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Statistical Assessment of Yield Loss of Sesamum Due to Insect Pests and Diseases

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Field experiments were conducted during Monsoon 1976 and 1977 seasons to study the levels of incidence of pests and diseases on sesame (*Sesamum Indicum*), the relationship of levels of incidence with yield loss due to pests and diseases. The avoidable loss in yield of sesame during monsoon 1976 and summer 1977 was 110 kg and 111 kg per hectare respectively which worked out to be 40 per cent of avoidable loss in sesame yield. The multiple regression analysis of yield on diseases like phyllody, Alternaria blight, powdery mildew and charcoal rot and incidence of shoot webber attack revealed that the partial regression co-efficients of sesame yield on phyllody and charcoal rot diseases were significant. One per cent increase in the incidence of charcoal rot disease brought down the sesame yield by 1.8 kg whereas that of phyllody disease reduced the sesame yield by 8.36 kg.

Crop yields are determined by the combination and the interaction of various factors. While some cannot be easily controlled by the farmer viz., weather, soil type, etc., some of the other factors such as crop varieties, type of cultivation, fertilizer inputs, plant protection measures can be modified and used at will. It is generally believed that incidence of pests and diseases cause an appreciable loss of field crops in India. Very little information on estimates of such crop losses and due to the incidence of pests and diseases is available for most of the important crops. Therefore, an investigation was carried out at Tamil Nadu Agricultural University, Coimbatore, to study the levels of incidence of pests and diseases on Sesamum (*Sesamum indicum*), the relationship of the levels of incidence with yield and the 'avoidable yield loss' due to pests and diseases.

Field experiments were conducted during the monsoon 1976 and summer 1977 seasons. In 1976, TMV 3 and Si 1740 varieties and during 1977, TMV 3 and Si 1855/1 were raised. Two plots were raised for each variety, one of which was given the recommended plant protection schedule as given in Table I and the other was unprotected and allowed to be affected by pests and diseases under natural conditions of incidence.

Randomised Block design was adopted with 10 blocks. The gross plot

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TABLE I. Plant protection schedule adopted in protected plots

Mode of application	Stage of crop	Pesticide
Seed treatment	Sowing	0.3% captan
Spray	40 DAS	Endosulfan at 0.07% +Dithane M-45 0.2%
Spray	60 DAS	Endosulfon at 0.07% + Wettable sulphur 0.2% (80% sulphur content at 1 kg/ha)

DAS — Days after sowing

size was (4.2 x 3) sq.m. The yield and other data on incidence of pests and diseases were recorded from a net plot size of 3.6 x 2.4 m^2. Incidence of *Alternaria* blight and powdery mildew was recorded by computing the disease index. In each plot 10 plants were selected at random for evaluation of disease intensity. In each plant 3 leaves from top, middle and bottom were observed for leaf infection and was rated on a score chart ranging from 0-8 modifying the method adopted by Natarajan *et al.* (1976). The maximum grade scored for each plant was taken as the disease index of the plant and the mean of 10 plants gives the disease index of the treatment. Incidence of phyllody, charcoal rot diseases and shoot-webber incidence was worked out as percentage of infestation to the total number of plants in a plot. The incidence of all the diseases except charcoal rot was recorded 10 days after the second spray, whereas the incidence charcoal rot was recorded 20 days after the second spray.

The analysis of data collected during each season was broadly divided into (i) the mean incidence of diseases and pests, (ii) assessment of yield loss due to insect pests and diseases and (iii) regression analysis to study the association of diseases and pests incidence with yield following the methods suggested by Seth *et al.* (1971) and Anonymous (1970). The analysis of variance in original scale was carried out in all cases except the following situation : Percentage data in respect of phyllody and charcoal rot diseases which ranged between 0 and 30 per cent $\sqrt{X + 1/2}$ transformation was adopted and in other cases percentage data angular tranformation was followed (Gomez and Gomez 1976). In as much as the same pests and diseases were prevalent in both the seasons: but in different intensities the multiple regression equation of yield on incidence of major pest and diseases has been worked out from the two seasons data with the following variables:-

Y = Grain yield of Sesamum in kg/ha

X_1 = Phyllody disease incidence (in per cent)

X_2 = Alternaria blight disease incidence (in disease index)

X_3 = Powdery mildew disease incidence (in disease index)

X_4 = Charcoal rot disease incidence (in per cent)

X_5 = Shoot webber pest incidence (in per cent)

As the varieties did not show any variation in diseases or pest incidence, the entire data were considered as drawn from the same population and

therefore it was taken up in the regression as such without grouping.

RESULTS AND DISCUSSION

i) **incidence of pest and diseases :** Data on the incidence of pests and diseases during the two seasons on the experimental Sesamum crop are presented in Table II. There was an attack of shoot webber (*Antigastra catalaunalis* Dup.) Only during monsoon 1976 season the incidence was significantly lower in treated plots than in untreated plots. There was no incidence of any insect pest during summer 1977 season. The incidence of disease like phyllody, blight *Alternaria sesami* (Kawamura Mohantis & Behera), powdery mildew (*Oidium* spp) and charcoal rot (*Macrophomina phaseolina* (Tassi) Goid) for the two seasons revealed that the protected plots mostly recorded a low incidence of disease than the untreated plots, excepting in summer 1977. The incidence was not significant among the control and treated plots for phyllody and Alternaria blight.

TABLE II. Mean incidence of pest and diseases on sesame during monsoon 1976 and summer 1977 seasons

Pest or disease	Monsoon 1976						Summer 1977					
	Transformed scale	Control	Treated	F test	S.E of mean	C.D (P=0.05)	Transformed scale	Control	Treated	F test	S.E of mean	C.D (P=0.05)
Phyllody (per cent)	$\sqrt{X+1/2}$	1.62 (2.12)	0.81	**	0.12	0.35	$\sqrt{X+1/2}$	2.39 (5.21)	2.26 (4.60)	n.s	0.13	—
Alternaria blight (disease index)	Original	3.11	1.66	**	0.22	0.64	Original	2.85	8.80	n.s	3.34	—
Powdery mildew (disease index)	Original	5.74	3.02	**	0 24	0.70	Original	5.79	2.63	**	0.15	0.44
Charcoal rot (per cent)	Angular	63.05 (79.45)	36.39 (35.2)	**	2.87	8.33	$\sqrt{X+1/2}$	2.54 (5.95)	1.86 (2.96)	*	0.21	0.62
Shoot webber (per cent)	$\sqrt{X+1/2}$	2 40 (5.26)	1.63 (2.16)	**	0.12	0.35	—	no incidence of shoot webber→				

(Figures in parenthesis refer to retransofrmed values to original scale)

* Significant at P = 0.05

** Significant at P = 0.01

n.s Not significant

TABLE III. Mean grain yield of sesame in kg/ha

Variety/ Treatments	Monsoon 1976			Summer 1977		
	TMV_3	SI 1740	Mean	TMV_3	SI 1855	Mean
Control	139.0	192.4	165.7	267.6	270.1	268.9
Treated	272.1	280.0	276.1	401.5	358.5	380.0
Mean	205.6	236.2	—	334.6	314.3	—
Source	F test	S.E. of mean	C.D. (P=0.05)	F test	S.E. of mean	C.D. (P=0.05)
Treatments	**	10.25	29.74	**	16.99	49.28
Varieties	*	10.25	29.74	n.s.	16.77	—
Treatments X Varieties	n.s.	14.5	—	n.s.	24.02	—
C.V (%) = 17.93				C.V (%) = 23.40		

* Significant at P = 0.05

** Significant at P = 0.01

n.s. not significant

The leaf hopper *Orosius albicinctus* Dist. is the vector of Phyllody disease; its incidence was not noticed during the investigation. Sellammal Murugesan *et al* (1973) found that the incidence of phyllody disease in Sesamum may be probably due to even a single leafhopper coming from the source of inoculum from outside the field that had inoculated a number of plants in the experimental plots where the population of leafhoppers was negligible. Lawson *et al* (1951) found that *Circulifer tenellus* (Baker) flew in the crepuscular periods after sunset and before sunrise since the temperature are more likely to be favourable above the threshold in the evening.

ii) yield loss due to pests and diseases : The mean grain yield of Sesamum obtained in the two saesons is given in Table III.

The avoidable loss in yield of Sesamum during monsoon 1976 and summer 1977 was estimated as 110 kg/ha with a standard error of 14.5 and 111 kg/ha with a standard error of 24.0 kg respectively, which worked out to be 40 and 29 per cent of avoidable yield loss in the two seasons.

Taking into account (i) the cost of insecticides and fungicides used in the plant protection schedule and (ii) the cost of labour engaged for this operation, the following economics can be worked out. The cost of spraying worked out to Rs. 231/= per hectare. Taking the price of Sesamum as Rs. 4/= per kg the expected net return on the account of the use of recommended plant protection measures worked out to Rs. 209/= and Rs. 213 in monsoon 1976 and summer 1977 seasons.

iii) Regression analysis of yield on incidence due to pests and diseases : The results of simple correlation studies revealed that there was significant negative correlations between the yield and *Alternaria* blight incidence (—0.3171*). yield and charcoal rot (—0.6637**) and yield and shoot webber (—0.5143**). As these simple correlations did not throw much light on the yield which was jointly affected by different pests and diseases, the multiple regression analysis was carried out and the prediction equation worked out The multiple regression equation fitted for Sesamum yield with five independent variables was

$$Y = 330.26 - 8.36 X_1 + 9.23 X_2 - 2.52 X_3 - 1.80 X_4 - 2.91 X_5$$

The partial regression coefficient with their standard errors, t values and the standard partial regression coefficients are furnished in Table IV. The partial regression coefficients of yield of phyllody and charcoal rot diseases were significant and negative. The regression equation fitted had a R^2 value of 0.5330, which explained 53.3 per cent in the variation in yield. The multiple correlation coefficient R = 0.7300 was tested and found to be highly significant. The standard partial regression coefficient indicated that the charcoal rot disease had much negative influence on yield followed by phyllody diseases. One per cent increase in the incidence of charcoal rot disease brought down the Sesamum yield by 1.8 kg. whereas one percent increase of phyllody disease brought down the Sesamum yield by 8.36 kg.

TABLE IV. Partial regression coefficients, standard partial regression coefficients, standard errors and t values (n=40).

Variable	Partial regression coefficient	Standard error	t value	Standard partial regression coefficients
X_1 (Phyllody disease per cent	—8.361	4.112	2.033**	—0.285
X_2 (Alternaria blight disease index)	9.230	8.702	1.061	0.192
X_3 (Powdery mildew disease index)	—2.524	10.855	0.233	—0.030
X_4 (Charcoal rot disease index)	—1.804	0.450	4.007**	—0.846
X_5 (Shoot webber incidence per cent) $R^2 = 0.6330$	—2.914	4.638	0.628	—0.115

Multiple correlation coefficients = 0.7300**

* Significant at P = 0.05

** Significant at P = 0.01

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