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Screening of Fusarium Wilt, Bacterial Blight and Phyllody Diseases Resistant Sesame Genotypes in Sesame Growing Areas of Northern Ethiopia

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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Original Research Article

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ABSTRACT

The experiment was carried out to evaluate the level of resistance of different genotypes, to study the incidence and severity of bacterial blight, fusarium wilt and phyllody and to select bacterial blight, fusarium wilt and phyllody resistant genotypes across six locations and two years. The experiment was laid out in Randomized Complete Block Designs (RCBD) with three replications across all environments. Assessment was conducted on seventeen sesame genotypes in northern Ethiopia during 2014-2015 main seasons. 75, 70 and 25 percent diseases incidence and 50, 50, 10 percent severity of bacterial blight, fusarium wilt and phyllody was recorded respectively. The assessment result indicated that bacterial blight showed about 62.5, 30, 25, 22.5, 20 and 12.5 combined mean percent diseases incidence and 37.5, 32.5, 25,,15,10 and 7.5 combined mean percent disease severity was recorded in Humera, Kebabo, Gendawuha, Sheraro, Maykadra, Wargiba respectively. Fusarium wilt was recorded from 5%-42.5%, and 7.5 to 25 to combined percent disease incidence and severity was recorded across locations. Phyllody was recorded 2.5 to 17.5%, and 2.5 to 7.5 percent disease incidence and severity respectively. ACC202514, HuRC-4, Abuseffa, HuRC-3, Acc 202300, Acc111824, Acc 27913 and Setit -1 were among the highest resistant (HR) sesame

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genotypes for phyllody disease. From 0-100% Sesame bacteria blight severity was recorded among genotypes and HuRc-4, HuAC-3 and the standard check (Setit -1) were among the highest resistant (HR) sesame genotypes. Fusarium severity was recorded from 5%-100% range among genotypes. HuRC-2, Acc 227880, Setit -1, Hirhir, HuRC-3, HuRC-4 and ACC202514 were among the resistant (R) sesame genotypes. Whereas Gumero, Acc 202300, Kefif, Acc 111518, Land race Gumero were the highest susceptible (HS) genotypes for fusarium disease across the tested environments and years. From the assessment result indicated that HuRC-4 and HuRC3 genotypes were found resistant to bacterial blight, fusarium wilt and phyllody. Those genotypes could be used for diseases resistant breeding program across different locations. HuRC-4 was evaluated by the national technical committee and it was found relatively resistant and high yielder among the genotypes. Therefore it was released as variety for commercial production to all the tested areas.

Keywords: Incidence; prevalence; severity; resistance; susceptible.

1. INTRODUCTION

Sesame has been grown for over 7,500 years in Asia and Africa even in very poor growing conditions. Sesame is a broad leaf summer crop similar to cotton, sunflower, soybeans, black-eyed peas, Mungbean, or guar. The fruiting form of sesame is a capsule, often called pods. Some varieties have a single capsule per leaf axil and others have triple capsules per leaf axil. Flowering starts about 35-45 days after planting and flowering stops 75-85 days after planting. The seed is produced in these capsules with about 70 seeds per capsule [1]. It is an annual self- pollinating plant with an erect, pubescent, branching stem. It is either single stemmed or branched growth habits or two growth characteristics of indeterminate and determinate, reaching up to 2m height. Sesame is a major oilseed crop in the ancient world because of its ease of extraction, great stability, and drought resistance. At present, it is cultivated in area of 9.4 million hectare with production of 3.48 million tonnes worldwide [2].

1.1 Sesame Production Constraints

Mono-cropping practice causes development of diseases, insect pests and weed seeds which results in poor productivity of sesame. So it is important to have a rotation scheme of sesame every three or four year [3]. [4] reported that about 28% productions decrement of sesame in Ethiopia is due to insect and diseases. Many diseases attack sesame, but only a few of them such as *Fusarium* wilt (*Fusarium oxysporum* f. sp. *sesame*), charcoal rot (*Macrophomina phaseolina*), Phyllody, *Phytophthora parasitica* var. *sesami*, *Pseudomonas syringae* pv. *sesami*, *Xanthomonas campestris* pv. *Sesami*, *Pseudomonas solanacearum*, *Alternaria sesamicola*, *Rhizoctonia solani*, *Sclerotinia rolfsii*, *Alternaria* sp., *Cercospora* sp., *Erysiphe cichoracearum*, *Pythium* sp., Leaf curl, is considered to be important diseases of sesame in the world and it occurs wherever sesame is cultivated [5].

Phyllody or “Gren Flowers” is one of the most important and destructive diseases of sesame in Turkey. The disease caused by a mycoplasma-like organism (phytoplasma) is present in the world where sesame is grown. The incidence of this disease varying year to year and its incidence is minor most of the growing area in the world. The incidence of this disease was reported as high as 100% in India and 90% in Burma [5]. Sesame phyllody is not seed borne. In nature, disease is mainly spread by leafhopper *Orosius albicinctus* and survives in alternate hosts [6]. The major disease symptoms were floral virescence, phyllody, proliferation, and seed capsule cracking, seeds germinating in capsules, formation of dark exudates on foliage and floral parts, yellowing, shoot apex fascinations. Infected sesame plants exhibited symptoms that varied according to growth stage and time of infection. Infection at an early stage of growth resulted in cessation of internodes elongation, reduction in leaf size, and stunting (to about two thirds of normal plant height). The entire inflorescence was converted into twisted reduced leaves closely arranged on the top of the stem, with very short internodes. Infections that occurred later in the season caused characteristic symptoms, such as virescence, phyllody, and witches’ broom [7]. Phyllody disease was successfully transmitted from diseased to healthy sesame plants using grafting, dodder, and the leafhopper *O. albicinctus* [8].

Phyllody is accompanied by abundant vegetative growth. The internodes are very much shortened

and there is abundant abnormal branching due to the stimulation of axillary buds, and the plants bear small-sized leaves. The disease symptoms become evident in the flowering stage and floral organs are transformed into green leafy structures. Inside the ovary, petiole-like outgrowths are produced instead of ovules [5].

Sesame is vulnerable to infection by a number of pathogens that cause considerable yield losses. Among the major diseases, phyllody is a very serious disease, which can inflict up to 80% yield loss with a disease intensity of 61-80% [9]. It has been reported from India, Iran, Iraq, Israel, Burma, Sudan, Nigeria, Tanzania, Pakistan, Ethiopia, Thailand, Turkey, Uganda, Upper Volta and Mexico [10]. Data on the incidence of phyllody in each genotype was recorded by counting the number of infected plants and total population before harvest from the first flowering. Resistance or susceptibility of genotypes was based on the average percentage of plants infected by the disease, following a seven point (0-6) rating scale, where 0 = no infection (highly resistant); 1 = 0.1-10% plants infected (resistant); 2 = 10.1-20% plants infected (moderately resistant); 3 = 20.1-30% plants infected (tolerant); 4 = 30.1-40% plants infected (moderately susceptible); 5 = 40.1-50% plants infected (susceptible) and 6 = more than 50% plants infected (highly susceptible).

Bacterial blight disease was assessed on randomly selected ten plants from each entry under natural epiphytotic conditions at 75 days after sowing using 0 to 5 rating scale [11] (Rajpurohit, 1983). The disease reaction was categorized as highly resistant (HR), resistant(R), moderately resistant (MR), moderately susceptible (MS), susceptible (S) and highly susceptible (HS) as per the disease severity range of 0%, 1 to10%, 11 to 25%, 26 to 50%, 51 to 70% and 71 to 100%, respectively.

Fusariym oxysporium sfp.sesami (Fos) is one of the most important soil borne fungal diseases infecting on root, stem and foliar components and causes economic yield loss in different countries. To evaluate the resistance level of collected white sesame genotypes 1-5 scale were used based in the infection percentage as follows:1-20%=1, 20.01-40=2,40.01-60=3,60.01-80=4,80.01-100=5. [12] the comments of those scale values [1=Resistant(R),2= Moderate Resistant (MR), 3=Moderate Susceptible (MS),4=Susceptible (S) and 5=highly susceptible (HS)]. In sesame growing areas of northern Ethiopia there is no information for the production constraints of diseases bacterial blight, fusarium wilt and phyllody prevalence, incidence and severity of the tested genotypes. Therefore; the study was designed with the following objectives (1) to evaluate level of resistance of different genotypes for bacterial blight, fusarium wilt and phyllody diseases across different locations and years, (2) to study the incidence and severity of bacterial blight, fusarium wilt and phyllody diseases across different locations and years (3) to select bacterial blight, fusarium wilt and phyllody resistant genotypes.

2. MATERIALS AND METHODS

2.1 Description of the Study Areas

The experiment was conducted in Northern Ethiopia; (Tigray and Amhara regional states) for two consecutive years 2014 and 2015 cropping seasons.

Table 1. Agro-climatic and soil types of six tested locations in Northern Ethiopia

Description	Locations					
	Dansha	**Maykadra**	**Humera**	**Sheraro**	**Wargiba**	**Gendawuha**
Altitude(m.a.s.l)	696	646	609	1028	1578	760
Latitude (°N)	13°36'	14°02'	14°15'	14°24'	12°41'	12°
Longitude (°E)	36°41'	36°35'	36°37'	37°45'	39°42'	36°
R.F. (mm)	888.4	NA	576.4	1000	750	850-1100
Temp. (°C)	28	NA	18.8-37.6	18.8-34.9	18-25	19.5-35.7
Soil type	Vertisol	Chromic vertisol	Chromic Vertisol	Vertisols	NA	Vertisol

Source: [13,14]

Table 2. The Study locations in Northern Ethiopia in 2014-2015 cropping season

Location	Region	Zone	District	Year	
				2014	2015
Humera	Tigray	Western	K/Humera	E1	E2
Dansha	Tigray	Western	Tsegede	E3	E4
Sheraro	Tigray	N/western	T/Adyiabo	E5	E6
Wargiba	Tigray	Southern	R/Azebo	E7	E8
Maykadra	Tigray	Western	K/Humera	-	E9
Gendawuha	Amhara	-	Metema	-	E10

Note: K/Humera=Kafta Humera, T/Adyiabo=Tahtay Adyiabo, R/Azebo=Raya Azebo. E1=Humera, E2=Humera-2, E3=Dansha-1, E4=Dansha-2, E5=Sheraro-1, E6=Sheraro-2, E7=Wargiba-1, E8=Wargiba-2, E9=Maykadra, E10=Gendawuha

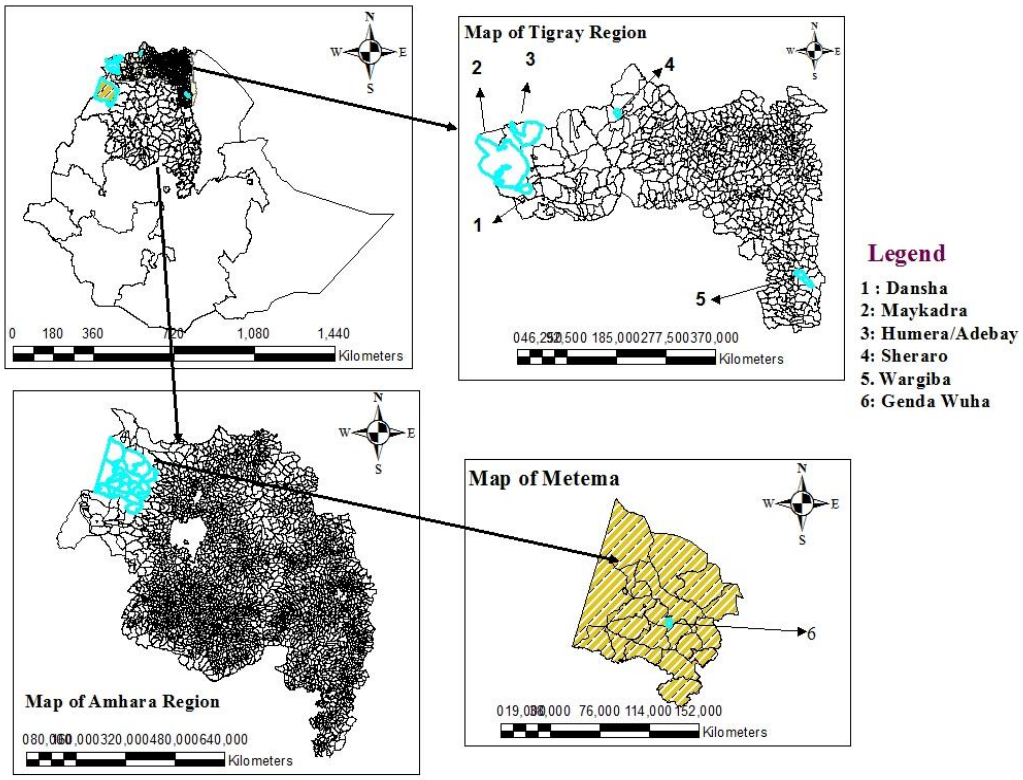

Fig. 1. Map of test sites in Northern Ethiopia

2.2 Experimental Genotypes

Seventeen white seeded sesame genotypes (fifteen selected, one standard checks and one local check) were evaluated in all locations and years. Description of the plant materials is presented in Table 3.

2.3 Experimental Design and Management

The experiment was laid out in randomized complete block design (RCBD) with three replications in all testing sites. Each genotype was randomly assigned and sown in a plot area of 2 m x 5 m with 1 m between plots and 1.5 m between blocks keeping inter and intra row spacing of 40 cm and 10 cm, respectively. Each plot had a total area of 10 m^2 and total of five rows and 6m^2 net plot areas with three harvestable rows. Each experimental plot received the same rate of DAP (100 kg/ha) and Urea (50 kg/ha) fertilizer and all field management practices were done equally and properly as per the recommendations to the study areas.

Table 3. Description of genotypes used in the study

Genotype (G)	Code	Status	Sources	Color	Remark
HuRC-4	G1	Advanced line	HuARC	White	Collection
Acc202514	G 2	Advanced line	HuARC	White	Collection
Land race Gumero	G 3	Advanced line	HuARC	White	Collection
Abuseffa	G 4	Advanced line	HuARC	White	Collection
HuRC-1	G 5	Advanced line	HuARC	White	Collection
Rawyan -2	G 6	Advanced line	HuARC	White	Collection
HuRC-3	G 7	Advanced line	HuARC	White	Collection
Acc 202300	G 8	Advanced line	HuARC	White	Collection
Kefif	G 9	Advanced line	HuARC	White	Collection
Acc111824	G 10	Advanced line	HuARC	White	Collection
Acc 111518	G 11	Advanced line	HuARC	White	Collection
Acc 27913	G 12	Advanced line	HuARC	White	Collection
Gumero	G 13	Advanced line	HuARC	White	Collection
HuRC-2	G 14	Advanced line	HuARC	White	Collection
Acc 227880	G 15	Advanced line	HuARC	White	Collection
Setit -1(Standard check)	G 16	Standard check	HuARC	White	Collection
Hirhir (Local check)	G 17	Local check	HuARC	White	Collection

Source: [15]

2.4 Data collection methods

Diseases prevalence, incidence and severity were collected from 2014 to 2015 cropping season in northern Ethiopia under six locations namely: Humera, Maykadra, Kebabo, Gendawuha, Sheraro and Warigba. Ten randomly sample plants were taken to check the healthy and diseased plants from each the genotype. A total of 17 white seeded sesame genotypes collected from northern Ethiopia were evaluated for their resistance against sesame bacterial blight, fusarium wilt and phyllody under natural field condition during 2014 and 2015 (Table 1).

2.4.1 Diseases prevalence

Proportion or percentage infected areas/ fields from the total assessed areas. Diseases prevalence tells us the geographic distribution of the diseases. The percent diseases prevalence is calculated as follows using the following formula

Disease prevalence (DP %) = [Total infected areas/ Total assessed areas (field) X 100]

2.4.2 Diseases incidence

Diseases incidence is the proportion or percentage of diseased leaves in a plant, diseased stalks or tillers or diseased seedlings in afield. It is the diseased percentage of parts or pants in the sample or population. Disease incidence generally tells about the prevalence of the disease in a given areas or host population. The percent of diseases incidence is calculated as follows using the following formula

Diseases incidence (DI %) = [(number of infected plants/ Total number of assessed plants) X 100]

2.4.3 Disease severity (DS)

Disease severity (DS) is the percentage of relevant host tissues or organ covered by symptom or lesion or damaged by the disease. Severity results from the number and size of the lesions. Disease severity tells about the extent of damage caused by diseases. Diseases severity calculated using the following formula [16].

Disease severity or Infection index= [(Sum of all disease rating/ Total no. of rating x maximum disease grade) X 100]

3. RESULTS AND DISCUSION

3.1 Incidence and Severity of Sesame Bacterial Blight

Wilt caused by *Fusarium oxysporum* f.spp. Sesami (*Fos*) is a devastating disease infecting the crop right from seedling to maturity resulting in crop losses to varied degrees depending on the severity of infection. It has been reported as

a most important soil born disease causing severe economic losses on sesame in different countries [17,18]. As it is a soil borne disease and once noticed in the field cannot be easily controlled by any means, insulation of agronomic superior varieties with genetic resistance to the disease is therefore, the best means to manage it and thereby minimize the yield losses. Unfortunately very little is known on the existence of reliable sources of resistance [19].

From each variety 10 random sample plants were taken in each tested environment and sesame bacterial blight was assessed from the sample plants during 2014 and 2015 main cropping seasons. Diseases infection revealed significance difference among genotypes in all tested environments both during 2014 and 2015 main season. From the analysis result blight was appeared both at early seedling stage (From 10 DAE up to 25DAE) and late capsule formation (From 75 DAE up to 90 DAE) during 2014 -2015 main cropping seasons in all tested environments. Diseases incidence and severity were higher at capsule formation than early seedling stage this is due to many favorable conditions at capsule formation. The bacterial blight incidence was sever in 2014 cropping season due to continuous high rain fall, high humidity and low temperature those conditions may provide favorable conditions for higher diseases incidence than 2015 cropping season which recorded low bacterial blight incidence Table 4.

From 0%-100% Sesame bacteria blight severity was recorded among genotypes. HuRc-4, HuAC-3 and the standard check (Setit -1) were among the highly resistant (HR) .Whereas Gumero and Hirhir were showed resistant (R) and ACC202514, HuRC-2 and Land race Gumero were moderate resistant (MR) genotypes. Four genotypes, Acc111824, Acc 27913, Acc 227880, and Rawyan -2 showed highly diseases susceptible (HS) in the tested environments. Conversely, HuRC-1 and Acc 111518 were moderate susceptible (MR) genotypes. In general, many genotypes in all the trials tended to show disease reaction more toward resistance. However, the best genotypes with the lowest percent diseases intensity (PDI) score were HuRC-4, HuRC-3 and the standard check (Setit -1). Therefore; genotypes showed best resistant performance were selected for diseases resistance development and production Table 4.

3.2 Incidence and Severity of Sesame Phyllody in Different Genotypes

From each variety 10 random sample plants were taken in each tested environment and sesame phyllody was assessed from the sampled plants during 2014 and 2015 main cropping seasons. Diseases infection revealed significance difference among genotypes in all tested environments both during 2014 and 2015 main season. From the assessment result phyllody was appeared at seedling, flowering and capsule formation during 2014-2015 main cropping seasons in all tested environments. Incidence and severity of phyllody Diseases were higher at capsule formation this was due to many transmitting agents available during flower initiation and capsule formation. The diseases incidence was sever in 2014 cropping season due to continuous high rain fall, high humidity and low temperature conditions may provide favorable conditions for severe incidence. Whereas, during 2015 cropping season low phyllody incidence was recorded as compared with 2014 main season. High diseases incidence differences were occurred among genotypes from 15% -60% in all environments during 2014-2015 cropping season Table 5.

Phyllody severity was recorded from 0%-75% among genotypes. However, ACC202514, HuRC-4, Abuseffa, HuRC-3, Acc 202300, Acc111824, Acc 27913 and Setit -1 were among the highest resistant (HR) sesame genotypes. Whereas, HuRC-1, Acc 111518, Gumero and Acc 227880 were moderate resistant (MR) genotypes for phyllody disease. Four genotypes, Rawyan -2, Land race Gumero and Kefif showed highly diseases susceptible (HS) in the tested environments. In general, most of the genotypes except three genotypes showed resistance in all the trials tended to show disease reaction more toward moderate to highest resistance. However, the best genotypes with the lowest percent diseases intensity (PDI) score were ACC202514, HuRC-4, Abuseffa, HuRC-3, Acc 202300, Acc111824, Acc 27913 and Setit -1.Therefore; genotypes showed best resistant performance across the tested environments were selected for diseases resistance development and production in high phyllody diseases occurred areas presented in Table 4.

3.3 Incidence and Severity of Fusarium Wilt

Wilt severity was recorded from 5%-100% among genotypes. HuRC-2, Acc 227880, Setit -

1, Hirhir, HuRC-3, HuRC-4 and ACC202514 were among the resistant (R) sesame genotypes. Whereas Gumero, Acc 202300, Kefif, Acc 111518, Land race Gumero were the highest susceptible (HS) genotypes for phyllody disease in the tested environments and years indicated in Table 5.

Research efforts should be further concentrated towards identification of more resistant genotypes by including vast and diverse germplasm from different parts of the northern Ethiopia. HuRC-4 and Gumero were identified as resistant and susceptible respectively in the present study were used as parental material in the development of mapping population for tagging of wilt resistance gene(s) in sesame similar work was reported from [20] selection for high seed yield that enabled identification of productive families with lowered infection. Similar to this effort, resistance source identified in the present study can be utilized in developing populations from which resistant variety coupled with high yield can be selected [21].

4. INCIDENCE, SEVERITY OF SESAME BACTERIAL BLIGHT, FUSARIUM WILT AND PHYLLODY ACROSS THE TESTED LOCATIONS

4.1 Bacterial Blight Incidence and Severity Across Locations and Years

Sesame bacterial blight is one of the most seed bore disease mostly distributed in the sesame growing areas of northern Ethiopia. Bacterial blight incidence and severity of different sesame genotypes was varied across locations and years. The highest diseases incidence was recorded in Humera (75%), Kebabo (40%), Sheraro (25%), and Warigba (15%) in 2014 main season. Whereas, low diseases incidence was recorded in Humera (50%), Gendawuha (50%), Maykadra (40%), Kebabo (20%), Sheraro (20%), Wargiba (10%) in 2015 cropping season. The highest bacterial blight severity was recorded in Humera (50%) and Kebabo (50%) followed by Sheraro (15%) and Wargiba (10%) in 2014 main season low diseases. Conversely low diseases

Table 4. Severity and incidence of bacterial blight on 17 genotypes across locations during 2014-2015

Genotype	Seed yield (kg/ha)	Incidence		Severity		
		Range	Mean	Range	Mean	Response
HuRC-4	867.4	0-35	20	0	0	HR
ACC202514	583.3	0-60	50	0-20	20	MR
Land race Gumero	753.8	0-95	45	10-65	51	S
Abuseffa	668.6	0-100	60	10-75	57	S
HuRC-1	694.6	0-95	45	5-100	50	MS
Rawyan -2	597.7	0-95	45	0-100	70	HS
HuRC-3	792.5	0-50	15	0	0	HR
Acc 202300	441.8	0-50	20	5-85	60	S
Kefif	562.1	0-75	50	10-95	51	S
Acc111824	548.1	0-75	35	80	80	HS
Acc 111518	561.3	0-55	25	50	50	MS
Acc 27913	619.1	0-65	35	100	100	HS
Gumero	571.8	0-50	15	1-10	10	R
HuRC-2	723.6	0-50	20	Tr-30	25	MR
Acc 227880	662.9	0-100	60	0-80	75	HS
Setit -1	745.1	0-25	12	0	0	HR
Hirhir	645.5	0.30	15	Tr-10	1-10	R

Tr=Trace, Sesame bacterial blight rating scale (0-5): The disease reaction was categorized as highly resistant (HR), resistant(R), moderately resistant (MR), moderately susceptible (MS), susceptible (S) and highly susceptible (HS) as per the disease severity range of 0%, 1 to 10%, 11 to 25%, 26 to 50%, 51 to 70% and 71 to 100%, respectively. The Percent Disease Intensity (PDI) was calculated according to Wheeler (1969)

Table 5. Incidence and severity of fusarium wilt and phyllody in 17 genotypes during 2014-2015

Genotype	SY (kg/ha)	Fusarium wilt Incidence		Fusarium Severity			Phyllody Incidence		Phyllody Severity		
		Range	Mean	Range	Mean	Response	Range	Mean	Range	mean	Response
HuRC-4	867.4	0-20	20	1-10	5	R	0	0	0	0	R
ACC202514	583.3	5-50	20	Tr-20	10	R	0	0	0	0	R
Land race Gumero	753.8	0-60	50	0-100	81	HS	5-10	5	-Tr-60	60	HS
Abuseffa	668.6	0-25	25	1-50	25	MR	1-20	15	10-45	10	R
HuRC-1	694.6	5-50	50	1-45	50	MS	5-30	25	5-50	20	MR
Rawyan -2	597.7	10-50	55	1-75	25	MR	0-45	20	-Tr-65	65	HS
HuRC-3	792.5	5-60	25	Tr-30	10	R	0	0	0	0	R
Acc 202300	441.8	0-40	40	0-99	82	HS	0	0	0	0	R
Kefif	562.1	5-30	25	0-100	100	HS	5-10	5	Tr-80	75	HS
Acc111824	548.1	1-30	20	1-55	50	MS	0	0	0	0	R
Acc 111518	561.3	0-50	50	0-99	99	HS	10-25	15	0-25	13	MR
Acc 27913	619.1	5-45	25	0-50	25	MR	0	0	0	0	R
Gumero	571.8	0-60	50	0-100	81	HS	0-10	10	5-25	15	MR
HuRC-2	723.6	0-20	20	Tr-25	20	R	10-20	20	5-10	5	HR
Acc 227880	662.9	5-15	15	Tr-10	10	R	10-30	15	10-35	12	MR
Setit -1	745.1	0-50	40	Tr-5	5	R	0	0	0	0	R
Hirhir	645.5	5-15	15	5-10	10	R	0	0	0	0	R

Tr =Trace, SY = seed yield, HR=highly resistant, MR= moderate resistant, R=resistant, S=susceptible, HS=highly susceptible, MR=moderate susceptible, HS=highly susceptible. Phyllody: (0-6) rating scale, where 0 = no infection (highly resistant); 1 = 0.1-10% plants infected (resistant); 2 = 10.1-20 % plants infected (moderately resistant); 3 = 20.1-30% plants infected (tolerant); 4 = 30.1-40% plants infected (moderately susceptible); 5 = 40.1-50% plants infected (susceptible) and 6 = more than 50% plants infected (highly susceptible). Sesame Fusarium wilt (1-5): based in the infection percentage as follows:1-20%=1, 20.01-40=2,40.01-60=3,60.01-80=4,80.01-100=5.the comments of those scale values [1=Resistant(R),2= Moderate Resistant (MR),3=Moderate Susceptible(MS),4=Susceptible (S) and 5=highly susceptible (HS)]

Table 6. Incidence and severity of bacterial blight disease across the tested locations during 2014-2015

Districts/ locations	Incidence in 2014		severity 2014		Incidence in 2015		Severity in 2015		Combined mean % incidence	Combined mean %severity
	Range	Mean	Range	mean	Range	Mean	Range	Mean		
Humera	0-80	75	0-60	50	5-65	50	0-30	25	62.5	37.5
Maykadra	-	-	-	-	10-75	40	0-70	50	20	25
Kebabo	0-50	40	0-75	50	0-25	20	5-25	15	30	32.5
Sheraro	5-35	25	0-20	15	5-30	20	5-25	5	22.5	10
Wargiba	5-20	15	0-10	10	5-15	10	0-10	5	12.5	7.5
Gendawuha	-	-	-	-	5-75	50	10-20	30	25	15

Table 7. Incidence and severity of fusarium disease across the tested locations during 2014- 2015

Districts/ locations	% Incidence in 2014		%Severity 2014		%Incidence in 2015		% severity in 2015		Combined mean % incidence	Combined mean % severity
	Range	Mean	Range	Mean	Range	Mean	Range	Mean		
Humera	0-30	15	0-10	5	5-100	40	0-30	15	27.5	10
Maykadra	-	-	-	-	10-60	50	5-100	40	32.5	20
Kebabo	5-40	25	5-35	15	0-100	60	10-99	30	37.5	22.5
Sheraro	5-40	25	10-25	15	5-50	40	10-99	10	27.5	12.5
Wargiba	10-30	15	0-20	10	0-25	10	0-10	5	12.5	7.5
Gendawuha	-	-	-	-	0-100	70	0-60	50	42.5	25

Table 8. Incidence and severity of phyllody diseases across the tested locations during 2014-2015

Districts/ locations	% Incidence in 2014		%Severity 2014		%Incidence in 2015		% severity in 2015		Combined mean % incidence	Combined mean % severity
	Range	Mean	Range	Mean	Range	Mean	Range	Mean		
Humera	0	0	0	0	0-50	25	0-10	5	12.5	2.5
Maykadra	-	-	-	-	5-30	15	5-20	10	7.5	5
Kebabo	5-20	15	0-10	5	0	0	0	0	7.5	2.5
Sheraro	10-30	20	5-10	10	0-5	5	0-10	5	12.5	7.5
Wargiba	0-30	20	0-10	10	10-30	15	0-5	5	17.5	7.5
Gendawuha	-	-	-	-	0-5	5	0-20	10	2.5	5

severity was recorded in Humera (25%), Gendawuha (50%), Maykadra (50%), Kebabo (15%), Sheraro (5%), and Wargiba (10%) in 2015 cropping season. The assessment result indicated that about 62.5%, 30%, 25%, 22.5%, 20% and 12.5% combined mean percent diseases incidence and combined mean percent disease severity 37.5%, 32.5%, 25%,,15%,10% and 7.5% was recorded in Humera, Kebabo, Gendawuha, Sheraro, Maykadra, Wargiba and respectively (Table 6).

4.2 Fusarium Incidence and Severity Across Locations and Years

Sesame fusarium wilt is one of the soil bore disease mostly distributed in the sesame growing areas of northern Ethiopia. Diseases incidence and severity of different sesame genotypes was varied across locations and years. The highest diseases incidence was recorded in Humera (15%), Kebabo (25%), Sheraro (25%), and Warigba (15%) in 2014 main season. Humera (30%), Gendawuha (70%), Maykadra (30%), Kebabo (20%), Sheraro (40%), Warigba (10%) in 2015 cropping season. Diseases severity is the Severity Humera (5%), Kebabo (15%), Sheraro (15%), and Wargiba (10%) in 2014 main season. Humera (15%), Gendawuha (50%), Maykadra (40%), Kebabo (30%), Sheraro (10%), Wargiba (5%) in 2015 cropping season. The assessment result indicated that about 42.5%, 37.5%, 32.5%, 27.5%, 27.5% and 12.5% combined mean percent of disease incidence and 25%, 22.5%, 20%,,12.5%,10% and 7.5% combined mean percent of disease severity was recorded in Gendawuha, Kebabo, Maykadra, Sheraro, Humera, Wargiba respectively (Table 7).

4.3 Phyllody Incidence and Severity Across Locations and Years

Diseases incidence and severity of different sesame genotypes was varied across locations and years due to environmental factors, management practices and cropping systems. The highest diseases incidence was recorded in Humera (75%), Kebabo (40%), Sheraro (25%), and Warigba (15%) in 2014 main season. Humera (50%), Gendawuha (50%), Maykadra (40%), Kebabo (20%), Sheraro (20%), Warigba (10%) in 2015 cropping season.. From the analysis result showed that Humera (50%), Kebabo (50%) and Sheraro (15%), were recorded highest diseases in 2014 main season. Humera (25%), Gendawuha (50%), Maykadra (50%), Kebabo (15%), Sheraro (5%), Wargiba (10%) in 2015 cropping season. The assessment result indicated that about 17.5%, 12.5%, 12.5%, 7.5%, 7.5% and 2.5% combined mean percent disease incidence and 7.5%, 7.5%, 2.5%, 2.5%, 5% and 5% combined mean percent disease severity was recorded in Wargiba, Sheraro, Humera, Kebabo, Maykadra; Gendawuha respectively (Table 8).

5. SUMMARY AND CONCLUSION

Sesame varieties affected and challenged by different biotic (bacteria, viruses, fungi and nematodes) and a biotic (water logging, moisture stress, wind and temperature) factors. Sesame bacterial blight, phyllody and fusarium wilt were assessed their incidence and severity in ten tested environments during 2014 and 2015 main seasons. Seventeen sesame genotypes were tested under field screening in natural epiphytotic conditions. In humid, high rain fall, sesame cultivated for long period, mono cropping, local seed producing areas aggravate bacterial blight, fusarium wilt and phyllody due to those reasons the prevalence percentages of those diseases were varied across the tested locations, genotypes and years. Even though the prevalence percentage of the major diseases were varied from location to location they occurred and distributed in all the tested locations Humera, Maykadra, Kebabo, Sheraro, Wargiba, and Gendawuha sesame growing areas. Bacterial blight, fusarium wilt and phyllody diseases are one of the most important sesame diseases widely distributed and identified in the sesame growing areas of northern Ethiopia. Due to new emerging sesame diseases, changing and variability of their behavior continues assessment and identification is very important in the sesame growing areas. Crop rotation, integrated disease management (IDM) options should give an emphasis in all sesame growing areas.

From the assessment result indicated that about 75%, 70% and 25% diseases incidence and 50%, 50% and 10% diseases severity was recorded for bacterial blight, fusarium wilt and phyllody diseases respectively. The assessment result indicated that bacterial blight showed about 62.5%, 30%, 25%, 22.5%, 20% and 12.5% combined mean percent diseases incidence and 37.5%, 32.5%, 25%,,15%,10% and 7.5% combined mean percent disease severity was recorded in Humera, Kebabo, Gendawuha, Sheraro, Maykadra, Wargiba and respectively, Fusarium wilt recorded about 42.5%, 37.5%,

32.5%, 27.5%, 27.5% and 12.5% combined mean percent of disease incidence and 25%, 22.5%, 20%,,12.5%,10% and 7.5% combined mean percent of disease severity was recorded in Gendawuha, Kebabo, Maykadra, Sheraro, Humera, Wargiba respectively. 17.5%, 12.5%, 12.5%, 7.5%, 7.5% and 2.5% combined mean percent phyllody disease incidence and 7.5%, 7.5%, 2.5%, 2.5%, 5% and 5% combined mean percent disease severity was recorded in Wargiba, Sheraro, Humera, Kebabo, Maykadra; Gendawuha respectively. ACC202514, HuRC-4, Abuseffa, HuRC-3, Acc 202300, Acc111824, Acc 27913 and Setit -1 were among the highest resistant (HR) sesame genotypes for phyllody disease. From 0%-100% Sesame bacteria blight severity was recorded among genotypes and HuRc-4, HuAC-3 and the standard check (Setit -1) were among the highest resistant (HR) sesame genotypes. Fusarium severity was recorded from 5%-100% range among genotypes. HuRC-2, Acc 227880, Setit -1, Hirhir, HuRC-3, HuRC-4 and ACC202514 were among the resistant (R) sesame genotypes. Whereas Gumero, Acc 202300, Kefif, Acc 111518, Land race Gumero were the highest susceptible (HS) genotypes for fusarium disease across the tested environments and years. In humid, high rain fall, sesame cultivated for long period, mono cropping, local seed producing areas can aggravate bacterial blight, fusarium wilt and phyllody due to those reasons the prevalence percentages of those diseases were varied across the tested locations and years. Most of the time no genotype can find resistant for many diseases this is due to many biotic and a biotic factors. Generally HuRC-4 and HuRC3 genotypes were found resistant to bacterial blight, fusarium wilt and phyllody therefore those genotypes could be used for diseases resistant breeding program across different locations. HuRC-4 was evaluated by the national technical committee and it was found relatively resistant and high yielder among the genotypes and released as variety for commercial production for all the tested areas.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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