UDC 632

# THE RESISTANCE OF TWENTY SUN FLOWER ACCESSIONS TO FUSARIUM OXYSPORUM WILT

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## ABSTRACT
There are many benefits of Sunflower such as for food, industry, animal food, ornamental plants, medicinal plants and oil-producing plants. One of the most important adverse diseases up to 45% is wilt disease caused by *Fusarium oxysporum*. This study is aimed to determine the survival rate of some sunflower accessions against wilt disease caused by *F. oxysporum* pathogens. The research was conducted from April to August 2016 in a laboratory and a gauze house of Plant Diseases, Indonesian Sweetener and Fiber Crops Research Institute by using Randomized Block Design with 20 accessions as three times repeated treatment, each replication for 40 plants/tub. Inoculation by spraying the pathogen suspension of F. oxysporum as much as 100 ml with a density of $10^5$ / ml on plants aged 7 days. The observations included the incubation period, disease progression and the severity of the disease. The result showed three accessions resistant to *F. oxysporum* were accession Ha. 7, Ha. 29, Ha. 52 with attack percentage on each are 5, 9, and 10%.

## KEY WORDS
*F. oxysporum*, resistance, sunflower.

Sunflower (*Helianthus annuus* L.) is a plant that has many benefits such as to be used as food, industry materials, animal food, ornamental plants, medicinal plants and oil-producing plants. The content of sunflower seed oil is between 48 - 52% with oleic acid content between 80 - 90%. Sunflower is one of the most important oil crops worldwide with the area of growing over 22 million hectares (Skoric *et al*., 2007). Sunflowers are also used for vegetable oils, seed and seed consumption (Afzal *et*., 2010). In Egypt sunflower is used for the production of essential oils among other oil crops. Fats and oils are important ingredients of human food. Besides containing oil/fat sunflower seeds also contain 23% protein, crude protein and fiber, and essential nutrients like many vitamins. Sunflower productivity is influenced by a large number of diseases caused by fungi (Godika *et al*., 1996).

An important disease in sunflower is the *Fusarium oxysporum* fungus which is an aggressive pathogen in sunflower (Mukhtar. 2009) and lately it is important in sunflower plants (Gontchanov. 2014). The pathogen F. species attacks on a large number of agricultural crops such as sunflower (Levic, 2008), corn (Fandohan *et al*., 2003), barley (Bottalico and Perrone. 2002), asparagus (Elmer *et al*., 1999), bananas (Marasas *et al*., 1998), and mangoes (Britz *et al*., 2002). Pathogen *F. oxysporum* causes withering on the root, stem and rot of fruits and and can decrease yields in Europe between 10% up to 30% (Logrieco *et al*., 2002). Result losses caused by *Fusarium* wilt in Indonesia can reach 45%. The most commonly found *Fusarium* species as a sunflower pathogen is *F. oxysporum,* the most economically important species in the *Fusarium* genus. The development of disease caused by *F. oxysporum* is in high temperature conditions and warm moist soil. The optimal temperature for growth of *F. oxysporum* in artificial medium is between 25-30 °C while the optimal soil temperature for root infection by this pathogen is 30˚C or ≥ $30^0$C.

The purpose of this research is to know the resistance level of some sunflower accessions to the wilt disease caused by *F. oxysporum* pathogen.

## MATERIALS AND METHODS

The research was conducted from April to August 2016 in a laboratory and a gauze house of Plant Disease, Research Institute of Crops Sweetener and Fiber Malang. The source of disease inoculum was obtained from the location of sunflower planted with *F. oxysporum* disease.

Sunflower seeds were grown on a 45 x 30 x 15 cm tank containing sterile sand (with hot steam) and placed in the screen house. A total of 20 sunflower accession numbers were planted as many as 40 plants per tub in three times repetitions. Watering was done every day to keep the moisture. The isolation to increase the amount of *F. oxysporum* fungus was done using PDA media. Inoculation was adjusted according to the method of Dalmadiyo *et al*. (2000) by dipping the 7-day-old seedlings for two hours into the suspension of *F. oxysporum*. In this method inoculation was performed 7 days after planting (HST) by watering each tub with 100 ml suspension of *F. oxysporum* with conidia density of $10^5$ conidia / ml.

The observations included the incubation period which was started from the occurrence of symptoms on sunflower plants. The development of the intensity of the attack was expressed in the disease severity index calculated by the following formula (Abadi, 2000):

$$I = \frac{n}{N} \times 100\%$$

Where: I = Severity of disease index; n = Number of plants withered or died; N = Number of plants observed.

To determine the criteria of plant's resistance it needed to observed the severity intensity of sick plants up to fifth week, while the rest weeks there was no more disease progression. The plant's resistance criteria by Miller-Gaervin and Viands method (1994) adjusted to Mandal method (1988) as follows:

Very Resistance (VR) = ≤ 1% attack plant,
Resistance (R) = 1.1 – 10.0 % attack plant,
Moderate (M) = 10.1 – 20 .0 % attack plant,
Suceptible (S) = 20.1 – 50.0 % attack plant,
Very suceptible (VS) = ≥ 50.0 % attack plant.

The incubation mass data were analyzed using Duncan Test 5%.

## RESULTS AND DISCUSSION

The incubation period with pathogenic phenomenon of *F. oxysporum* on sunflower between one accession with other accession is 5.66 to 33.33 days after inoculation (Table 1). The fastest incubation period on the pathogen *F. oxysporum* is Ha. 15 while the latests is Ha. 7. The faster incubation period indicates that the faster the sunflower accessory is attacked and also indicates the plant is susceptible to *F. oxysporum* pathogens.

The development of disease intensity of *F. oxysporum* showed by disease severity and survival criteria on some tested accessions indicate that the disease attack was quite varied (Table 2). Some accessions that is still in the category attack resistance with the severity of the disease below 10% are on accession number 6, 14, and 16 with the percentage of attacks for each are 5, 9, and 10%. In the moderate category with disease severity between 10.1 - 20% are accession no. 1, 2, 3, 4, 5, 7, 9, 12, 13, 15, 18, and 20. Meanwhile the vulnerable category with disease severity ranging from 20.1 to 50% occurs in accessions no. 8, 10, 11, and 17 (Table 2 and 3).

Table 1 – Incubation period of wilt disease *F. oxysporum* on some sunflower accessions

| Number | Code Accession | Incubation period disease *F. oxysporum* wilt (DAI) |
|---|---|---|
| 1 | Ha. 1 | 7.66 (tn) |
| 2 | Ha. 2 | 9.00 |
| 3 | Ha. 3 | 13.33 |
| 4 | Ha. 4 | 9.00 |
| 5 | Ha. 5 | 7.00 |
| 6 | Ha. 7 | 33.33 |
| 7 | Ha. 10 | 7.66 |
| 8 | Ha. 12 | 10.33 |
| 9 | Ha. 14 | 9.66 |
| 10 | Ha. 15 | 5.66 |
| 11 | Ha. 16 | 8.33 |
| 12 | Ha. 17 | 11.00 |
| 13 | Ha. 18 | 9.33 |
| 14 | Ha. 29 | 7.00 |
| 15 | Ha. 39 | 6.66 |
| 16 | Ha. 52 | 20.00 |
| 17 | Ha. 60 | 7.00 |
| 18 | Ha. 61 | 7.66 |
| 19 | Ha. 70 | 11.33 |
| 20 | Ha. 71 | 6.66 |

*Tn.: Not significantly different based on Duncan test 5%*
*DAI: Day after Inoculation*

Table 2 – The development of pathogen intensity of *F. oxysporum* attack on some sunflower accession up to week 5.

| Number. | Code Accession | The development of the intensity of *F. oxysporum* attack on | | | | |
|---|---|---|---|---|---|---|
| | | I | II | III | IV | V |
| | | ..... % ..... | | | | |
| 1 | Ha. 1 | 7.50 T | 10.00 T | 13.33 M | 13.33 M | 13.33 M |
| 2 | Ha. 2 | 6.67 T | 9.17 T | 15.00 M | 15.00 M | 18.33 M |
| 3 | Ha. 3 | 0.83 T | 0.83 T | 2.50 T | 7.56 T | 10.10 M |
| 4 | Ha. 4 | 2.50 T | 2.50 T | 4.17 T | 10.83 M | 14.17 M |
| 5 | Ha. 5 | 10.00 T | 10.00 T | 10.83 M | 10.83 M | 15.00 M |
| 6 | Ha. 7 | 0.00 ST | 0.00 ST | 0.00 ST | 0.00 ST | 5.00 T |
| 7 | Ha. 10 | 6.67 T | 10.00 T | 12.50 M | 12.50 M | 16.67 M |
| 8 | Ha. 12 | 1.67 T | 3.33 T | 7.50 T | 15.50 M | 27.50 R |
| 9 | Ha. 14 | 12.50 M | 12.50 M | 15.00 M | 15.00 M | 15.83 M |
| 10 | Ha. 15 | 21.67 R | 25.00 R | 38.33 R | 38.33 R | 39.17 R |
| 11 | Ha. 16 | 11.67 M | 15.00 M | 20.00 M | 20.00 M | 20.83 R |
| 12 | Ha. 17 | 4.17 T | 4.17 T | 10.83 M | 11.67 M | 11.67 M |
| 13 | Ha. 18 | 2.50 T | 4.17 T | 7.50 T | 7.50 T | 17.50 M |
| 14 | Ha. 29 | 3.33 T | 3.33 T | 5.00 T | 5.00 T | 9.00 T |
| 15 | Ha. 39 | 5.83 T | 6.67 T | 9.17 T | 9.17 T | 12.50 M |
| 16 | Ha. 52 | 0.00 T | 0.83 T | 0.83 T | 6.67 T | 10.00 T |
| 17 | Ha. 60 | 7.50 T | 7.50 T | 13.33 M | 14.17 M | 25.00 R |
| 18 | Ha. 61 | 1.67 T | 4.17 T | 4.17 T | 9.17 T | 11.83 M |
| 19 | Ha. 70 | 8.33 T | 8.33 T | 8.33 T | 11.33 M | 18.33 M |
| 20 | Ha. 71 | 7.50 T | 8.33 T | 15.83 M | 15.83 M | 15.83 M |

*Note: ST = Very resistant. T = Resistance. M = Moderate. R = Susceptible.*

The appearance of susceptible and resistant sunflower can be seen in Figure 1. Sunflower accession number 10 (Ha 15) is vulnerable while the number 6 (Ha 7) is the resistant one. The susceptible flower plants are indicated by the intensity of severity up to 39.17% while those the resistance plants are accession number 6 (Ha 7), number 14 (Ha 29) and number 16 (Ha 52) with the severity intensity are 5.00%, 9%, and 10%. (Table 2). The differences of vulnerable accessions compared to resistance accessions are number 6 (Ha 7), number 14 (Ha 29) and number 16 (Ha 52) with each percentage are 34.17%, 30.17%, and 29.17%..

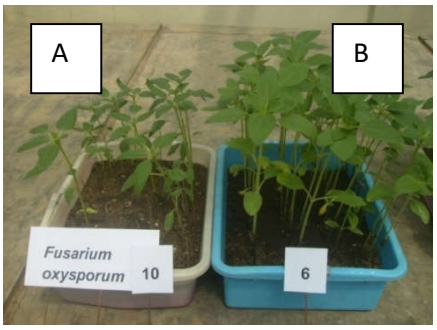


Figure 1 – Appearance of susceptible (A) and resistant (B) sunflower plants to pathogen *F. oxysporum*

Plant's resistance can be generated by the presence of pathogen infection reactions to defend against pathogens such as cytoplasmic's defense caused by the cytoplasm forming small grains and compact causing myocardial myocyte to crush. Also the resilience of cell wall structures including changes in cell wall morphology due to the reaction of pathogen infection (Abadi, 2000). Plant's resistant are affected by substances that are unsuitable by pathogens and are capable of producing compounds that neutralize toxins produced by pathogens. Plant's resistance is also affected by cellular defense, Biochemistry, and the response of pathogenic infections to the plants. Higher antioxidant enzyme activity than peroxidase, ascorbate peroxidase and glutathione reductase is found in anthrax-infected melon cultures by *Colletotrichum lagenarium* (Ge *et al.,* 2013). Antracugosa-resistant blueberry fruit produces more anthocyanins and non-anthocyanin flavonoids compared with susceptible ones (Miles *et al*., 2013). In tomato and blueberry plants are seen in the presence of transkeptom and proteome (Chen *et al*., 2013; Dahal *et al*., 2010; Miles *et al.,* 2011). According to Dogbo *et al.* (2008) dates and apples inoculated with *F. oxysporum* pathogens increase the total phenol thus increasing endurance. Meanwhile according to Dalmadiyo *et al*. (2000) plant's resistance caused by *F. oxysporum* is caused by the inhibition of discoloration development on xylem. High chlorophyll on CR-Hagwang cultivars also provides plant resistance to disease (Lee and Hong, 2014). One example reduced by chlorophyll with inhibition of photosynthesis may cause cabbage seeds to be susceptible to infection with *Alternaria brassicicola* (Leon-Reyes *et al*., 2009).

## CONCLUSION

The results of the study obtained three accessions resistant to *F. oxysporum* they are accession Ha.7, Ha. 29, Ha. 52 and each attack percentage are 5, 9, and 10%.

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