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A STUDY OF CORRELATION BETWEEN SEED AND FIELD INFECTION INTENSITY FOR ESTABLISHING DISEASE TOLERANCE LIMITS IN SUNFLOWER

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SUMMARY

A study has been carried out in the greenhouse in order to establish correlations between seed and field infection intensities and to determine disease tolerance limits. It was observed that the pre- and post-emergence mortality of seedlings increased as the seed infection increased. On the other hand, yield and seed mass decreased with the increase in seed infection. Seed infection levels of 5 to 10 percent due to *M. phaseolina* and *A. alternata* showed no significant effect on yield performance in relation to the control (healthy seeds). It was concluded that with infection levels from 10 to 5 percent due to *A. alternata* and *M. phaseolina*, sunflower seed can be sown safely without seed treatment. This finding may be helpful in reducing the cost of seed and health hazards involved in indiscriminate use of chemicals.

Key words: sunflower, *M. phaseolina*, *A. alternata*, seed infection, field infection, correlation, tolerance limits

INTRODUCTION

Sunflower (*H. annuus* L.) is known to suffer from a number of diseases. Up to now, 90 sunflower diseases have been reported worldwide (Bai *et al.*, 1985). It has been estimated that sunflower diseases cause average annual losses of 12 percent in yield from nearly 12 million hectares under sunflowers in the world (Zimmer and Hoes, 1978). According to Sackston (1981), rust, Verticillium wilt, downy mildew, Sclerotinia wilt and rot, charcoal rot and leaf spots are the main sunflower problems in the USA. Among 25 diseases in China, Xiaojian *et al.* (1988) considered *Alternaria helianthi*, *Septoria helianthi*, *Sclerotinia sclerotiorum* and

Orobanche coerulescens as the most important, causing 10-15 percent losses in yield and even crop failure in some years.

In Pakistan, more than 16 diseases have been reported from different field surveys (Maširević *et al.*, 1987; Mirza and Beg, 1983; Bhutta *et al.*, 1993). Charcoal rot, heat rot and leaf spots appeared to be the most prevalent and serious diseases having maximum incidence up to 93.7, 95.0 and 80.0 percent, respectively (Mirza, 1984; Bhutta *et al.*, 1995). Alternaria leaf spot has been reported to reduce seed and oil yield by 27-80 percent and 17-33 percent, respectively (Balasubrahmanyam and Kolte, 1980; Reddy and Gupta, 1977). Losses during germination period varied from 23 to 30 percent (Balasubrahmanyam and Kolte, 1980; Jhamaria *et al.*, 1975). *M. phaseolina*, the cause of charcoal rot, is of great economic important in arid areas of the world (Kolte, 1985). In the Krasnodar region of the former Soviet Union, the disease was found to reduce head diameter by 30 percent, yield by 10 to 64 percent, 1000-grain mass by 13 to 36 percent and oil contents by 5 to 8 percent (Tikhonov *et al.*, 1976). About 30-40 percent reduction in seed mass occurred due to this disease in India (Raut, 1981). The incidence of this disease in Yugoslavia was reported to be about 30-35 percent, reducing the yield from 20 to 50 percent (Hoes, 1985).

Although much work has been done in various parts of world on charcoal rot and Alternaria leaf spot and these diseases have been found to be the major causes of destruction of sunflower seeds, seedlings and mature plants, there are no many information on the correlation between levels of seed and mature plant infection. Therefore, a correlation study was conducted in order to determine the amount of seed infection capable of starting plant infection in the field and the extent of yield losses caused by various levels of disease intensity. Tolerance limits were established for *A. alternata* and *M. phaseolina*. The investigations may be helpful for minimizing the use of chemicals by using a seed health technology in seed production and certification program (Bhutta *et al.*, 1992).

MATERIALS AND METHODS

This experiment was carried out in a randomized complete block design in three replications with five treatments for each pathogen, i.e., *M. phaseolina* and *A. alternata*. Only one sunflower cultivar, SMH-24, was used for both pathogens. Seedbed was prepared by mixing clay soil, farmyard manure and sand in the 7:3:2 ratio and disinfected by flooding with formalin (40 percent) in water. The seedbed was prepared on three steel tables (10.05 m long and 1.82 cm wide), in the greenhouse. It was covered with polythene for five days. Seeds were sown after eight days. For *M. phaseolina*, plastic bags (size 12 x 18 cm) were filled with this soil and five surface sterilized seeds were planted in each bag. After twelve days, twenty seedlings were maintained in each row with one plant in each bag. Plant-to-plant distance was 23 cm whereas row-to-row distance was 30.5 cm.

Seedlings raised in petri dishes were transferred together with pathogen culture media, covering the seed surface and space in plastic bags to achieve the desired percentages of infection, i.e., 0, 5, 10, 20 and 40 percent. To obtain comparable healthy and infected seedlings, seeds were sown on the same date.

For *A. alternata*, seeds were disinfected with one percent sodium hypochlorite and sown in soil directly. Seeds mixed with *A. alternata* were also sown to achieve the desired percentages of infection (0, 10, 20, 40 and 80 percent) in all the treatments. The plant-to-plant and row-to-row distances were the same as in *M. phaseolina*. Seeds were covered with a 2 cm layer of soil. Irrigation was provided by the sprinkler system of the greenhouse as required. The post-emergence mortality of seedlings was checked and recorded after one month. Disease assessment was carried out on the scale 1-5 at maturity stage. Yield data were taken and analyzed statistically.

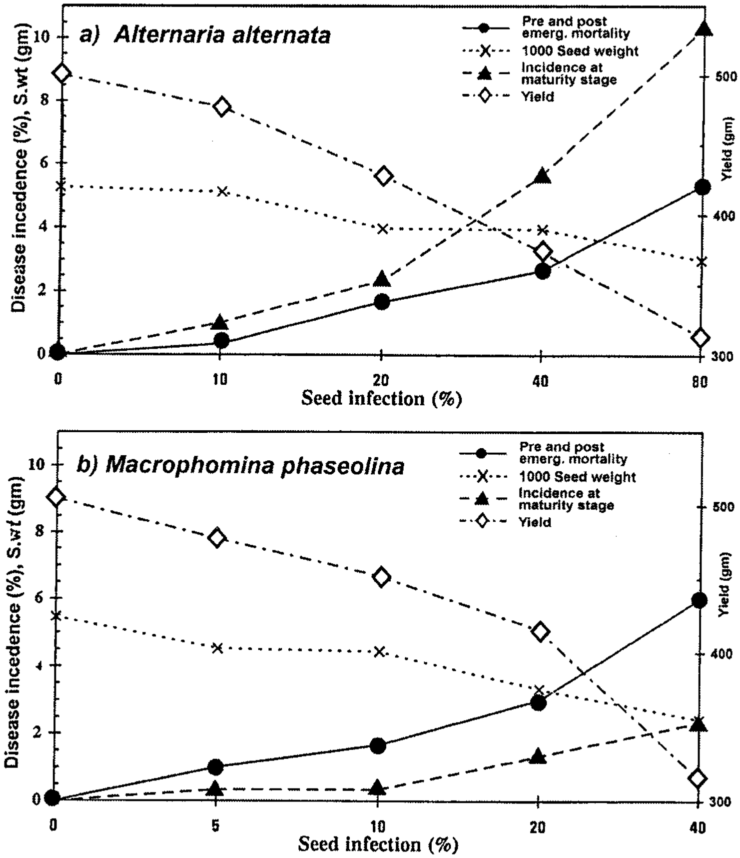

Figure 1: Greenhouse experiment for correlation of seed to field incidence of pathogens

RESULTS AND DISCUSSIONS

Pre- and post-emergence mortality increased due to increase in seed infection by *A. alternata* and the disease incidence increased similarly at plant maturity. On the other hand, 1000-seed mass showed a negative correlation to seed infection (Figure 1a). From the various seed infection levels (10, 20, 40 and 80 percent), the level of 10 percent seed infection by *A. alternata* was found to give no significant differences in yield and 1000-seed mass when compared with the control.

M. phaseolina caused high levels of pre- and post-emergence mortality at 10, 20 and 40 percent seed infection which were negatively correlated with 1000-seed mass and yield (Figure 1b). The seed infection level of five percent showed no significant effect on yield compared with the control. Mirza *et al.* (1984) reported that *M. phaseolina* caused 1.18 to 30 percent sunflower seedling mortality and 7.97 to 58.84 percent incidence in mature plants of various sunflower hybrids. It is not known what was the level of seed infection in that study. In the present study, seed infections of more than 5 and 10 percent for *M. phaseolina* and *A. alternata*, respectively, should not be sown because the higher infection levels caused high seedling mortality and significant yield reductions.

CONCLUSIONS

Regular assessment of the intensity of occurrence of seed-borne pathogens through seed health testing technology and use of disease tolerance limits may minimize the indiscriminate use of chemicals. It will be helpful not only for reducing the cost of seed but also for avoiding health hazards and environmental pollution.

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ESTUDIO DE CORRELACIÓN ENTRE SEMILLAS Y LA INFECCIÓN EN EL CAMPO PARA LA DETERMINACIÓN DE VALORES LIMITES DE APARIENCIA DE ENFERMEDAD EN EL GIRASOL

RESUMEN

El estudio ha sido emprendido en el invernadero para constatar las correlaciónes entre semillas y la intensidad de apariencia de enfermedad en las semillas en el campo y para determinar valores limites de apariencia de enefermedad. Fué notado que la mortalidad de plántulas antes y después de la germinación se aumentaba con el aumento de infección de semilla. Por otro lado, el aumento de infección de semillas causaba la reducción de rendimiento y de masa de semilla. Los niveles de infección por los hongos *M. phaseolina* y *A. alternata* de 5 a 10% no tenian una importancia importante sobre el rendimiento con respecto al control (semillas sanas). La conclusión ha sido hecha que es posible, a los niveles de infección por los hongos *M. phaseolina* y *A. alternata* de 5 a 10%, de hacer la siembra aun sin tratar semillas. Esta conclusión puede ser util para reducir el precio de semillas y evitar los problemas sanitarios por la utilización demasiada de productos quimicos.

ETUDE DE LA CORRELATION ENTRE L'INTENSITE D'INFECTION DE LA SEMENCE ET DES CHAMPS DANS LE BUT DETERMINER LES LIMITES DE TOLERANCE A LA MALADIE DANS LE TOURNESOL

RÉSUMÉ

Cette étude faite en serre a été entreprise dans le but d'établir les corrélations entre les intensités d'infection dans les semences et dans les champs et pour déterminer les limites de tolérance à la maladie. On a observé que la mortalité de la plantule avant et après la germination augmentait avec l'augmentation de l'infection de la semence. De plus, l'augmentation de l'infection de la semence conduit à une diminution du rendement et de la masse. Après comparaison avec les groupes de contrôle (semences saines), on constate que le niveau d'infection de 5 à 10% dû aux champignons *M. phaeseolina* et *A. alternata* n'a pas d'influence significative sur le rendement. On peut donc conclure qu'à des niveaux de 5 à 10% d'infection par les champignons *M. phaseolina* et *A. alternata*, on peut semer en toute sécurité sans traiter la semence. Ceci permet donc une diminution du coût de la semence mais aussi du danger que représente pour la santé une trop grande utilisation de produits chimiques.