

STUDIES ON DISEASES OF MAIZE II : EAR ROT

BY

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Apart from indirect damage caused by foliar diseases on grain yield, a number of pathogenic organisms were found to be responsible for causing direct damage to ears of maize particularly due to congenial climatic conditions namely high rainfall, high humidity and comparatively higher temperature at the time of formation and maturity of cobs. In the North Eastern Himalayan region, ear rot is likely to be serious because of favourable climatic conditions. Of the various types of ear rots those caused by *Rhizoctonia zeae*, *Diplodia zeae*, *Gibberella zeae* were found to be more important. *Fusarium moniliforme*, different species of *Penicillium*, *Aspergillus niger* were also observed to cause damage but they were of less significance in causing extensive ear rot.

1. *Rhizoctonia* ear rot caused by *Rhizoctonia zeae*—Voorhes.

This disease was first reported to be present in North Eastern Himalayan region, and Sikkim by Ullstrup in 1960, but its importance and distribution were not fully known (Ullstrup, 1960). This disease was found to cause extensive damage in the Kalimpong hills. It was found to be the most destructive of all ear rots present in Kalimpong (Fig. 1).

Infection generally started from the base of ears either through the leafsheath or earshank from stem. It was almost invariably found to be associated with sheath blight caused by the same pathogen. Though infection in general took place from the base of the cob, the same was noticed also on the tip first from where it proceeded downwards towards the base of the ears.

From perusal of the data, it would be seen that rainfall in the month of June might play a decisive role in the severity of ear rot disease. In the year of 1974, in the second fortnight of June and first week of July rainfall was comparatively less and a number of rainless days were interspersed. Rainfall was insignificant in a number of days. On the other hand, in the year of 1975, during the same period, the rainfall was much higher and more frequent. Analysis at micro level is needed to arrive at definite conclusion on the role of weather elements; it may however be stated that data were indicative of the possible role of rainfall and long spells of high relative humidity in incidence of



Fig. 1 : *Rhizoctonia* ear showing the presence of sclerotia on the cob husk.

ear rot *Rhizoctonia zeae* This would be corroborated from the meteorological data presented in Table 2.

In 1974, the disease incidence was very low in respect of varieties affected and average disease score where as in 1975, it was highest as shown in Table 1.

2. Diplodia ear rot caused by *Diplodia zeae* (Schw.) Lev=*D. maydis* (Berk.) Sacc.

Though in India this disease has only been reported by Kapoor (Kapoor, 1963) and Dhanraj (Dhanraj, 1966) from Sikkim and Kalimpong respectively, nothing



Fig. 2: Gibberella ear rot showing the presence of bluish black perithecia on the cob husk
Right :—Affected dehusked cob with Vivipary

has not yet been known regarding its importance and distribution in this regions. During the four years of study in the Kalmpong hills, this disease was found to be prevalent every year in varying intensities. The number of varieties affected ranged from 16.32 to 33.63 per cent with an average disease incidence of 22.79 per cent of four years. Several factors were considered to pre-dispose the attack by pathogen. Ears with loose husk cover and in upwright position were found to be more vulnerable to attack. The disease was most prevalent in dry pollinating period followed by wet weather as reported by Jugenheimer (Jugen-

heimer, 1975). Heavy rainfall in the months of August and September was especially favourable for the development of disease which usually appeared late in the season.

From Table 1, it is evident that highest disease incidence also with highest percentage of varietal infection of 33.63 were observed in 1977 next to 1976. Variation of disease incidence between 1974 and 1975 were negligible.

The varieties sown by the first week of April, 1977, were in flowering stage by and large by the middle of June which was followed by a comparatively dry period (Rainfall recorded 115.31 mm in 9 rainy days of first fortnight of June)

TABLE 1. Data (summarised) on incidence of different ear rots in the years of study

Year	Name of the disease	Per cent of variety Affected	Highest disease incidence of the season	Lowest disease incidence of the season	Average disease incidence of the season
1974	Rhizoctonia	19.38	30.00	3.0	2.44
1975	ear rot	49.23	50.00	1.00	9.87
1976		43.13	70.00	1.00	8.27
1977		37.27	60.00	1.25	5.60
Average		37.25	32.5	1.56	6.55
1974	Diplodia	16.32	10.00	1.75	0.75
1975	ear rot	17.69	16.66	1.00	1.33
1976		23.52	16.00	1.25	1.52
1977		33.63	16.36	1.96	2.75
Average		22.79	14.75	1.49	1.59
1974	Gibberella	17.34	11.11	1.78	1.05
1975	ear rot	21.53	25.00	1.50	1.44
1976		22.22	20.00	1.00	1.65
1977		30.90	25.00	0.62	2.96
Average		22.99	20.27	1.23	1.78
1974	Fusarium kernel	5.10	7.00	2.50	0.24
1975	rot	6.15	7.50	2.00	0.35
1976		3.26	5.00	2.00	0.13
1977		6.36	5.75	2.38	0.23
Average		5.21	6.31	2.22	0.24

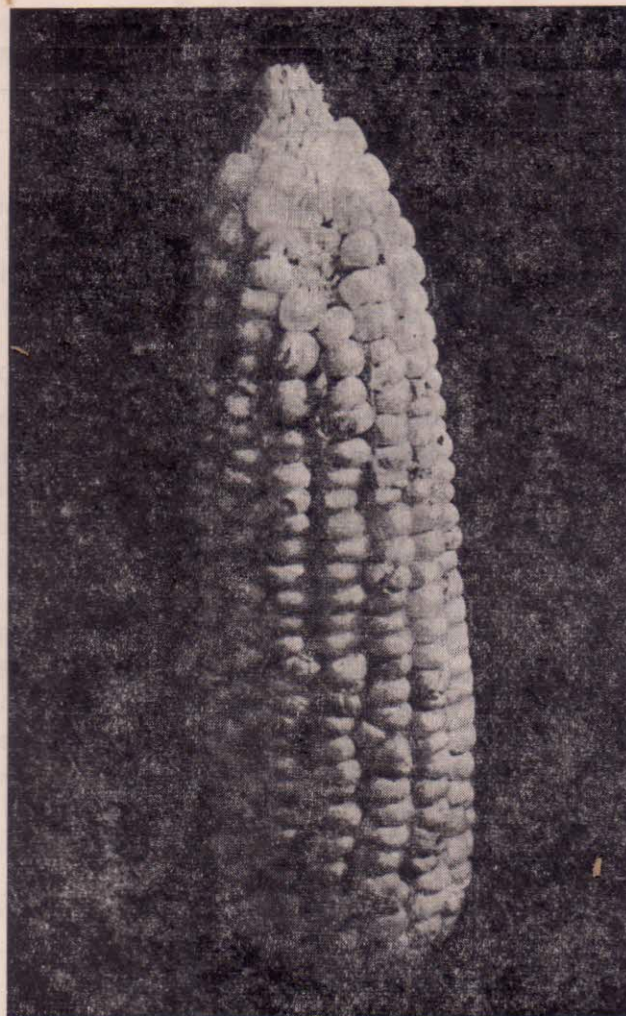


Fig. 3 : Fwornium Kernel rot showing the affected Kernels with random distribution.

when most varieties received pollen. From 4th week of June, there was almost an uninterrupted rainfall upto 28th August (26 rainy days in July and 28 rainy days in August).

In 1976, there was an uninterrupted rainfall from 28th July to upto the first week of September. In August, 1976 a total rainfall of 770 mm in 27 rainy days were recorded.

3. Gibberella ear rot caused by *Gibberella zeae*

In India this disease was reported by Kapoor in 1963 (Kapoor, 1963) from only one stored cob collected from Sikkim, the description of diagnostic symptoms

TABLE 2. Meteorological data for rainfall in mm.

Month	Date	Year			
		1974	1975	1976	1977
June	16	58.42	—	24.89	5.08
	17	43.18	16.76	1.01	—
	18	1.52	60.19	—	—
	19	19.05	43.94	—	30.92
	20	6.50	48.76	—	—
	21	—	—	—	—
	22	—	7.62	25.90	9.39
	23	19.55	12.70	59.80	10.79
	24	—	32.00	—	13.16
	25	17.78	—	17.78	9.65
	26	—	2.50	—	13.20
	27	—	11.93	—	44.35
	28	0.78	10.66	52.83	62.26
	29	—	76.20	80.26	21.59
	30	22.86	50.03	46.99	17.78
July	1	70.35	74.16	47.49	55.11
	2	25.40	134.36	8.89	11.68
	3	36.38	3.30	5.84	17.01
	4	3.04	6.35	34.03	—
	5	53.02	—	—	6.08
	6	—	0.04	—	53.34
	7	26.41	11.43	—	10.16
	8	—	2.03	—	—
Total		324.34	604.96	398.98	381.47

from early stage of infection is however meagre. So an account of disease symptoms as noticed in the field is given below for identifying this new disease.

An early symptoms was the pink to red discolouration of infected area including the husks near the cob tip. But the most characteristic diagnostic symptoms are the presence of bluish-black perithecia of the fungus commonly observed at the tip regions of the ear late in the season. In maximum cases, ear-tip infection was observed but basal infection was not uncommon in the Kalimpong hills. Vivipary was observed in a number of ears which were infected (Fig. 2). An early infection resulted complete rooting of infected ears.

During the four years study, the number of varieties affected ranged from 17.34 to 30.90 per cent with an average disease index of 22.99 per cent, almost similar to that of diplodia ear rot. It is interesting to note that there was a close parallelism between diplodia ear rot and *Gibberella* ear rot infection in all the year of study.

It may be due to the fact that factors which effect the *Gibberella* ear are the same as those in diplodia ear. Both the fungi are reported to more active in cooler and more humid region (Ullstrup, 1960). Both disease incidence and intensity were found to be severe in 1977 next to 1976.

4. *Fusarium* Kernel rot caused by *Fusarium moniliforme*

Though the disease may be widely distributed in drier areas, it was found also in the Himalayan hills specially in the later part of the growing season, when rainfall was low and temperature comparatively warm. Symptoms of disease could only be observed when the husks were removed from the ears. Infected kernels were distributed at random in the mature cobs (Fig. 3).

Average disease incidence (score) of four years appear to support this view point. The highest average disease score of 0.35 was observed when rainfall and temperature in August, 1975 recorded 229.10 mm and 25.21°C (maximum) respectively. Average disease incidence (score) of 1974 and 1977 season was almost similar and rainfall in these two years was also almost same. Lowest average disease incidence (score) of 0.13 were obtained in the year of 1976 when rainfall in August recorded 770.00 mm. However, number of varieties affected ranged from 3.26 to 6.36 per cent the lowest, among the ear rot studied.

5. *Penicillium* and *Aspergillus* ear rot.

Penicillium ear rots were occasionally found in the Kalimpong hills in later part of the season. The disease was comparatively more extensive when mature cobs were exposed to late showers of the season nearing harvest. The same was found to be true in case of *Aspergillus* ear rot caused by several species of *Aspergillus* particularly *Aspergillus niger*. In most cases, species of *Aspergillus* and *Penicillium* were found to be associated together in the same infected ears. *Penicillium* ear rot caused by mainly *Penicillium oxalicum* and other species of *Penicillium* were found to be associated in some cases. Infection in general was very low and restricted to a few varieties. The number of varieties affected due to these disease complex ranged from 4.57 to 9.09 per cent during the four years of study.

DISCUSSION

From the perusal of the data presented, it would be seen that three types of ear rot diseases namely *Rhizoctonia* ear rot, *Diplodia* ear rot, and *Gibberella* ear rot

were found to constitute a major threat to the maize cultivation in the Kalimpong hills which might be considered to be representative of the average agro-climatic conditions in North Eastern Himalayan region. These three types of ear rots cause considerable loss in yield every year in this region. Efforts should be made to develop resistant/or tolerant varieties to over-come this yield loss due to these pathogens. Sometimes cultivation of maize year after year may aggravate the situation. Crop rotation or sanitation measure may be advised to lower down the incidence. Prophylactic measures in the shape of chemical control etc. will not be effective due to high precipitation.

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