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A re-evaluation of geographical distribution of charcoal rot on sunflower crop in various agroecological zones of Pakistan

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Abstract

A countrywide survey was conducted to update the status of charcoal rot on sunflower crop in Pakistan. During survey, charcoal rot was observed as a serious threat to sunflower. The areas like Bahawalpur, Rahim Yar Khan and Sahiwal which were reported disease free in 1996, showed occurrence of the disease but Sahiwal showed high incidence and severity in 1999. Distribution of the disease in Sindh, Punjab and NWFP provinces was 85, 83 and 48% respectively. Among Provinces NWFP showed highest incidence57%, and Punjab exhibited highest severity 2.62 according to 0-5 severity rating scale. Continuous increasing trend of charcoal rot is alarming for farmers and authorities engaged in sunflower business.

Introduction

In Pakistan sunflower is cultivated on 37935 hectares with 42713 metric tons production with 22 mounds per hectare average yield. The area and production of sunflower is higher than other non conventional oilseed crops (http://www.statpak.gov.pk). The average per hectare yield of sunflower in Pakistan is much lower than Russian Federation, United States of America, Egypt, Argentina, and India, which are the leading countries for sunflower production. Average per hectare yield of these countries ranges from 2300 to more than 2800 Kg/hectare (FAO, 1999).In spite of the low yield factor it has the potential to bridge the gap between production and consumption of edible oil in Pakistan because of its short duration (maturation period 90-110 days), high oil content and adaptability to a wide range of climatic variations. Low yield of sunflower in Pakistan can be attributed to several biotic and abiotic constraints. The important factors are lack of production of good quality seed for cultivation, post harvest treatment facilities and unplanned marketing system. However, pests and diseases play a major role in this regard. Rana (1999) and Zimmer and Hoes (1978) reported that, on an average, diseases cause losses of 12% in yield to sunflower from nearly 12 million hectare in the world. Until now more than 25 diseases have been reported on sunflower in China (Xiang *et al*., 1988). Mirza and Beg, (1983) conducted first survey of the sunflower crop in the central and northern areas of Pakistan and reported up to 90% yield losses due to *M. phaseolina* in Pakistan.

Charcoal rot of sunflower was reported for the first time from Faislalabad (Mirza, 1984) and later from other areas of Punjab, Sindh and NWFP as a serious threat to sunflower (Mirza and Beg, 1983; Steven *et al*., 1987). In Pakistan charcoal rot is associated with maturity of plants under water stress. Favorable conditions for the development of the pathogen may lead to the death of plant or failure of the crop. Up to 60% yield losses due to charcoal rot have been reported (Steven, *et al*., 1987). The fungus is soil, seed and stubble borne. The evidence suggests that it is primarily a root inhabiting fungus and produces tuber or cushion shaped black sclerotia, 1-8 mm diameter. These sclerotia serve as a primary means of survival (Smith, 1969; Mirza, 1984; Kaisar, *et al*., 1988). Khan *et al*. (1999), conducted a survey on major diseases on sunflower and reported charcoal rot a serious threat to the crop. The present studies were conducted to update the statistics on frequency and severity of charcoal rot of sunflower in Pakistan.

Materials and Methods

During May-June, 1999 when the crop acquired its physical maturity stage a total of 700 ha were inspected from 109 fields of 13 agro-ecological zones of the country (Figure 1). During survey, fields were examined in a zigzag or diagonal schemes depending upon geometry of the field. A questionnaire was designed to document pathological and socioeconomic factors affecting cultivation of sunflower in the country. The prevalence, incidence and severity of the disease were recorded. The surveys were conducted in Sindh, Punjab, and NWFP provinces of the country on a planned route starting from south (Lower Sindh) to North (NWFP Province). In Lower Sindh crop achieves its maturity in the month may is sown earlier than rest of the country During survey 0.40 ha was considered as basic unit and data for severity of disease were recorded on the basis of % incidence and severity rating was recorded on a 0-5 rating scale (Figure 1).

$$\text{Prevalence} = \frac{\text{No. of sites showing charcoal rot}}{\text{Total no. of sites inspected in a zone}} \times 100$$

$$\text{Incidence} = \frac{\text{No. of Plants showing charcoal rot}}{\text{Total no. of plants in the field}} \times 100$$

Key:

Sindh

a. Lower Sindh, Sunflower cultivated as major crop.
   1. Umar Kot, 2. Badin, 3. Hyderabad.
b. Upper Sindh, Sunflower is not cultivated as major crop as it is the newly introduced in this region.
   4. Sukkur

Punjab

Lower Punjab
Cotton Zone
i. Sunflower is not cultivated as major crop.
   1. Rahim Yar Khan, 2. Bahawalpur.
ii. Sunflower cultivated as major crop.
   Multan.
Central Punjab
iii. Mixed cropping zone
   Sahiwal, Pakpattan.
iv. Rice Zone
   Gujranwala, Sialkot.

NWFP

1. Kohat, 2. Peshawar, 3. Nowshehra, 4. Dera Ismail Khan.

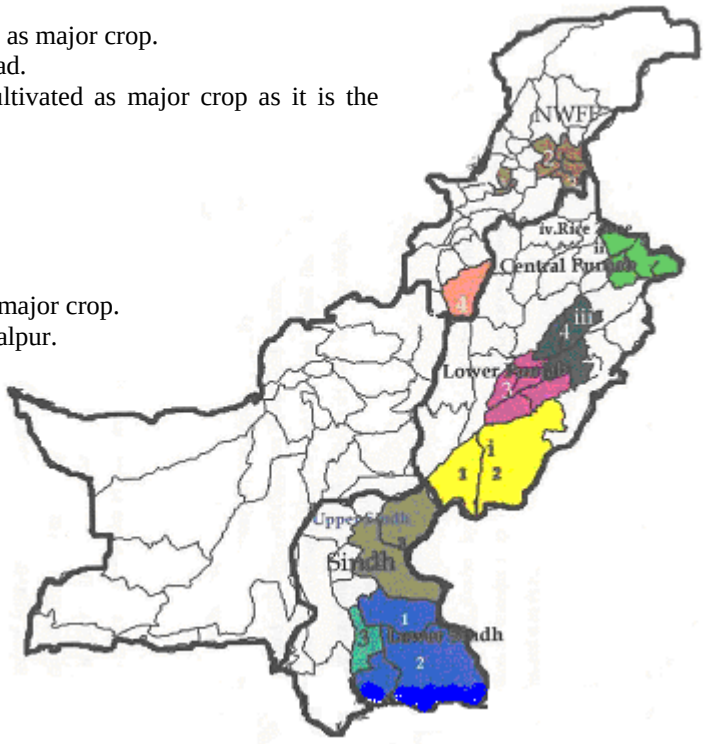

Figure 1: Zonal allocation for assessment of status of charcoal rot of sunflower crop in Pakistan.

Results and Discussions

Charcoal rot was found widely distributed with high incidence and severity. The average distribution of the disease in the provinces of Sindh and Punjab was approximately equal i.e 85 and 83% respectively. In the NWFP province, distribution of the disease was 48%. Sindh province showed 36.91% incidence and 1.82 severity rating. Due to high moisture in soil and atmosphere prevailing in the coastal areas of Sindh, incidence and severity of charcoal rot was lesser than in Punjab and NWFP. The incidence and severity rating of the disease was significantly higher in Punjab and NWF Charcoal rot ı Sindh (Fig. 2). The cropping hist(these fields

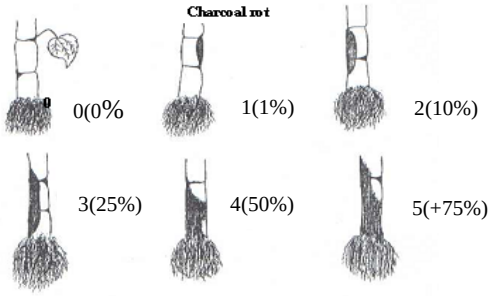

Fig.2: Visual scale for evaluating severity of charcoal rot (on the basis of % tissue damage) under field conditions.

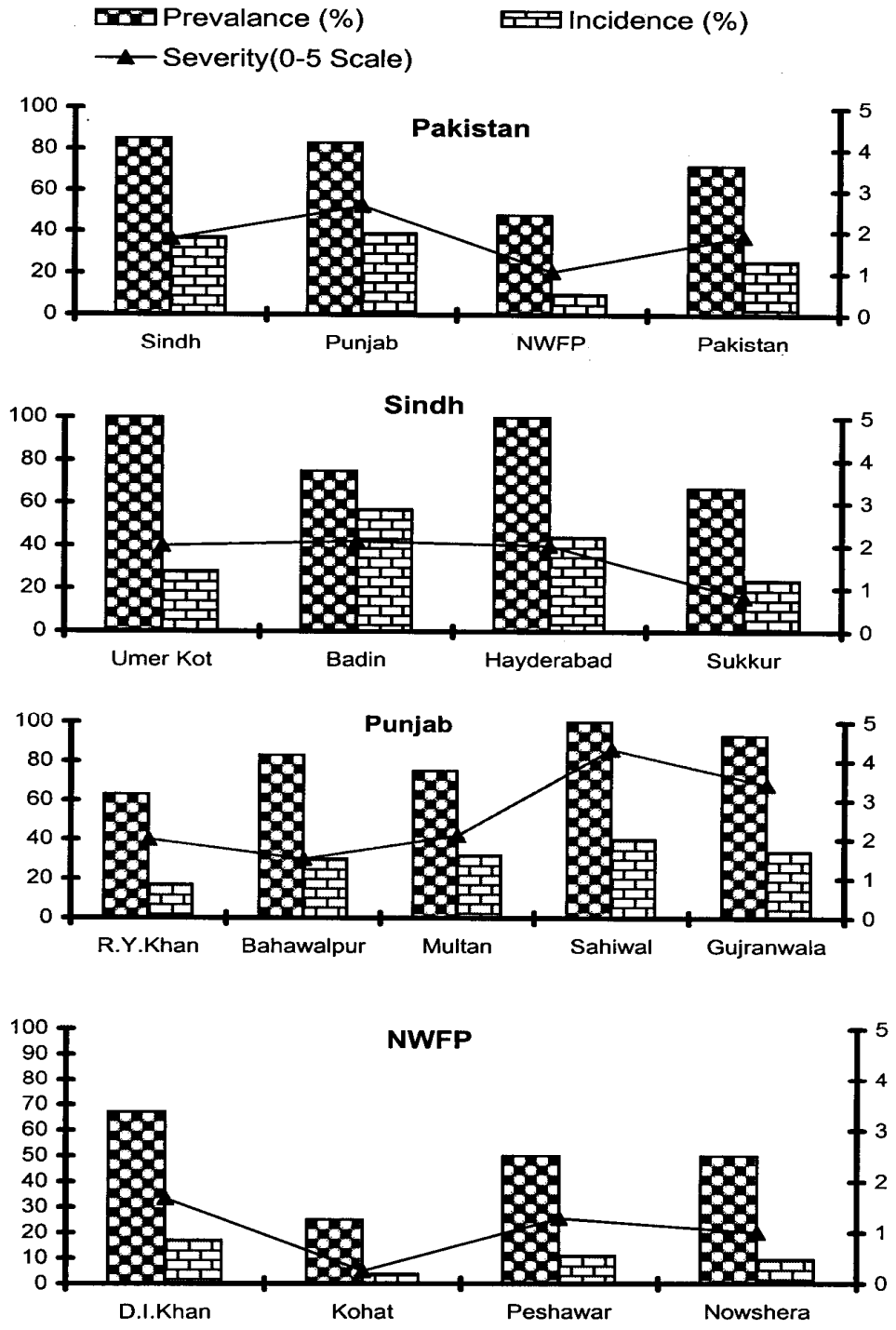

Fig. 3: Status of charcoal rot of sunflower in various agroecological zones of Pakistan.

sunflower had been cultivated continuously for several years and crop rotation with *M. phaseolina* host crops is practiced, which resulted in the increase of sclerotia count of fungus in the soil. Average disease prevalence and incidence of charcoal rot was higher in cotton than in rice zone. High temperature with low soil moisture prevails in the cotton zone, which favors the development of *M. phaseolina*. In Lower Sindh hot and humid climate prevails disease statistics for the observed parameters are higher than Upper Sindh (figure 2). Lower Sindh is coastal zone, and consists of Umerkot, Badin and Hyderabad districts where sunflower is cultivated. The area marked as Upper Sindh consists of Sukkur to the Obaro Taaeluka (Tehsil) borders of Punjab are separated from Sindh. In Lower Sindh sunflower is major crop and is cultivated since long time and monovarietal culture prevails i.e Hysun 33 is cultivated on most of the areas this is susceptible to charcoal rot, better marketing and comparatively higher yield are the main factors favored the repeated cultivation. In Upper Sindh sunflower is a recent introduction and inoculum of *M. phaseolina* is not present in high concentration besides this cultivation of improved hybrids is also in practice. In Rahim Yar Khan and Bahawalpur districts of Punjab cultivation of sunflower is subjected to crop health and marketing trend of cotton. In these zones initial crop was cultivated in the river belt, where danger of flood is expected (Figure 1). Cropping culture resembles that of Upper Sindh where high moisture and relatively low temperature are unfavorable for the development of *M. phaseolina* in rice zone. Besides increasing sclerotia count of *M. phaseolina* in the soil, high temperature and moisture stress also increases susceptibility of the host. In moist soil, sclerotia of *M. phaseolina* rapidly loose their viability and fungus fails to regulate water contents in constitutive dormancy. In highly moist soils availability of O_2 is reduced or level of CO_2 volatizes, which results in a decrease of population density of *M. phaseolina* in rice zone (Singh *et al.*, 1990 and Olya *et al.*, 1996).In case of charcoal rot soil inoculated with *M. phaseolina* plays more effective role than seed borne *M. phaseolina*.. For better management of the disease, soil management and strict quarantine measures should be adapted (Rana 1999).

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