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Evaluation of Sesame Varieties for Phyllody Disease Resistance

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Sesame Phyllody disease, caused by Phytoplasma, is a highly destructive and serious economical disease in irrigated sesame production areas of Ethiopia. The field experiment was laid out in a Randomized Complete Block Design (RCBD) having seven treatments with three replications at Werer Agricultural Research Center for three successive years. During the first year (2015), two varieties namely T-85 and Argane were grouped as moderately resistant while, Mehado-80, Serakamo and Abasena grouped as moderately susceptible. Kelafo 74 and Adi were grouped as susceptible and tolerant respectively. During second year (2016), T-85 and Argane grouped as moderately resistant and Kelafo-74 and Serkamo grouped as susceptible. During last year (2017), only T-85 was ranked as resistant and Kelafo-74 and Abasena were ranked as moderately susceptible. Combined analysis of data showed that Argane and T-85 was moderately resistant against phyllody disease while the heighst mean yield was obtained by Argane (11.32qt/ha) and Serkamo (11.06 qt/ha) and the lowest yield was recorded by Adi variety (9.08 qt/ha). The study advises the use of resistant varieties is considered as an economical and durable method of controlling Phyllody disease and further studies will be done on the evaluation of sesame varieties against Phyllody disease.

Key words: Phyllody, phytoplasma, varieties, resistance, Ethiopia

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INTRODUCTION

Sesame (*Sesamum indicum* L.) is one of the most ancient edible oil crop grown in many parts of the world (Akbar *et al.,* 2012; Naqvi *et al*., 2012). Ethiopia ranks among the top six world producers of sesame seed. Sesame is the third most important oil crop in the country and occurs both as cultivated and wild (Wijnands *et al*., 2009). Sesame production is increasing in Ethiopia especially in southwest and northwestern parts of the country which is driven by high market value and suitability of environmental conditions (Wijnands *et al*., 2007). The production of the crop is also increasing in Middle Awash under irrigation condition. Although the crop is expected to play significant role in national economy of the country but diseases and insect pests constrained its production. Piercing and sucking insects have great economic importance to sesame plants. They cause serious damage directly by sucking plant sap or indirectly by transmission of virus and mycoplasma diseases (El-Gindy, 2002). Among the disease; bacterial blight is a series problem in humid and high rainfall areas,

while Phyllody is a highly destructive disease in irrigated sesame production areas. Sesame Phyllody (SP), caused by phloem limiting phytoplasmas, is primarily distributed in the tropical countries including Asia and Africa (McCoy *et al*., 1989; Nakashima *et al*., 1999) and also present in neighboring countries like Thailand (Nakashima *et al*., 1995) and India (Khan *et al*., 2007). The disease is characterized by virescence, Phyllody, yellowing, floral sterility and stem proliferation of infected plants (Akhtar *et al*., 2008) and causes seed yield loss up to 33.9 percent (Abraham *et al*., 1977). Yet, in irrigated sesame production in Ethiopia there is no management options for this disease. Therefore the present study was designed to evaluate sesame varieties for its reaction against Phyllody disease under irrigation condition at Middle Awash.

MATERIALS AND METHODS

The field experiment was conducted during the main cropping season of 2015, 2016 and 2017 at Werer Agricultural Research Center. The area is located at 280 km to the south east of Addis Ababa at longitude $40^0$9'E, latitude $9^0$60' and the altitude of 740 m a.s.l in the Middle Awash Valley of Ethiopia. The soil type of the study area is chromic vertisol (silty clay to clay) and alluvial (sandy loam to silty loam). The area is under the influence of arid-tropical region receiving mean annual rainfall of 540 mm and the mean maximum and minimum temperatures are 34.4 ^{0}C and 19.6 ^{0}C, respectively (Wendmagegn and Abere, 2012).

The study was designed in a Randomized Complete Block Design (RCBD) with three replications. Seven released sesame varieties (Adi, Serkamo, Kelafo-74, Abasena, Argane, Mehado-80, and T-85) was used as a treatments. The plot size of 9.6 x 10.0m (96m^2) and the net plot size was 8.0 x 10.0m (80m^2) was used. The sesame seed was sown at 3cm depth thoroughly by mixing 500g sesame seed with 1kg sandy soil was applied in order to achieve uniform distribution during sowing. Thinning was done at 15 days after sowing in order to keep the appropriate inter-raw (40cm) and intra-raw (5cm) spacing. All agronomic practice was applied as per recommendation except insect and disease management measures.

Disease assessment in the field: The Incidence of Phyllody infection (incidence percentage calculated on the basis of diseased plants over the total plants assessed) was assessed on weekly base starting 20 days after crop emergence and continued up to 11 weeks after sowing. This was intended to see the progress of the disease in each treatment. Assessment of the number of infected plants was done using three permanent, randomly placed quadrants (1m x 1m) per plot. The total number of plants and number of infected plants in a quadrant were counted and the percentage disease Incidence was worked out. Severity was estimated by assessing 20 randomly tagged plants per plot and determining overall score using a scale of 0-6. Incidence and Severity of plant disease were recorded according to Akhtar *et al*., 2013., where 0= no Phyllody infection (highly resistance); 1=0.1-10 percent plant infected (resistant); 2=10.1-20 percent plant infected (moderately resistant); 3=20.1-30 percent plant infected (tolerant); 4=30.1-40 percent plant infected (moderately susceptible); 5=40.1-50 percent plant infected (susceptible) and 6=more than 50 percent of plant infected (highly susceptible). The disease Severity progress was evaluated on weekly base in order to record the Severity of the disease in each treatment. Finally the yield data of each treatment was collected at harvest and data were analyzed to test the significance of differences between treatments in relation to Phyllody disease Severity. When F-values were significant ($P < 0.05$), means were compared by Fisher's least significant difference (LSD) test with SAS software.

RESULT AND DISSCUSSION

RESULT

Seven sesame varieties (Adi, Serkamo, Kelafo-74, Abasena, Argane, Mehado-80, and T-85) were evaluated for their resistance against Sesame Phyllody in the field during 2015, 2016 and 2017. The varieties were evaluated for their Incidence and Severity of sesame Phyllody disease.

DISCUSSION

During 2015 experiment year Phyllody disease Incidence was observed in treatments (Kelafo-74, Abasena, Argane and Mehado-80) at 8 weeks of sowing and T-85 and Adi varieties was observed Incidence at 9 weeks of sowing and then progressed steadily (figure 1). Data shows that disease Incidence progress in each treatment was a gradual increase from 8 to 11 weeks after sowing. The data in figure 1 revealed that the highest Incidence was observed on kelafo-74 variety (31%) and the lowest Incidence was observed on T-85 and Serkamo varieties (10%) at 11WAS. In 2016 experiment year high Incidence was recorded in all varieties starting from 8 WAS (Figure 2). In 2017 cropping season no Phyllody disease Incidence at 8 WAS in all treatments and then the disease start infecting the crop at 9 WAS in all treatments (Figure 3). The highest Incidence recorded was at 11 WAS by Mehado-80 variety (100%) and the lowest was recorded by T-85 variety (12%).

Incidence of Phyllody disease infection on sesame:-

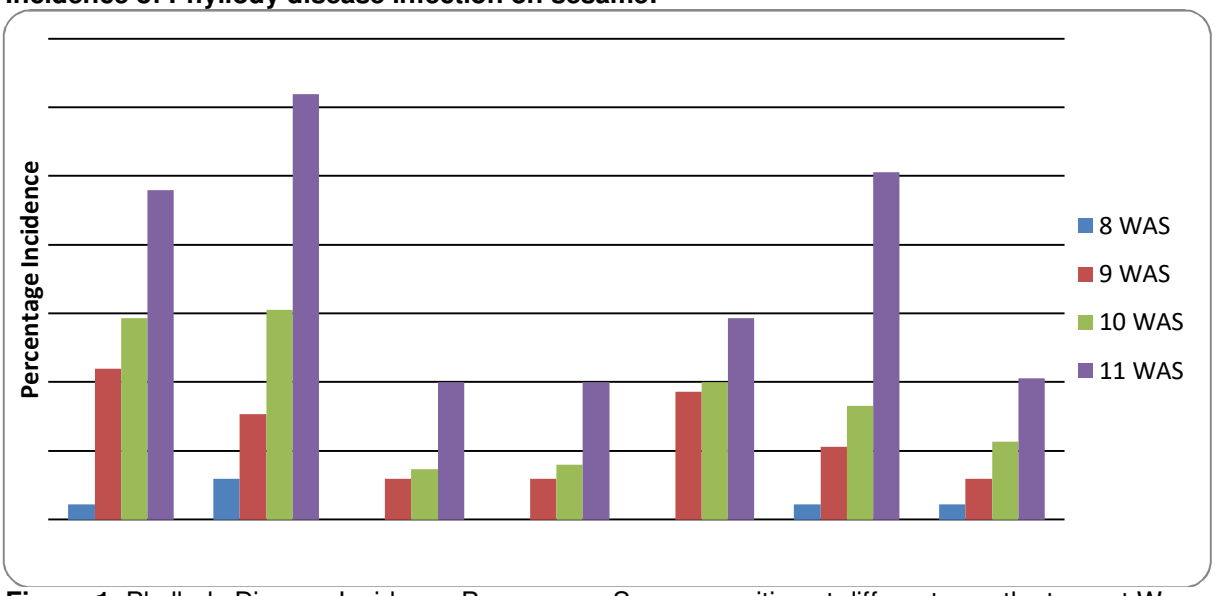

Figure 1. Phyllody Disease Incidence Progress on Sesame verities at different growth stage at Werer, 2015. WAS = Weeks after Sowing

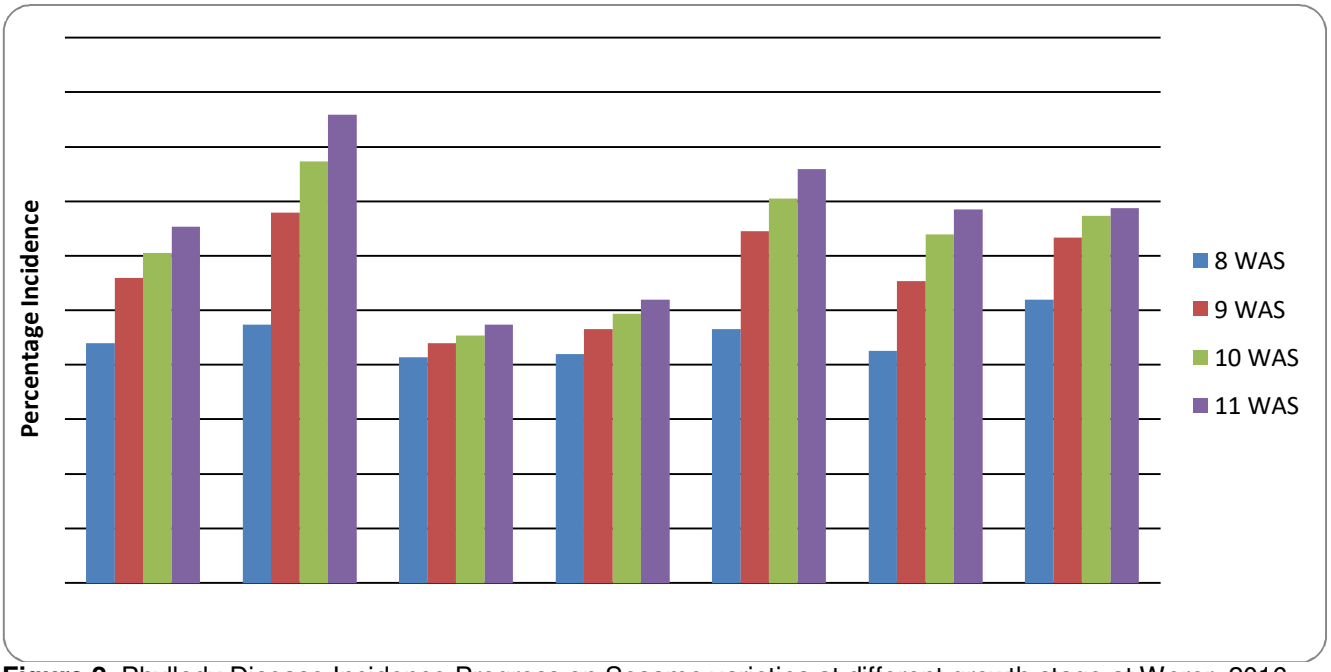

Figure 2. Phyllody Disease Incidence Progress on Sesame varieties at different growth stage at Werer, 2016

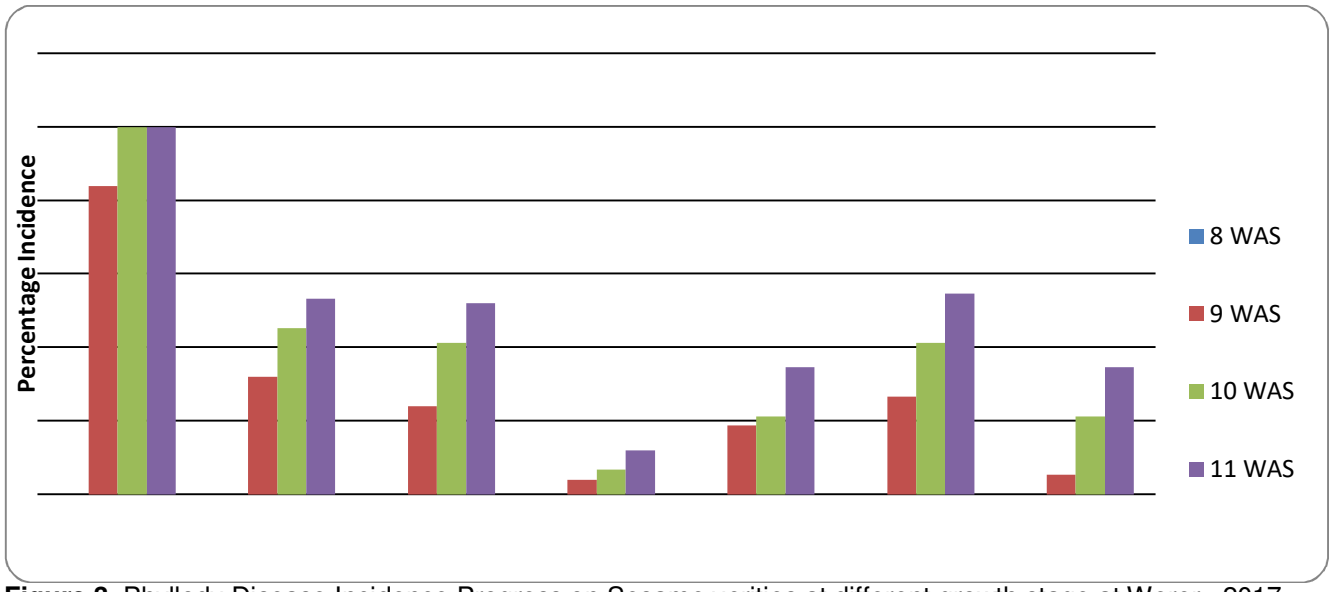

Figure 3. Phyllody Disease Incidence Progress on Sesame verities at different growth stage at Werer, 2017. WAS = Weeks after Sowing

During 2015 experiment year Phyllody disease Severity was observed in all treatments at 8 WAS except T-85 variety which was not infected at this stage (Figure 4). The Severity of disease progressed slowly in between 8 to 9 weeks after sowing. Beyond 10 weeks after sowing, the disease Severity increases in all treatments. The data shows that the lowest disease Severity was recorded by T-85 and Argane varieties (15 and 16%), whereas the highest disease Severity was recorded by Serkamo variety (43%) at 11 WAS respectively. In 2016 experiment year the highest Severity was recorded by Kelafo-74 and Serkamo varieties (44%) at 11 WAS and the lowest was recorded by Argane and T-85 (16.2%) varieties (Figure 5). In 2017 experiment year the disease was Severe after 8 WAS (Figure 6). The highest Severity was recorded at 9, 10 and 11 WAS by Mehado-80 variety (62, 72.3 and 79.6%) the lowest was recorded by T-85 (9.7%) variety (Figure 6). In the first and third year trial there was no statistical different ($P< 0.05$) among varieties for yield parameter (Table 1 & 2). The data has statistical significance difference at ($P< 0.05$) among treatments at second year experiment. T-85 is significantly different from Kelafo-74, Abasena and Adi varieties, but par with Mehado-80, Argane and Sekamo varieties for yield parameter. The highest yield recorded by T-85 variety (10.29 qt/ha) and the lowest yield was recorded by Adi (8.67 qt/ha) variety (Table 1). The overall combined result of yield showed that Serkamo and Argane varieties were significantly different from ($P< 0.05$) Kelafo-74, Adi and Abasena varieties, but par with Mehado-80 and T-85 varieties. The highest overall mean yield was recorded by Argane (11.32qt/ha) and Serkamo (10.91 qt/ha) and the lowest was recorded by Adi variety (9.08 qt/ha). Resistance or susceptibility of sesame varieties was categorized according to Akhtar *et al*., 2013. The overall three years result showed that, the two varieties Mehado-80 (49.5%) and Kelafo-74 (40.4%) are grouped under susceptible varieties for Phyllody disease. Argane (14.6%) and T-85 (13. %) varieties was moderately resistant and also high yielder when compared with other varieties. Adi variety was tolerant (23.4%) for Phyllody disease infection but low yielder. The other two varieties Abasena (35.3%) and Serkamo (35.1%) are grouped under moderately susceptible to Phyllody disease under irrigated condition. The data shows that, yield of sesame varieties was greatly affected by the Incidence of Phyllody disease, which is in line with Kumar and Mishra (1992) who found that Phyllody disease plays a significant role in reducing yield of sesame, which can cause up to 80% yield loss with disease Incidence of 61-80%.

The data showed that most of the varieties were infected between 8 to 9 weeks after sowing during flowering period. All the varieties infected during flowering period to maturity showed floral Phyllody, viridescence and proliferation. Sesame plants infected before flower initiation had severe symptom on the entire plant and showed complete sterility. This study is in line with Akhtar *et al.* (2009) reported that the Severity of the transformation of floral parts into malformed structure was correlated with time of infection. However, plant infected during flowering had severe symptom on the upper of the plants, occasionally followed by some rudimentary flowers that yielded very small capsules with

Severity of Phyllody disease infection on sesame:-

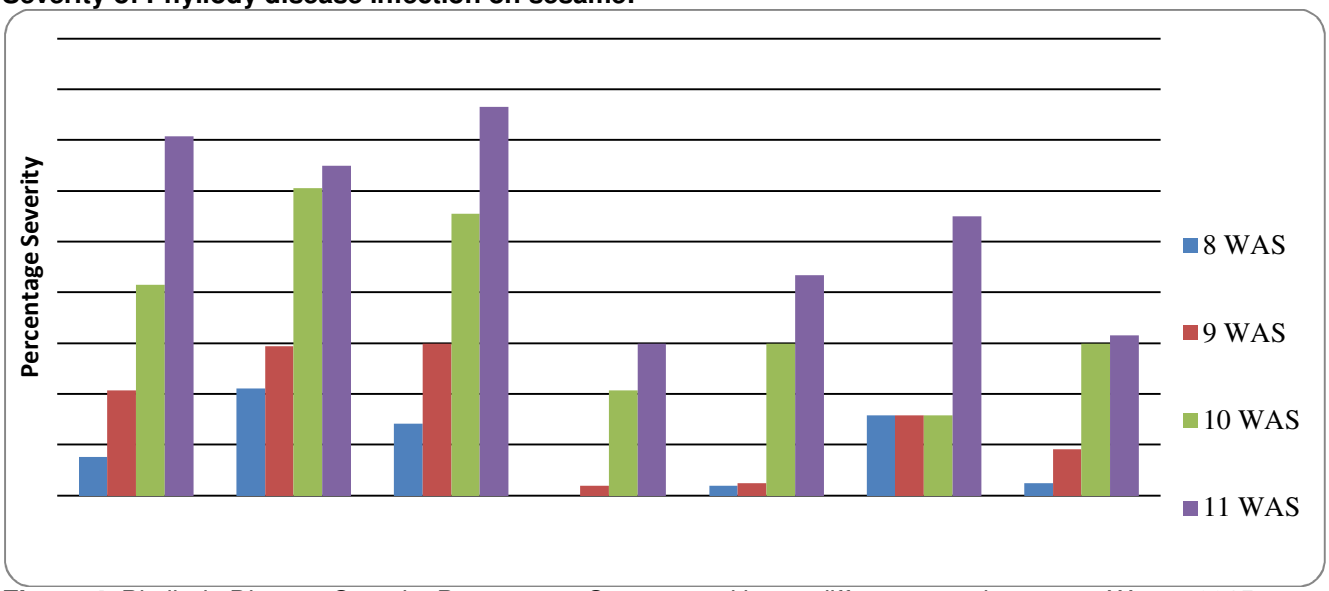

Figure 4. Phyllody Disease Severity Progress on Sesame verities at different growth stage at Werer, 2015.

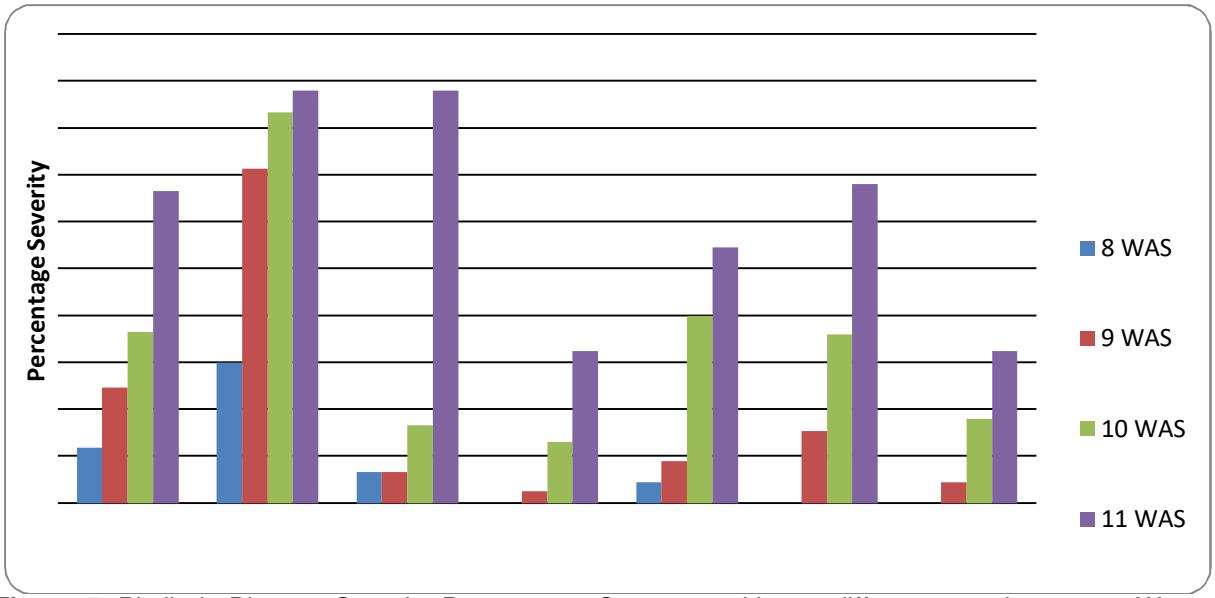

Figure 5. Phyllody Disease Severity Progress on Sesame verities at different growth stage at Werer, 2016.
WAS = Weeks after Sowing

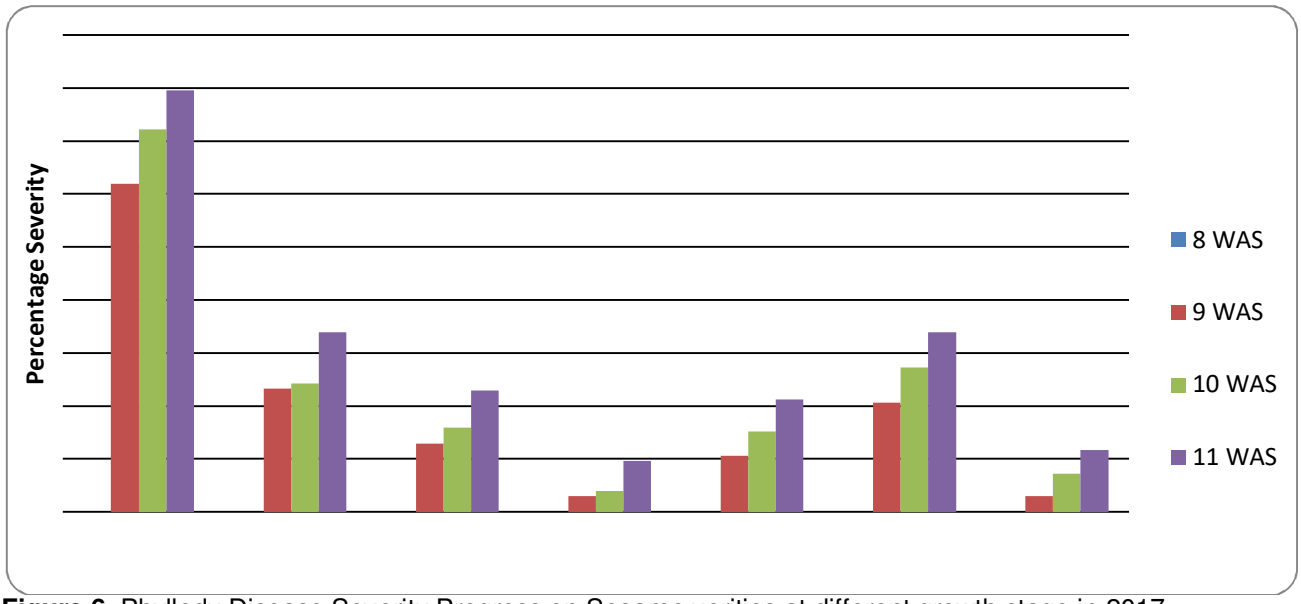

Figure 6. Phyllody Disease Severity Progress on Sesame verities at different growth stage in 2017.

A B

Figure. 7. Figure A & B shows symptom of Phyllody disease on sesame at flowering and pod setting

Table 1: The Incidence and Severity of Sesame Phyllody disease on yield of Sesame varieties at Werer, 2015, 2016 and 2017.

Treatments	Incidence (%) at 11WAS	Severity (%) at 11 WAS	Response	Seed yield (kg/ha)	Incidence (%) at 11WAS	Severity (%) at 11 WAS	Response	Seed yield (kg/ha)	Incidence (%) at 11WAS	Severity (%) at 11 WAS	Response	Seed yield (kg/ha)
Mehado-80	31	36	MS	13.1	32.7	33.3	MS	9.75^{ab}	100	79.6	HS	9.90
Kelafo-74	27	43	S	10.5	43	44	S	9.08^{bc}	53.3	34	MS	10.09
Serkamo	24	38	MS	13.8	23.7	44	S	9.67^{ab}	52	23	T	10.42
T-85	10	15	MR	12.6	26	16.2	MR	10.29^{a}	12	9.7	R	8.32
Adi	15	22	T	11.5	38	27.3	T	8.67^{c}	34.7	21.3	T	7.09
Abasena	25	38	MS	13.4	34.3	34	MS	9.21^{bc}	54.7	34	MS	7.12
Argane	10	16	MR	15.8	34.4	16.2	MR	9.75^{ab}	34.7	11.7	MR	8.41
Mean				12.9				9.49				9.8
CV (%)				15.1				6.92				15.93
LSD@ 0.05				Ns				0.68				Ns

In vertical columns, means followed by the same letter (s) within a column are not significantly different from each other at 5% level of significance, Least Significant Difference (LSD). CV= Coefficient of Variability, NS= None Significant, WAS=Week after sowing, S= susceptible, MS= moderately susceptible, T= Tolerable, MR= moderately resistant.

Table 2: The Incidence and Severity of Sesame Phyllody disease on yield of sesame varieties combined data of three years at Werer, 2015, 2016 and 2017.

Treatments	Combined Incidence (%) at 11WAS	Combined Severity (%) at 11 WAS	Combined years Response	Combined Seed yield (kg/ha)

Table 2: continuation

Mehado-80	54.4	49.5	S	10.91^{ba}
Kelafo-74	41	40.4	S	9.89^{bc}
Serkamo	33.2	35.1	MS	11.06^{a}
T-85	16	13.6	MR	10.40^{ba}
Adi	29.1	23.4	T	9.08^{c}
Abasena	38.1	35.3	MS	9.91^{bc}
Argane	21.6	14.6	MR	11.32^{a}
Mean				10.32
CV (%)				14.34
LSD@ 0.05				1.23

In vertical columns, means followed by the same letter (s) within a column are not significantly different from each other at 5% level of significance, LSD=Least Significant Difference. CV= Coefficient of Variability, WAS=Week after sowing, S= susceptible, MS= moderately susceptible, T= Tolerable, MR = moderately resistant

degenerated seeds. A number of authors reported that sesame crop was greatly affected by Phyllody disease in different countries (Singh *et al*., 2007; Win *et al*., 2010 and Mahmoud, 2013). According to Akthar *et al*. (2013) reported that from 133 sesame genotype for two years tested for Phyllody disease resistance obtained that there was highly significant differences in the infection of all genotypes. On the basis of percent infection values none of the genotype was ranked as highly resistant while 7 were resistant, 9 were moderately resistant, 28 were tolerant, 33 were moderately susceptible, 23 were susceptible and 33 were highly susceptible, in Pakistan.

CONCLUSSION

Phyllody disease plays a significant role in reducing sesame yield. The present study showed that, the tested sesame varieties have a clear difference in the degree of resistance was noted between the varieties and responding differently (Resistant, tolerable and susceptible) against Phyllody disease. Argane and T-85 varieties were moderately resistance while Adi variety is tolerable whereas Kelafo-74 and Mehado-80 variety were susceptible to Phyllody disease. The moderately resistant varieties gave better yield than the susceptible varieties. Use of resistant varieties is considered as an economical and durable method of controlling this Phyllody disease. The study included limited number of sesame varieties out of the registered in Ethiopia. Therefore, further additional research findings must be done on sesame Phyllody disease through conventional or modern breeding system and the effect of date sowing and stage of infection of Phyllody disease on Sesame.

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