PATHOLOGICAL EFFECTS OF MACROPHOMINA PHASEOLINA (TASSI.) GOID ON SUNFLOWER (HELIANTHUS ANNUS L.)

BY

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Abstract

Macrophomina phaseolina (Tassi.) Goid was isolated from sunflower plants showing typical charcoal rot symptoms. The pathogen causes pre-and post-emergence damping-off at low frequency, but its major damage occurs on mature plants. The disease was most prevalent at Behera and less frequent at Giza, Beni-Suef and Minia.

Pathogenicity of 4 isolates of the pathogen was tested on sunflower plants. The pathogen did not appreciably affect seed germination at the pre-and post-emergence stages, while considerable loss was recorded on 8 weeks-old plants. Slight differences were recorded between the pathogenicity of the tested isolates especially 3 weeks after sowing.

The disease significantly decreased the seed yield per plant in all tested sunflower cultivars by 15.0-52.2%. Head diameter was reduced by 27.1-41.1%. and average weight of 1000 seeds was also reduced by 5.3-12.5 %. The oil content and the average oil yield per plant were reduced by 3.6-10.8% and 22.4-53.9 %. respectively.

These findings indicate the significant economic loss due to this disease on sunflower plants in ARE.

Introduction

Sunflower (Helianthus annus L.) is one of the most impotant oil crops in the world. Total cultivated area in ARE. was 20.126 feddans in 1976 season giving a total seed yield of I3, 475, 320 kg. However, the total acreage of sunflower decreased to 17, 381 in 1977 season (Anon,1978).

Sunflower in Egypt is subjected to several destructive diseases during seedling and mature stages (El-Helaly et al., 1966; El-Zarka, 1976; Abdelal et al., 1978 and Maklad, 1978). From which, Macrophomina phaseolina attacks sunflower plants causing pre-and post-emergence dapming-off at the seedling stage, wilt at pollination and charcoal rot at the mature stage (Acimovic, 1962; Bekesi, 1970; Bekesi et al., 1970 and El-Zarka, 1976).

This work was conducted to study the frequency of the charcoal rot disease on sunflowers in different locations cultivating the major areas of the crop in Egypt. Pathogenicity of several isolates was studied. Pathological effects on seedlings and growing plants as well as yield components (i.e. seed yield, head diameter, oil content and oil yield) were investigated.

Material and Methods

Seedlings or mature plants of sunflower showing symptoms of root rot and charcoal rot were collected from different Governorates namely; El-Behera; Giza, Beni-Suef and Minia. The infected roots or stems were carefully washed with tap

water to remove soil particles, than cut into small pieces and surface sterilized with 0.1% mercuric chloride for 2 minutes and washed several times in sterilized water then dried between sterilized filter paper. Each piace was placed onto plain agar plates and incubated at 28°C for 5 days. Hyphal tips were transferred to P D A plates and pure cultures were obtained. The isolated fungi were identified by microscopical examination. These identifications were verified by the commonwealth Mycological Institute, Ferry Lane, Kew, Surrey, England.

Pathogenicity tests of the isolates were carried out in the greenhouse of the Faculty of Agric. Sci., Moshtohor, Zagazig University. Sterilized pots (25 cm in diameter) were filled with autoclaved or formalin-sterilized loamy soil. The inocula of different isolates were built up by growing on barley medium (100 g barley grains-100 ml tap water) and incubated at 28°C for 2 weeks. Soil infestation was undergone by adding 5% (W/W) of the inoculum, then thoroughly mixed with the soil. Sterile barley medium was mixed at the same rate to the control pots.

Seeds (Giza 1 cultivar) were surface sterilized by soaking in 0.1% mercuric chloride for 2 mins., washed with sterilized water then air dried and planted at the rate of 6 seeds per pot. A set of 8 replicate pots was used for each treatment. Disease readings were taken a percent survived plants after 10, 21 days and 8 weeks from sowing. At 8 weeks, ten plants from each treatment, taken at random, were carefully uprooted, then thoroughly washed in tap water and roots were cut and dried in a hot - air oven at 70°C until a stable weight was reached.

Reisolations from artificially infested seedlings and plants were checked and the resultant fungi were compared with the original cultures.

Effact of infection with M. phaseolina on sunflower crop and oil content was studied to find out the economic importance of infection with this fungus. The experiment was carried out in a complete randomized blocks design in the experimental Farm of the Agric. Res. Centre at Giza. Four local and introduced sunflower cultivars (provided by the oil Crop Institute, Agric. Res. Centre; Giza, A.R.E.) were planted in the infested soil. Readings for yield components were taken from 10 replicate plants taken at random from each variety and were expressed as :-

a. Head diameter in cm.
b. Weight of 1000 seeds in grams.
c. Seeds yield per plant (mean weight in grams).
d. Oil content (%) of 3 seed samples were determined after extraction with petroleum ether (b.p. 70-80°C) according to the method recommended by the A.O.A.C. (1950) using soxhlet apparatus.
e. Oil yield per plant was thus mathematically determined by multiplying the seed yield per plant by its oil content.

Results and Discussion

Disease symptoms:

Macrophomina phaseolina (Tassi.) Goid infects sunflower plants either in the seedlings or adult stages. In naturally infected seedlings, pre-and post-emergence damping-off almost occur at low frequency.

As plants grow up, charcoal rot disease symptoms were mostly encountered at a higher frequency. Symptoms (Fig. 1) appeared

Figure(I): I. Hralthy sunflower plant;
2,3 and 4 are naturlly infected sunflower plants showing different degrees of charcoal rot disease.

as dark brown lesions on the stem base which gave light-ash colour by aging, extending upwards to the fourth internode. Black sclerotia could be seen through the epidermis of the stalk. Internal tissues were disintegrated leaving the vascular tissues unaffected but covered with numerous small black sclerotia. In severe infections, the disease might cause a premature withering and collapse of the whole plant. These symptoms are typically the same as those recorede by other workers indicating no abnormal reactions under various environmental conditions (Bekesi, 1978; El-Zarka, 1976 and Abdelal et al., 1978).

Disease Occurrence:

Survey of the disease was made in some Governorates in which the majority of the area grown with sunflower plants are found (i.e. El-Behera, Giza, Beni-Suef and Minia) and which give a clear view for the distribution of the disease in the country. Numerous diseased samples were selected from each location and isolations were made. The number of isolation trials, which revealed the recovery of M. phaseolina from diseased plants, was taken as an indication for disease frequency in a particular locality.

Results show that M. phaseolina was most prevalent in El-Behera region (18 trials), but clearly less frequent at

Giza, Beni-Suef and Minia(i.e.4, 2 and 4 isolation trials respectively). This would strongly deminstrate that the disease is more adapted to the northern regions of the country, where high humidity and mild temperature almost prevail. This conclusion is in conformity to the previous observations of El-Zarka (1976).

Pathogenicity tests:

It is apparent from data presented in Table 1 that M. Phaseolina did not affect seed germination as compared with non inrected soil. However, isolates 3 and 4 have slightly reduced the emergence ability of sunflower seedlings after 10 days of sowing. At the post-emergence stage (21 days), no clear adverse effect was recorede. These data give an evidence that M. phaseolina is not a true damping-off pathogen. However, considerable loss was recorededby all isolates after 8 weeks of plant growth. Isolates 2 and 3 were reported to be more aggressive than the other ones at this stage of growth, while isolate 4 was the least effective. This implies a slight difference in the pathogenicity of M. phaseolina isolates. Reaction of the pathogen at pre-and post-emergence stages was in conformity to the results of Abdelal et al. (1978). Hoffmaster et al. (1943) attributed its adverse effect to the abnormal environmental conditions, wounds or infection by other organisms.

The fungus was noticed to reduce the extension of plant roots giving weak root systems associated with symptoms of root rot. This was correlated with an apparent reduction in dry weights of infected plant roots (Table 1). However Sackston (1958) in Uruguay, found that the root rot of yourg sunflower plants caused by M. phaseolina was of little economic importance, being more serious on mature plants.

Effect of M. phaseolina on yield components of some sunflower cultivars:-

It is clear from data presented in Table 2 that all sunflower cultivars either local of introduced, are markedly affected by infection with M. phaseolina. As sunflower is mainly an oil crop, its yield is finally expressed by the seed yield and its oil content. It is clear that the disease caused a reduction of 15.0 - 52.2% in the seed yield according to the cultivar.

Table 1: Effect of infection with 4 isolates of M. phaseolina on seedling survival and root weight of sunflower (Giza 1 cultivar).

Isolate No.	% Survivals after; 10 days	21 days	8 weeks	Av.dry weight of plant root(g)*
1	83.4	66.7	50.0	0.83
2	83.4	66.7	45.0	1.18
3	80.0	60.0	45.0	0.96
4	76.7	60.0	58.4	1.20
Control	83.4	70.0	70.0	1.31
L.S.D. 0.05	NS	9.8	8.5	0.00

* Each reading is the average of 10 replicate plants.

Table 2: Effect of infection with *M. phaseolina* on yield components of 4 sunflower cultivars.

Cultivars	Av. head diam. (cm)	Wt. of 1000 Seeds (g)	Av. seed yield per plant (g)	Oil %	Av. oil yield/plant (g)
Giza 1					
Healthy	21.2	73.2	94.2	33.7	31.7
Diseased	15.4	66.6	80.0	30.7	24.6
% reduction	27.4	9.0	15.0	8.9	22.4
Rom. H S 301					
Healthy	18.2	66.9	101.6	44.9	45.6
Diseased	12.6	62.5	48.6	43.3	21.0
% reduction	30.8	6.6	52.2	3.6	53.9
P I 245736					
Healthy	17.0	76.3	68.6	27.9	18.8
Diseased	12.4	66.8	35.8	24.5	8.8
% reduction	27.1	12.5	47.8	10.6	53.2
P I 251902					
Healthy	18.0	75.9	74.6	29.6	22.1
Diseased	10.6	71.9	55.8	26.4	14.7
% reduction	41.1	5.3	25.2	10.8	33.5

However, the local cultivar "Giza 1" was less affected than the introduced ones. It is known that the seed yield is affected by head diameter and filling of the seeds. Head diameter was greatly reduced in the introduced cultivars namely; Rom. H S 301 and P I 251902 by 30.8 and 41.1 % respectively as compared with reduction by 27.4 % for Giza 1 cultivar. Also, the average weight of 1000 seeds was reduced by 12.5 % in the cultivar P I 245736 as compared by other cultivars. No clear differences were reported between different cultivars as regards seed filling. The abovementioned yield losses due to the disease are in agreement with those reported by Acimovic (1962) who found that M. phaseolina reduced the total yield by 20.13 - 51.38 %. Also, Tikhonov et al. (1976) recorded a reduction in sunflower head diameter more than 30% and the weight of 1000 seeds was reduced by 13-36 %. He also reported a reduction in seed yield by 18-64 %.

Oil contont of seeds was also affected by infection wiht M. phaseolina. The rate of reduction in seed oil content ranged from 3.6 - 10.8 % in different sunflower cultivars. However, oil content of seeds taken from infected plants of the introduced cultivar "Rom. H S 301 " was not considerably reduced comparing with the healthy ones.

Analysis for seed oil yield per infected plant was reduced by 22.4-53.9 %. Giza 1 was the least cultivar affected by disease infection while P I 245736 and Rom.H S 301 were greatly affected showing a reduction in oil yield per plant by 53.2 and 53.9 % respectively. Tikhonov et al. (1976) reported a considerable drop in seed oil content by 5-8 %. Thus, these data indicate the significant economic importance of M.phaseolina infection to sunflowers especially at latter stages of plant growth.

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دراسات مرضيه على الفطر ماكروفومينا فاسيولينا على نبات عباد الشمس

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عزل الفطر ماكروفومينا فاسيولينا من نباتات عباد الشمس عليها اعراض الاصابة بالعفن الفحمى على قاعدة الساق حيث يظهر عفن لونه أسود على السلاميات الملامسة لسطح التربه ثم يمتد حتى السلاميه الرابعه مع ضعف شديد فى المجموع الجذرى .

فحصت عينات عديده من نباتات عباد الشمس مأخوذة من عدد من المحافظات التى تتزرع مساحات كبيرة من هذا المحصول وأجرى العزل منها فوجد أن الفطر كان اكثر انتشارا فى محافظات شمال الدلتا مثل محافظة البحيره ـ حيث يسود جو معتدل الحراره ـ ورطوبة نسبية مرتفعه ـ يليها محافظة الجيزه واقلهم كانت محافظة بنى سويف .

اختبرت المقدرة المرضية لاربعة عزلات من الفطر المسبب على اصابة النبات فى اطواره المختلفه ولم توجد اختلافات واضحة بين الشدة المرضية للعزلات المختبره .

اثبتت التجارب أن الفطر تأثيره ضعيف على النباتات فى طور البادرة ولكن يظهر اثره على النباتات المتقدمه فى العمر . كما بينت التجارب أن الفطر يؤثر على انتشار المجموع الجذرى مما قلل من الوزن الجاف لجذور النباتات المصابة بالمقارنة بجذور النباتات السليمه .

اجريت دراسة لتأثير الاصابة بالفطر ماكروفومينا فاسيولينا على مكونات المحصول لنبات عباد الشمس بمقارنة بالنباتات السليمه على عدد من الاصناف المحليه والمستورده منها الصنف المحلى جيزه ١ والاصناف المستورده P I 245736 ، Rom. HS 301 والصنف P I 251902 وجد أن الاصابه بالفطر تؤدى الى نقص النورة بنسبة ١ر٢٧ ـ ٠ر٤١ ٪ حسب الصنف ـ وينقص وزن الالف بذره بنسبة ٣ر٥ ـ ٥ر١٢ ٪ عن النبات السليم .

كما أدت الاصابة الى نقص المحصول بمعدل ١٥ ـ ٢ر٥٢ ٪ أما محتويات البذور من الزيت فقد وجد أنه ينخفض بنسبة ٦ر٣ ـ ٨ر١٠ ٪ وبالتالى ينقص محصول النبات من الزيت بنسبة ٤ر٢٢ ـ ٩ر٥٣ ٪ .

وقد بينت التجارب أن الصنف المحلى جيزه ١ كان أقل الاصناف تأثرا بالاصابة حيث كان النقص فى محصول النبات من الزيت يعادل ٤ر٢٢ ٪ فى حين الاصناف المستورده كان نقص المحصول من الزيت فى النبات يصل الى ٩ر٥٣ ٪ كما فى الصنف Rom. HS 301