is not possible with natural infection. This is because symptoms generally appear only 7 days after infection. Therefore fungicides should be sprayed at the onset of the initial symptoms.

CONCLUSIONS

Sheath blight disease of rice causes yield reduction when infection spreads beyond three-fourth of the sheath and three-fourth of the leaf. Yield reduction is mainly due to empty earheads. There is higher disease infection at higher densities of sowing than at the DOA recommended rate.

Incorporation of straw whether infected or uninfected does not affect sheath blight incidence. Higher doses of nitrogen than the recommended level will cause more disease incidence. Fungicides Pencycuron 25% (Monceren) and Tri phenyl tin hydroxide (Duter) will effectively control sheath blight of rice when sprayed at the onset of initial symptoms.

ACKNOWLEDGEMENT

The authors greatly appreciate the help, guidance and encouragement given by Mr. G. A. Gunatilaka Deputy Director (Research) in the conduct of these experiments at the Regional Agricultural Research Centre, Bombuwela.

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Table 1. Effect of disease severity on yield and yield components

Disease Index	*Yield/panicle (g)* Bg 276—5	Bg 379—2	LD 125	*% filled grain per panicle* Bg 379—2	LD 125	*1000 grain weight (g)* Bg 379—2	LD 125
0	—	0.87a	1.19a	76.6a	70.0a	19.5a	26.0 a
1	1.68a	0.80b	0.87b	72.6ab	66.0ab	23.3a	29.3 a
3	1.37b	0.69c	0.81c	74.6ab	64.9abc	21.8a	25.2 a
5	1.08c	0.67d	0.66d	68.0ab	66.6ab	20.4a	26.6 a
7	1.01d	0.58e	0.52e	48.5bc	59.0c	19.5a	24.7 a
9	0.72e	0.42f	0.42f	32.3c	48.5c	20.2a	20.7 a
CV(%)	32.8	19.7	20.5	15.8	4.4	4.4	6.5

Values followed by the same letter in a column are not significantly different at 5% level using Duncan's Multiple Range Test (DMRT)

Table 2. Disease incidence and grain yield for different times of inoculation (yala 1983; Variety Bg 400 — 1)

Time of inoculation	*% flag leaf infection*	*Yield (t/ha)*	*% yield loss*	*1000 grain weight (g)*
Uninoculated	0 c	3.85 a	0 b	25.7 a
3rd WAT	14.0 b	2.64 abc	31.4 a	25.1 a
4th WAT	29.9 a	2.66 abc	30.9 a	23.9 a
5th WAT	42.0 a	2.57 abc	33.2 a	24.9 a
6th WAT	44.6 a	2.31 bc	40.0 a	34.1 a
7th WAT	52.0 a	1.62 c	57.9 a	23.4 a
8th WAT	38.0 a	3.13 ab	18.7 b	23.5 a
CV (%)	21.1	35.2	14.4	7.9

Values followed by the same letter in a column are not significantly different at 5% level using DMRT. WAT = Week after transplanting.

Table 3. Disease incidence and grain yield for different times of inoculation (maha 83/84; Variety Bg 94 — 1)

Time of inoculation	*% flag leaf infection*	*Yield (t/ha)*	*% yield loss*	*1000 grain weight (g)*
Uninoculated	0 c	3.61 a	0 c	23.9 a
4th WAS	32.7 b	2.01 a	44.3 b	21.3 a
5th WAS	38.1 ab	1.69 b	53.1 a	21.9 a
6th WAS	36.1 ab	1.91 b	47.1 b	23.7 a
7th WAS	35.1 ab	1.93 b	46.5 b	21.8 a
8th WAS	42.5 a	1.43 c	60.4 a	21.3 a
9th WAS	37.5 ab	1.92 b	46.8 b	21.5 a
CV (%)	5.8	14.5	2.8	9.5

Values followed by the same letter in a column are not significantly different at 5% level using DMRT; WAS = week after sowing.

Table 4. Disease incidence and yield at different seed rates

Variety	*Density (seed rate) kg/ha*	*Disease incidence (%)*		*Yield (t/ha)*	
		maha 82/83	*maha 83/84*	*maha 82/83*	*maha 83/84*
Bg 400-1	50	40.2	40.2	4.3	3.1
	100	54.1	54.1	3.9	2.9
	150	57.3	58.0	3.8	3.2
	200	66.2	65.5	3.9	2.7
Bw 100	37.5	44.8	42.8	3.5	3.1
	75	55.1	57.1	4.0	2.9
	112.5	67.8	67.8	3.4	2.7
	150	71.7	69.4	3.4	2.6
CV(%)		12.4	8.3	10.4	11.7
LSD(P = 0.05)		12.4	5.0	NS	NS

NS = Not significant

Table 5. Disease incidence and grain yield as affected by different methods of straw incorporation

Treatment	*Disease incidence (%)*		*Yield (t/ha)*	
	maha 84/85	*yala 85*	*maha 84/85*	*yala 85*
Tillers cut at ground level and added on the surface	2.49	1.26	2.19	3.89
Tillers cut at ground level and incorporated deeply	2.77	1.88	2.21	4.15
Tillers cut at ground level and straw removed	2.25	1.50	2.25	3.74
Tillers cut at 30 cm and straw removed	2.60	1.53	2.15	3.88
Tillers cut at 60 cm and straw removed	2.58	1.70	1.91	3.70
Tillers cut at ground level, added on the surface and treated with Monceren	2.71	1.60	2.48	2.85
Stubble burnt	2.40	1.48	2.02	3.93
Control	2.36	1.59	1.84	3.44
CV (%)	17.5	19.1	19.6	15.8
LSD (P = 0.05)	NS	NS	NS	NS

NS = Not significant

Table 6. **Effect of different fertilizer combinations of nitrogen and potassium on sheath blight disease incidence and grain yield of rice**

Nutrient combination	*Disease incidence (%)*		*Grain yield (t/ha)*	
	yala 86	*maha 86/87*	*yala 86*	*maha 86/87*
$N_1 K_1$	2.54 bc	2.96 cd	4.51 a	2.82 c
$N_1 K_2$	2.30 cd	2.35 e	4.89 a	3.55 ab
$N_1 K_3$	2.69 ab	2.51 de	4.21 a	4.07 a
$N_2 K_1$	2.19 d	2.93 cd	4.25 a	3.28 bc
$N_2 K_2$	3.09 a	3.48 bc	4.42 a	2.77 cd
$N_2 K_3$	3.05 ab	3.32 bc	4.55 a	2.90 c
$N_3 K_1$	3.04 ab	4.18 a	2.83 b	1.24 f
$N_3 K_2$	2.97 ab	3.60 ab	2.86 b	2.08 e
$N_3 K_3$	3.13 a	3.07 bcd	3.69 ab	2.26 de
CV (%)	9.4	10.6	1.6	9.7

Values followed by a common letter in a column are not significantly different at 5% level of probability using DMRT.

Fertilizer levels: $N_1 K_1$ = Departmental recommendation (DR); N_2K_2 = 2 DR; N_3K_3 = 3 DR

Departmental recommendation: N_1 = 65 kgN/ha; K_1 = 65 kg K_2O/ha.

Table 7. **Disease incidence and grain yield as affected by different fungicidal application**

Fungicide	*Time of application*	*Disease incidence (%)*		*Grain yield (t/ha)*	
		maha 84/85	*yala 85*	*maha 84/85*	*yala 85*
50% Benomyl	1 DAI	3.88 a	3.22 a	3.17 a	3.57 a
	14 DAI	3.12 ab	2.55 bc	3.52 a	3.65 a
Tri phenyl	1 DAI	2.50 b	2.29 c	3.65 a	3.52 a
tin hydroxide	14 DAI	3.26 ab	2.80 ab	3.59 a	3.62 a
25% Pencycuron	1 DAI	2.38 b	2.30 c	3.62 a	3.62 a
	14 DAI	2.48 b	2.52 bc	3.62 a	3.39 a
No fungicide (Control)	—	3.63 a	2.85 ab	3.86 a	3.16 a
CV (%)		18.8	9.0	11.5	11.7

Values followed by a commen letter in a column are not significantly different at 5% level probability using DMRT; DAI = Days after inoculation

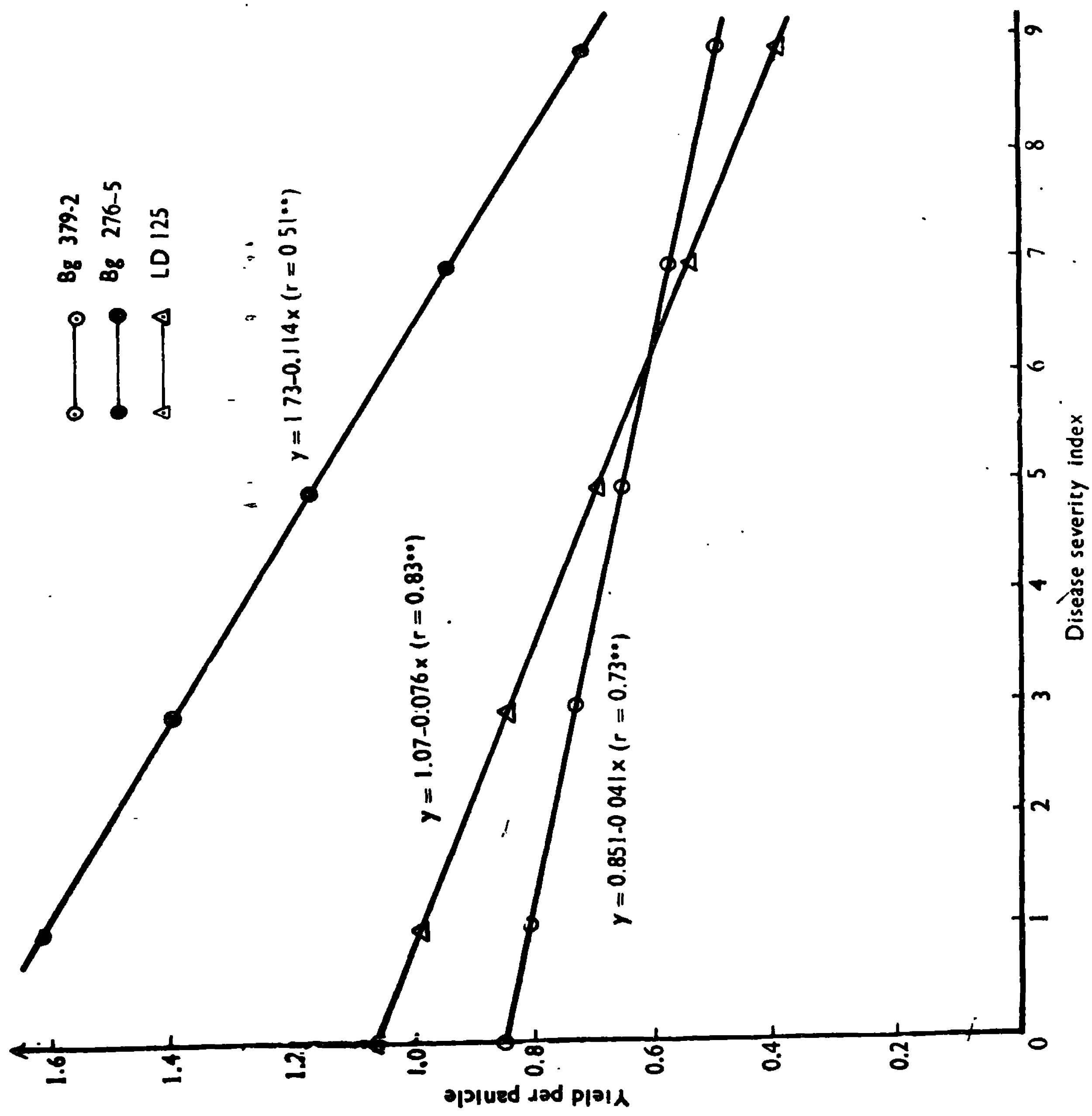

Fig. 1. Yield per panicle at different disease severity indices

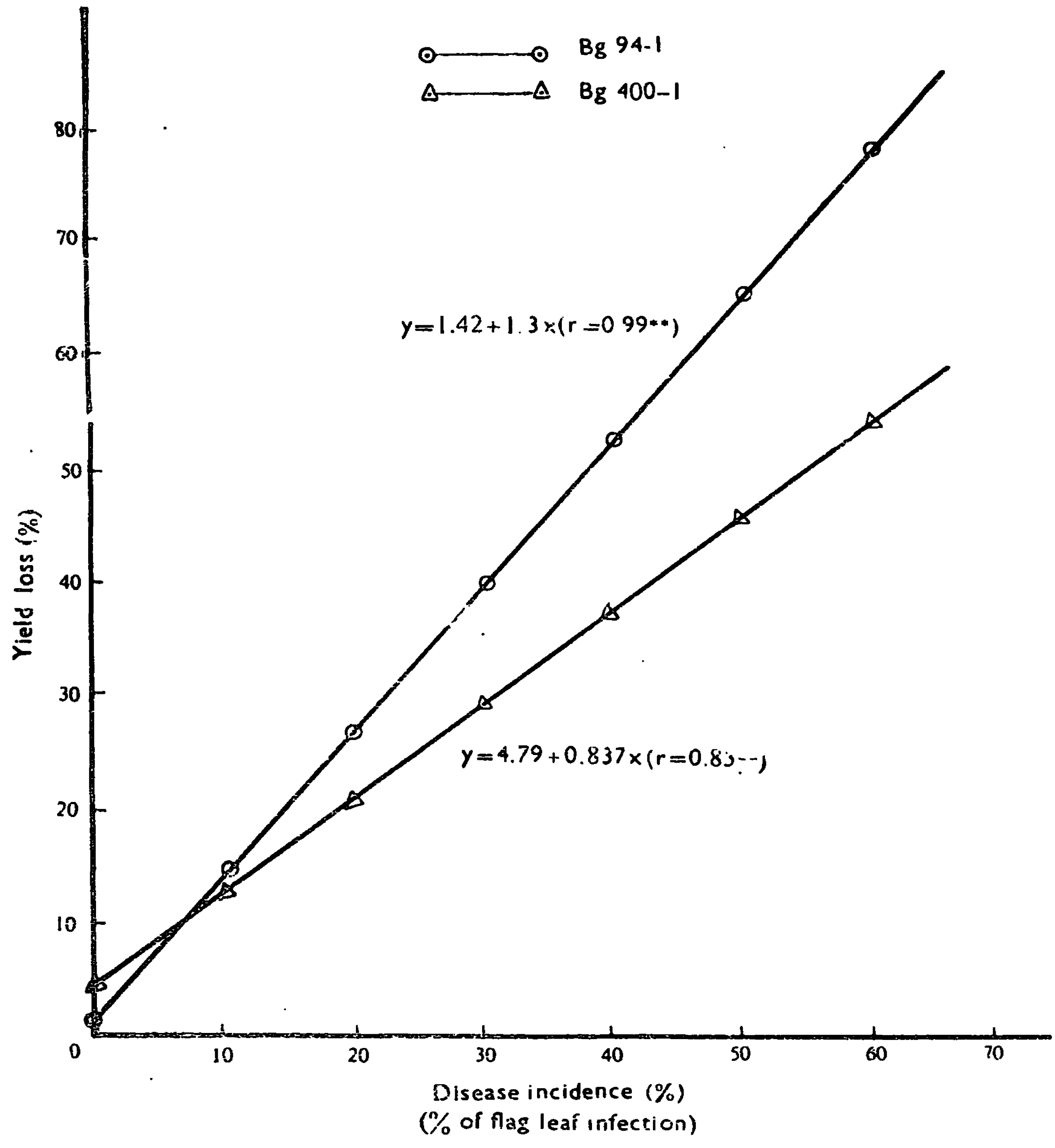

Fig. 2. Yield loss at different disease incidences