

DEVELOPMENT OF BROWN SPOT OF MAIZE (*ZEA MAYS* L.) CAUSED BY *PHYSODEMA MAYDIS* SHAW AS INFLUENCED BY HOST NUTRITION

By

B. B. LAL AND B. P. CHAKRAVARTI

Department of Plant Pathology, Rajasthan College of Agriculture University
of Udaipur, Udaipur, India

Marked effect of nitrogen and phosphorus were found on the infection and subsequent development of brown spot caused by *Physoderma maydis* when these were supplied in different doses as nutrients. The infection were 84.0 and 71.2 when high doses of nitrogen were supplied as compared to 3.3 and 4.71 in control plants belonging to two maize varieties Ganga 5 and Malan. High doses of phosphorus reduced disease, the infection index having 12.7 as against 30.0 in the control. Potassium had no marked effect on infection and disease development.

INTRODUCTION

Brown spot of maize caused by *Physoderma maydis* is much influenced by environmental factors and the systemic nature of the disease has been established, (Lal and Chakravarti, 1975, 1977, 1977, 1977 and 1977). Beside environmental factors, host nutrition has often been found to influence disease development. Some diseases are severe on weak and undernourished plants while others severely attack vigorous growing plants (Castano and Kernkamp, 1956; Daly, 1949; Bloom and Couch, 1960; Krishnaswami, 1952; Stakman and Aamodt, 1924; Suryanarayanan, 1958 and Tisdale, 1919). There is, however, no information available on the effect of nitrogen, phosphorus and potassium on the development of brown spot. In the present work effects of nitrogen, phosphorus and potassium were studied in sand culture on infection and disease development. The results are given below.

MATERIALS AND METHOD

Seeds of 2 maize varieties Ganga 5 and Malan were planted in acid washed quartz sand in (6' diam) plastic pots. Each pot containing 2 seedlings was supplied twice a week with 200 ml, of nutrient solution according to Hoagland and Aron (1950). Each pot was flushed with distilled water after every third day. Fifteen days old plants were inoculated with 2ml sporangial suspension (c. 5×10^8 /ml). Each plant was inoculated thrice at intervals of 1 day. Intensity of the disease was recorded by following an arbitrary scale ranging from 0 to 5, 0 indicating no infection and 5 indicating maximum infection. Infection index was calculated as described earlier (Lal and Chakravarti, 1977). Each treatment was replicated four times and 6 plants were taken in each treatment. Trace elements were similar in all treatments and the pH of the nutrient solution was adjusted to 7.0. For different experiments, KCl, CaCl_2 , $(\text{NH}_4)\text{NO}_3$ and NaH_2PO_4 salts were used for modifying the normal Hoagland nutrient solution.

RESULTS

Nitrogen : The composition of the basal solution was varied so as to contain different levels of nitrogen in the nutrient solution. Treatments were as follows :

- I. Basal nutrient solution without nitrogen (ON)
- II. Basal nutrient solution with nitrogen (0.5N)
- III. Basal nutrient solution (1N)
- IV. Basal nutrient solution with double nitrogen (2N)
- V. Plants grown in distilled water (DW)

In general, there was increased disease with increasing amounts of nitrogen in the basal medium (Table 1) In low level of nitrogen (ON) the infection index was 3.3, in optimum nitrogen (1N) it was 35.8 while in high level of nitrogen (2N), infection index was 84.0 in Ganga 5. The same trend was observed

in case of Malan. In basal medium and in basal medium with 2N, plant growth was vigorous. The plants in low nitrogen level were poorer in growth while plants grown without any nutrient solution and in nitrogen free solution were smaller, paler in colour, distinctly less vigorous with very thin. Plants grown in distilled water did not show any infection except once in Ganga 5, when very few small spots developed and the plants did not survive more than $1\frac{1}{2}$ months,

Table 1 Effect of different levels of nitrogen on brown spot of maize in sand culture.

Treatment	Infection index	
	Ganga 5	Malan
1. ON	3.3	4.17
2. 0.5N	14.8	10.5
3. 1N	35.8	41.9
4. 2N	84.0	71.25
5. DW	0.0	0.83

Phosphorus and potassium: In another experiment plants of Ganga 5 were provided with different concentrations of phosphorus and treatments were as follows :

- 1 Basal nutrient solution BS without phosphorus (OP)
2. BS with $\frac{1}{2}$ phosphorus (0.5N)
3. BS with double phosphorus (2P)
4. BS without potassium (OK)
- 5 BS with $\frac{1}{2}$ potassium (0.5K)
6. BS with double potassium (2K)
7. BS without nitrogen (0N)
8. BS with $\frac{1}{2}$ nitrogen (0.5N)
9. BS with double nitrogen (2N)
10. Basal nutrient solution BS (1H).

Infection index increased with the increase of nitrogen in Hoagland nutrient solution. There was no significant difference in infection indices when plants were supplied with OP, 0.5P and basal solutions but at higher level of phosphorus (2P), infection index was much less. However, there was no significant differences in development of disease on plants grown at high or low levels of potassium (Table 2).

Table 2 Effect of high and low levels of nitrogen, phosphorus and potassium on brown spot of sand culture.

S. No.	Treatments	Infection index
1.	OP	30.0
2.	0.5P	28.85
3.	2P	12.73
4.	OK	35.0
5.	0.5K	29.57
6.	2K	35.0
7.	ON	4.0
8.	0.5N	16.65
9.	2N	44.82
10.	1H	29.57

Combination of nitrogen, potassium and phosphorus : In another experiment, the treatments with varying amounts of N, P and K in basal nutrient solution were taken and the effect of individual as well as of 2 elements in combination at a time were studied. Thus the treatment with solutions having optimum levels of N, P and K was compared with the optimum levels of either N or PK, NK, NP and PK + high nitrogen. Treatments were as follows : The plants were grown in

1. Basal solution (NPK)
2. Solution having only nitrogen (N)
3. Solution having only nitrogen and phosphorus (NP)
4. Solution having only nitrogen and potassium (NK)

5. Solution having only phosphorus and potassium (PK)
6. Solution having double nitrogen with normal phosphorus and potassium (PK 2N)

The quantities of minor elements were similar in all the treatments.

It is evident from the Table 3 that the presence of nitrogen in the treatment predisposed the plants to disease. The basal solution as well as the solutions as with high level of nitrogen (PK 2N) and only nitrogen without P and K (N) consistently revealed high disease intensity. There was no significant difference in infection indices in plants supplied with either NP or NK but it was low when N was omitted from the solution.

Table 3 Effect of NPK and their combination on the development of brown spot of maize

S. No.	Treatments	Infection index	
		Malan	Ganga 5
1.	NPK	40.0	35.2
2.	N	35.0	36.9
3.	PK	9.68	9.0
4.	NK	28.55	33.10
5.	NP	22.8	19.97
6.	PK 2N	49.60	61.52

Different concentrations of balanced nutrient solution: Ganga 5 variety was grown in quartz sand in plastic pots and the plants were provided with different concentrations of Hoagland nutrient solution. The basal solution herein designated as 1H was as described by Hoagland and Aron (1950). The concentration of the major salts in the basal solution (1H) was modified to 0.25, 0.5 and to 2 times (2H). The concentrations of minor elements was identical in all solutions. The plants were inoculated when 15 days old by pouring sporangial suspension. Observations were taken after 1 month of inoculation.

Because of unfavourable weather conditions during the period of experimentation, the infection index was low in all the treatments. However, least

disease developed at the 0.25H concentration of the nutrient solution while maximum infection index was observed at 2H of nutrient solution. The infection index increased proportionately with increase in the concentration of nutrient solution (Table 4).

Table 4 Effect of 4 concentrations of Hoagland's solution on brown spot of maize

S. No.	Concentration of Hoagland's solution	Infection index
1.	0.25H	7.33
2.	0.5H	22.64
3.	1.0H	29.57
4.	2H	46.91

An increase in the concentration of nitrogen increased the infection of brown spot of maize. The results indicate that high nitrogen level has a marked effect on intensity of disease. Maximum infection index (84.0) was observed in plants receiving high level of nitrogen (2N) and minimum (3.3) in case where no nitrogen was present. When the nitrogen level of basal solution was reduced, there was a reduction in the infection index. From these results it is apparent that plants supplied with increased doses of nitrogen become predisposed to disease. Low levels of P had little effect on infection but plants supplied with higher doses of phosphorus had lower infection index (12.73). Perhaps, phosphorus when fed to maize plants in increased amounts is able to protect them, at least to a limited extent, from the pathogen. Similar results have been found with some other diseases (Thayer and Williams, 1966). However, different levels of potassium did not influence the disease intensity. Disease severity was highest at high concentrations of normal Hoagland solution and low at lower concentration. If, nitrogen was omitted from a balanced nutrition, plant development was reduced and disease severity was also reduced. If nitrogen was present in basal solution, there was an increase in disease severity. But omission of P or K did not have marked effect on disease development. In normal and 2H Hoagland solution, plant growth

was more vigorous as compared to plants grown in low concentration of Hoagland solutions i. e. 0.25H and 0.5H. Infection indices were similar higher when plants were more vigorous. Thus it is evident from these results that more vigorous plants are attacked more. Tisdale (1919) made similar observations which were however, not supported by any experimentation.

REFERENCES

- Bloom, J. R. and Couch H. B. 1960. Influence of environment on diseases of turf grasses. I. Effect of nutrition, pH and soil moisture on *Rhizoctonia* brown patch. *Phytopathology*, 50 : 532-535.
- Castano, J. J. and Kernkamp M. F. 1956. The influence of certain plant nutrient on infection of soybeans by *Rhizoctonia solani*. *Phytopathology*. 40 : 326-328.
- Daly, J. M. 1949. The influence of nitrogen source of the development of rust of wheat. *Phytopathology* 39 : 387-397.
- Hoagland, O. R. and Aron D. I. 1950. *California Agri. Exp. Cir.* 347.
- Krishnaswami, C. S. 1952. Influence of nitrogen, phosphorus and potash on the incidence of the rice blast in Madras State. *Madras Agric. J.* 39 : 205-218.
- Lal, B. B. and Chakravarti B. P. 1975. Occurrence, symptomatology of brown spot of maize and survival of the pathogen *Physoderma maydis* show. *Indian J. Mycol. & Pl. Pathol.* 5 : 134-180.
- Lal, B. B. and Chakravarti 1977. Factors affecting development of brown spot on maize caused by *Physoderma maydis*. *Iranian J. Pl. Pathol.* 13 : 6-13.
- Lal, B. B. and Chakravarti B. P. 1977. Root and collar inoculation and control of brown spot of maize by post-infection spray and soil application of systemic fungicides. *Pl Dis. Reprtr.* 61 : 334-335.
- Lal, B. B. and Chakravarti B. P. 1977. Inoculation methods of brown spot of maize caused by *Physoderma maydis* *Indian J. Mycol. & pl. pathol.* 7 : 82-84.
- Lal, B. B. and Chakravarti B. P. 1977 Influence of light on infection and development of *physoderma maydis* in corn. *The philippine Agriculturist*. vol. 61.
- Stakman, E. C. and Aamodt 1924. The effect of fertilizers on the development of stem rust of wheat. *Jour. Agri. Res.* 27 : 341-379.
- Suryanarayanan, S. 1953. Role of nitrogen in host Susceptibility to *pyricularia oryzae*. *Curr. Sci.* 27 : 447-448.
- Thayer, P. and Williams L. E. 1966. Effect of nitrogen, phosphorus and potassium concentration on the development of *Gibberella* stalk and root rot of corn. *phytopathology* 50 : 212-214.
- Tisdale, W. H. 1919. *Physoderma* disease of corn. *Jour. Agri. Res.* 16 : 137-154.