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SURVEILLANCE OF FUNGAL DISEASES ON SUNFLOWER CULTIVARS AND HYBRIDS IN DIFFERENT AREAS OF PUNJAB PAKISTAN

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ABSTRACT

The study's objectives were to report the fungal diseases of sunflower hybrids present in different areas of Punjab and to record their incidence in these areas. For this purpose, surveys of sunflowers' summer crops were conducted in various areas of Punjab (Chakwal, Faisalabad, and Sargodha), Pakistan, during October 2020, for the collection of data. The incidence of leaf spot was recorded maximum in Chakwal (40%), Faisalabad (34%), and Sargodha (40%), whereas the prevalence of phomopsis was lowest in Chakwal (24%), Faisalabad (22%), and Sargodha (20%). Leaf spot and leaf blight were with high incidence (maximum 40% both, respectively) and widely distributed in three regions of the Punjab than remaining other fungal diseases. The other diseases observed in these areas were charcoal rot (30%), phoma black stem (22-30%), rust (26%), verticillium wilt (22%), powdery mildew (23-30%) and phomopsis stem canker (24%). A significant difference in the incidence of fungal diseases was also observed in different locations. The current study provides baseline information about the prevalence of fungal diseases in different areas of Punjab. It will help in design new studies regarding these diseases so that future epidemics of these fungal diseases can be avoided.

Keywords: Incidence, sunflower, charcoal rot, phoma black stem, rust, verticillium wilt.

INTRODUCTION

Sunflower (*Helianthus annuus* L.), common name Surajmukhi, has its place in Asteraceae family and is a short seasoned plant. *Helianthus* genus has 70 distinct species. (Vilvert *et al.*, 2018). *Helianthus* name is given to it because it follows the sun and its shape looks like it. *Helianthus* obtained from Helios (the sun) and Anthos (a blossom). It has a property that it always turning towards sun direct rays. Sunflower is an annual plant

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with an enormous inflorescence (blossoming head), stem of the plant is hairy and rough, the head of the flower is circular, and the leaves are rough (Puttha *et al.*, 2023). The head contains many individual flowers that are later converted into seeds. Sunflower is used for different purposes, its seeds are eaten, and the dried stalk is charred. Sunflower is the fourth biggest oil seed crop. It had been used in ancient rituals as a decorative herb. Sunflower have some medical importance and is also used in the textile industry for body painting and different designs. Sunflower oil is utilized in serving of mixed greens dressing, cooking, and margarine (Shahgholian and Jalilpiran, 2022).

Sunflower is useful crop in many ways like it is an important source of edible oil and its seeds are used as a food. It absorbs radioactive material and other pollutants from the

soil without much harm to the plants. Its seeds are rich source of vitamins. It has gained popularity because of usage as a feedstock crop for biodiesel (Mahmood *et al.*, 2022). The cultivation of sunflower can limit the import of edible oil from other countries to Pakistan. Reducing the issues between local sunflower production and import production can save a lot of money, which is then used in different agriculture sectors. The government should take notice of sunflower production and provide subsidy for its production. Government should establish a research Centre for sunflowers. Awareness to farmers about sunflower cultivation can earn good income and meet the demand for edible oil because it is sown in both spring and autumn seasons (Yaseen *et al.*, 2022).

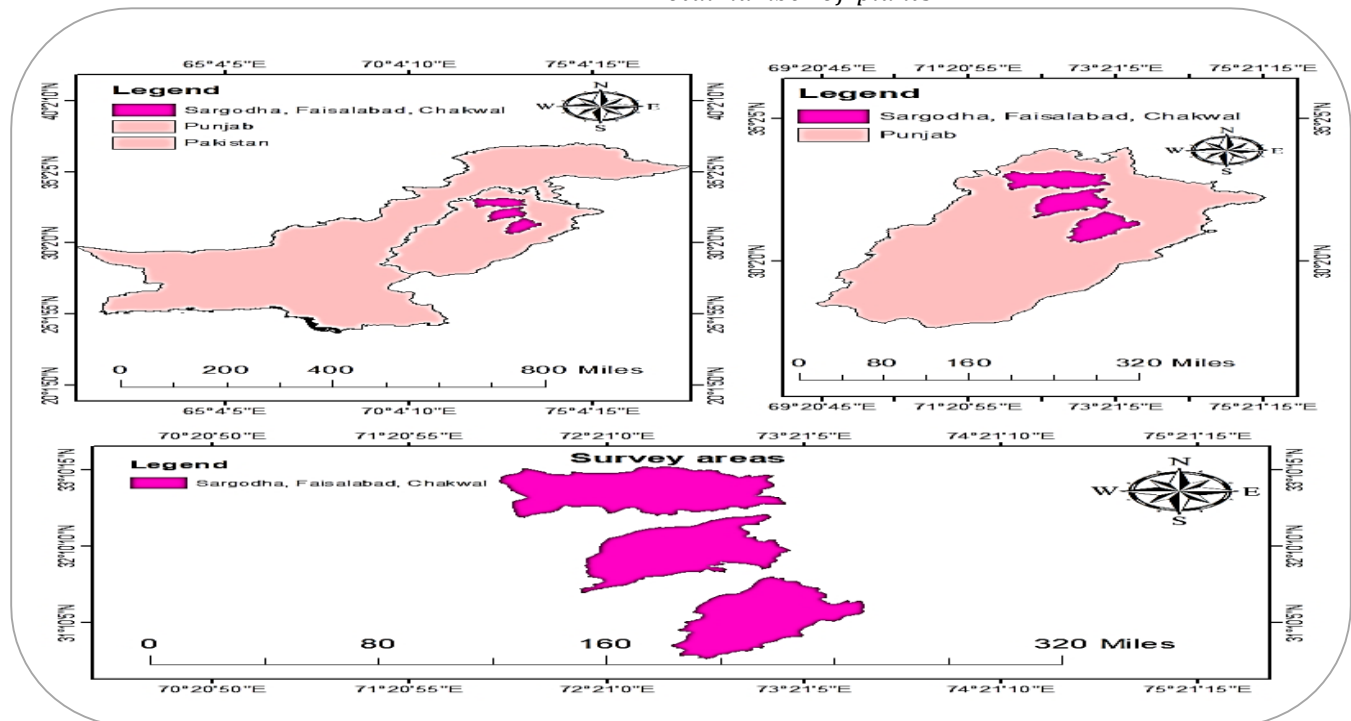
Sunflower have some interesting agronomic features as compared to other basic oil crops like canola and soybean; it gives great yield in natural situations and can be grown effectively at both little farm and huge field scales with the usage of fewer agriculture inputs as compared to other crops and a permanent source of food for farmers having low land. To maintain the high yield of sunflower, it is also important to reduce the yield losses caused by different sunflower fungal diseases (Saif *et al.*, 2023). Currently, scarce information is available on the fungal diseases of sunflowers prevalent in Punjab, Pakistan.

The primary goal of this research was to document the distribution and frequency of fungal infections across the province of Punjab.

MATERIALS AND METHODS

Survey Procedure: A survey was arranged to collect data from three different locations (Figure 1) viz., Sargodha, College of Agriculture Research Area (CARA), Faisalabad, Ayoub Agricultural Research Institute (AARI) and Chakwal, koont Research Farm (KRF)] were selected, and each area was visited three times for the collection of data on different fungal diseases of sunflower at different stages. A color sheet containing various fungal diseases was taken to the field for easy identification. For data collection, 4 corners and one from the center of the field were selected. Randomly 10 plants were selected from each corner and center of the field and then diseases were identified and incidence was noted. The diseases which were observed were (1) Septoria Leaf Spot, (2) Charcoal Rot, (3) leaf Blight, (4) Sclerotinia stalk, (5) Rust, (6) downy mildew, (7) Powdery Mildew, (8) Phoma Black Stem (9) Phomopsis Stem Canker (10) Verticillium Wilt and (11) Head Rot. The number of plants displaying disease symptoms were counted, and the percent incidence for each disease was determined to meet this study objective. For the calculation of disease incidence following formula was used:

$$Disease\ incidence\ (\%) = \frac{Number\ of\ diseased\ plants}{Total\ number\ of\ plants} \times 100$$



Map of Pakistan indicating the survey areas for data collection of fungal diseases of sunflowers

DATA COLLECTION

The data was collected based on primary symptoms of fungal diseases in sunflowers. The data was collected by visiting different fields of sunflowers in different areas during October 2020.

STATISTICAL ANALYSIS

Survey technique, i.e., the cross method, was used to collect the data. Further, statistical tools such as average, incidence, standard deviation and standard error were

used for the analysis of data (Steel *et al.*, 1997).

RESULTS

Response of sunflower variety PRC1 against different fungal diseases at KRF: On this cultivar, the diseases observed were leaf spot, leaf blight, head rot, powdery mildew, and phomopsis stem rot canker. The incidence of leaf spot was significantly ($P \leq 0.05$) high (40%) while incidence of phomopsis was low (24%) (Figure 1).

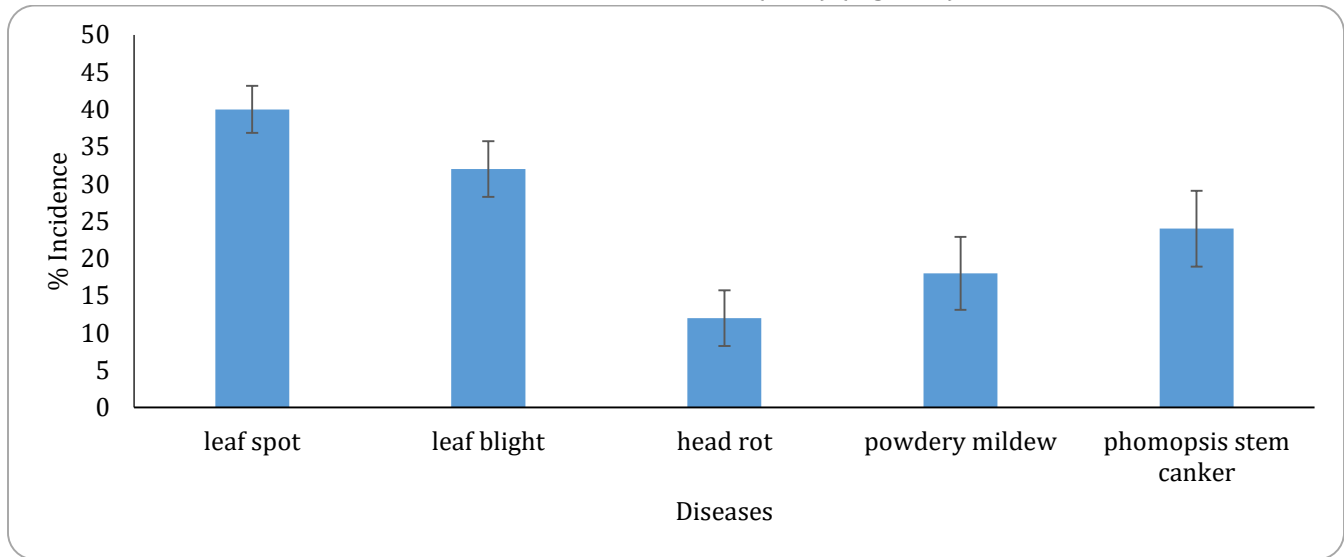


Figure 1. Percent incidence (mean±SE) of fungal diseases on variety PRC1 at KRF.

Response of sunflower variety Hyson-33 against different fungal diseases at AARI: The diseases observed on this variety were leaf spot, leaf blight, phoma black stem,

leaf rust and Verticillium wilt (Figure 2). The incidence of leaf spot was significantly ($P \leq 0.05$) high (34%) while incidence of phomopsis was low (22%) (Figure 2).

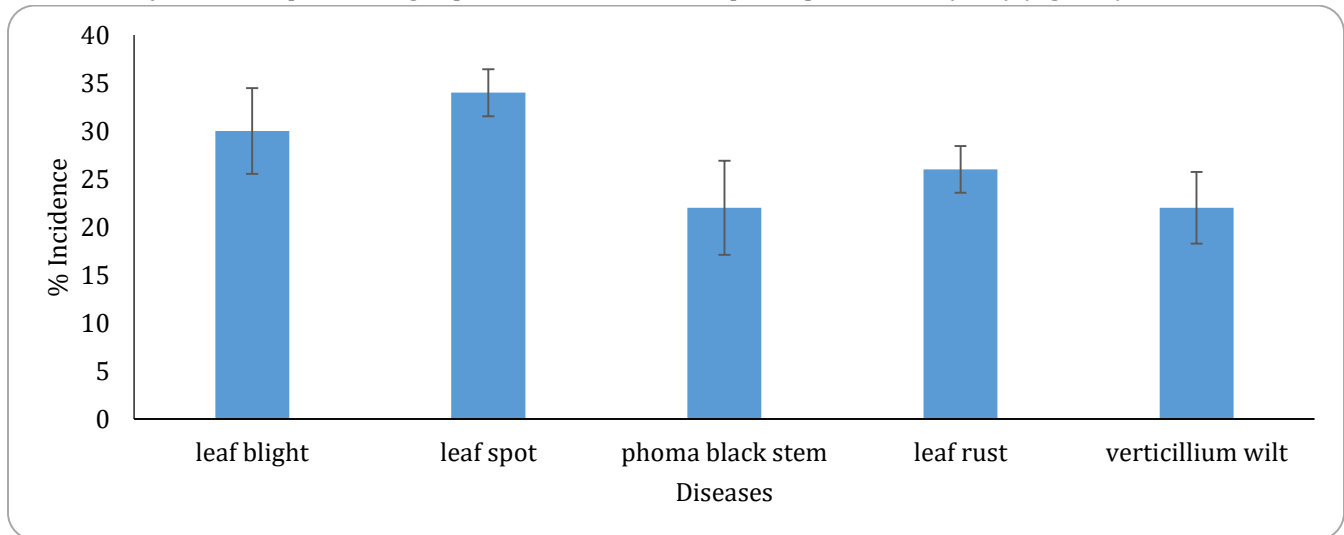


Figure 2. Percent incidence (mean±SE) of fungal diseases on variety Hyson-33 at AARI.

Response of sunflower hybrid C291 against different fungal diseases at CARA: On this hybrid, the diseases observed were septoria leaf spot, leaf blight, charcoal rot, sclerotinia stalk rot, phoma

black stem and powdery mildew. The incidence of leaf spot was significantly ($P \leq 0.05$) high (40%), while incidence of powdery mildew was low (20%) (Figure 3).

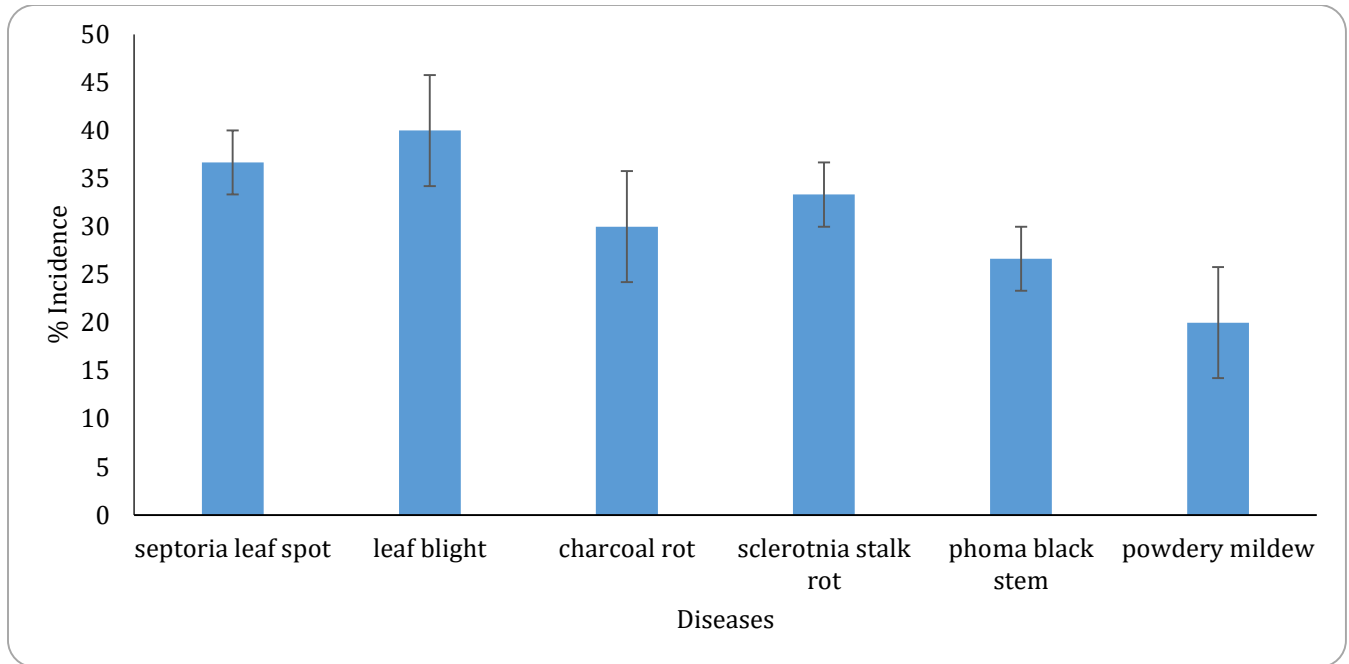


Figure 3. Percent incidence (mean±SE) of fungal diseases on hybrid C219 at CARA.

Response of sunflower hybrid C208 against different fungal diseases at CARA: On this hybrid, the diseases observed were also septoria leaf spot, leaf blight, charcoal rot, sclerotinia stalk rot, phoma

black stem and powdery mildew. However, the incidence of septoria leaf spot was significantly ($P \leq 0.05$) high (47%), while incidence of leaf spot was low (27%) (Figure 4).

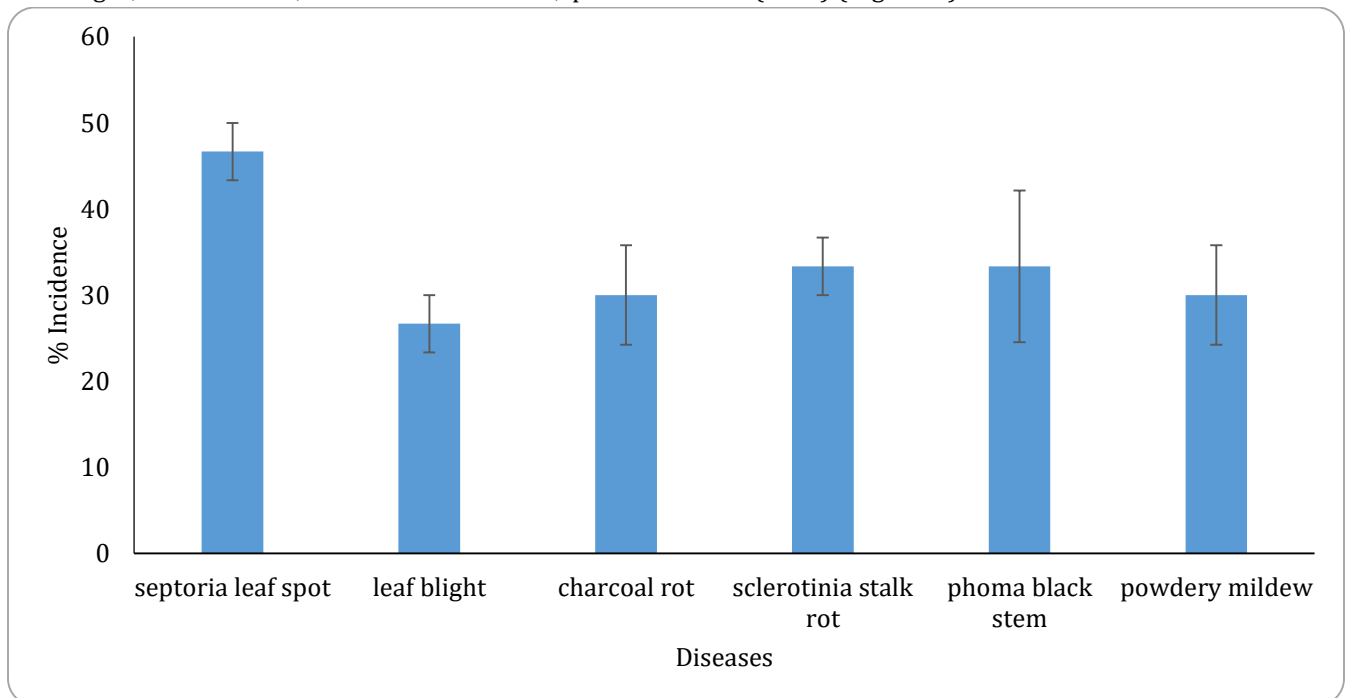


Figure 4. Percent incidence (mean±SE) of fungal diseases on hybrid C219 at CARA.

Response of sunflower hybrid C250 against different fungal diseases at CARA: On this hybrid, the diseases observed were comparable to hybrids C291 and C250; however, the incidence of diseases

was different. On this hybrid, the incidence of septoria leaf spot was significantly ($P \leq 0.05$) high (40%), while incidence of powdery mildew was low (23%) (Figure 5).

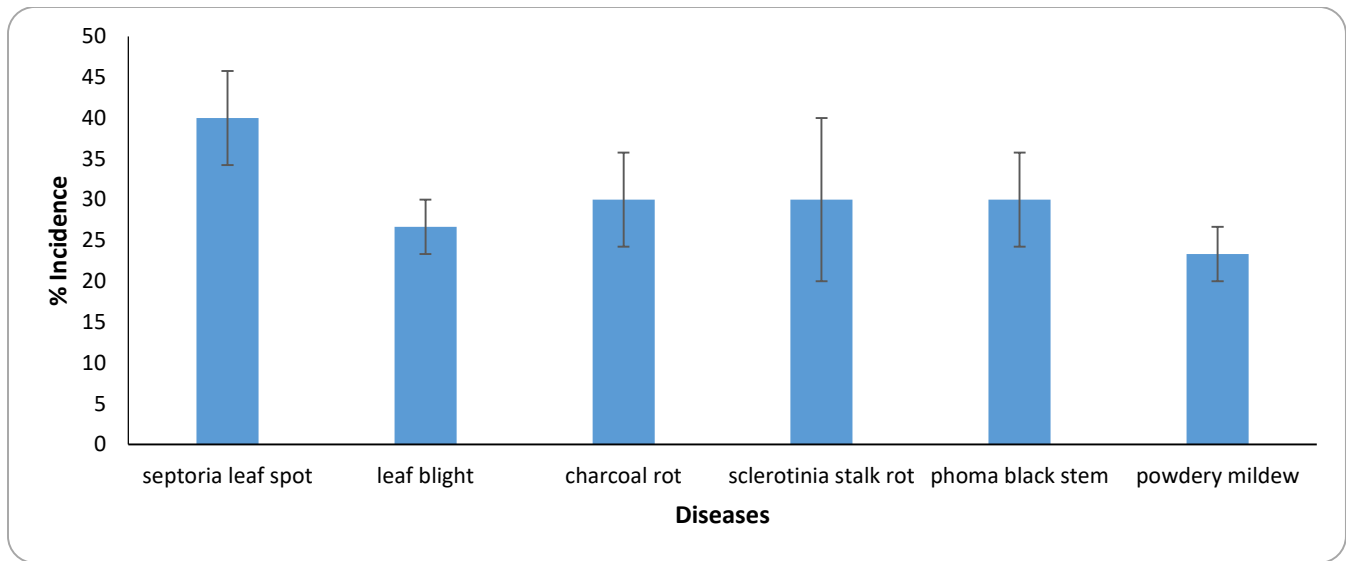


Figure 5. Percent incidence (mean±SE) of fungal diseases on hybrid C250 at CARA.

Response of sunflower hybrid C116P against different fungal diseases at CARA: On this hybrid the diseases reported were septoria leaf spot, leaf blight, charcoal rot, sclerotinia stalk rot, phoma black

stem and powdery mildew. However, the incidence of septoria leaf spot was significantly ($P \leq 0.05$) high (40%), while incidence of powdery mildew was low (23%) (Figure 6).

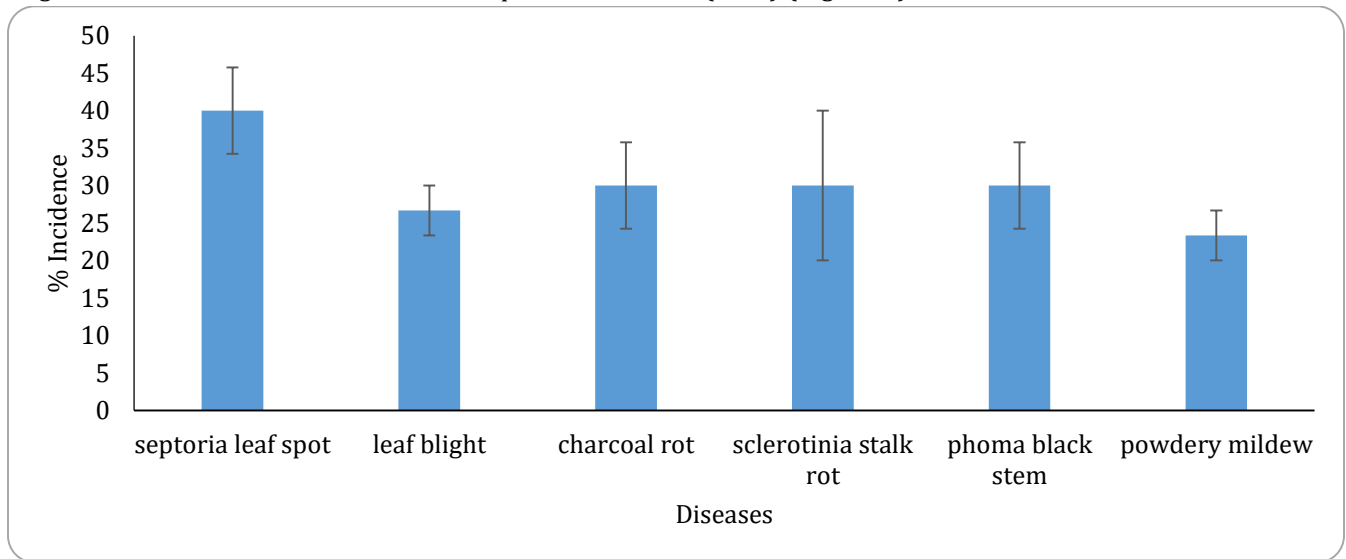


Figure 6. Percent incidence (mean±SE) of fungal diseases on hybrid C116P at CARA.

DISCUSSION

Our surveys provided very useful information regarding the occurrence of sunflower diseases in different areas of Punjab. Surveys are the only way to record numerical sunflower disease data in different regions or countries. Surveys are the common practice to monitor the incidence of diseases in any region of the country (Ajith *et al.*, 2023). Usually governmental or non-governmental agencies and university research groups arrange surveys. Surveys are always planned for shorter area and narrow-geographic regions for a limited period and only for few stress causing

factors (Gulya *et al.*, 2019). In Europe, where sunflower is commonly grown, multi-country disease surveys' history dates back to 1970 and continued spasmodically until the 1980s. The prime objective of these surveys was to judge whether there is presence of sunflower diseases or no. Still, in these surveys, no incidence data was recorded. From 1980 to 1990, phytopathologists arranged several surveys in their countries and reported several diseases on sunflowers (Sara *et al.*, 2022).

Present investigation proved most effective to understand the response of different cultivars and hybrids against

fungal diseases in different areas of Punjab. To check the response of cultivars/hybrids, a questionnaire was developed. This in line with the findings of Lamey (1994). They planned surveys in USA when acreage under sunflower cultivation increased. They undergone surveys and collected response of USA farmers. They distributed around 4,000-8,000 questionnaires to sunflower farmers through the mailing list of *Sunflower* magazine. They focused only on North Dakota growers during the first year. In the coming years, the surveys were expanded to Minnesota, Kansas and South and North Dakota (Lamey, 1992). The questionnaires were having questions about diseases, weeds and insects of sunflower together with pesticide use. The farmers were asked about a list of diseases on the basis of their significance from 1 to 9. The questionnaires also focused on Sclerotinia diseases, their incidence, lodging, and head rot occurring through Sclerotinia diseases. The 7-15% farmers respond to these questionnaires annually, and results are published accordingly (Lamey, 1994). In 2001, NSA (the National Sunflower Association) arranged surveys for more robust quantification and identification of factors reducing sunflower yield in the USA. Comprehensive surveys were conducted under the leadership of experts' team on national level. During these surveys, the first challenge was the cultivation of sunflower on vast area of USA. The crop sunflower in USA is cultivated over 2,000 km between North Dakota to Southern Texas. To overcome this challenge, the pathologists of North-Dakota and South-Dakota State Universities along with the pathologists of Minnesota State University were assigned duties for surveys. Similarly, services of pathologists of seed companies were also taken. This survey obtained comprehensive information about the incidence of several sunflower diseases (Gulya *et al.*, 2019). Our findings also report phomopsis stem canker and head rot disease in different areas of Punjab. These both diseases have also been reported during surveys in USA (Mathew *et al.*, 2015; Harveson *et al.*, 2018). We also reported the presence of charcoal rot, leaf rust, phoma black spot and powdery mildew diseases in different areas of Punjab, which is in line with the findings of different researchers (Donald *et al.*, 1987; Gulya *et al.*, 2011; Harveson *et al.*, 2018; Gilley, 2017; Berghuis *et al.*, 2018). These researchers have confirmed their presence in different countries also.

CONCLUSIONS

We revealed the presence of several fungal diseases of sunflower in different parts of the province, Punjab,

Pakistan. Among these diseases, septoria leaf spot and leaf blight were the most prevalent.

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Contribution of Authors:

Salman Ahmad:	:	Designed the experiment and wrote the manuscript
Nazakat Hussain	:	Performed the experiments
Malik A, Rehman	:	Helped in designing the experiment
Irfan Ahmad	:	Edited the manuscript
Yasir Ali	:	Reviewed manuscript
Muhammad E.U. Haq	:	Analyzed the data
Ikram-ul-Haq:	:	Helped in data analysis
Muhammad A. Zardari	:	Prepared figures
Kamra Mahmood	:	Helped in editing the manuscript