

Survey and Identification of Major Sesame Diseases in Low Land Areas of Western Zone of Tigray, Ethiopia

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Abstract: The survey was conducted at ten specific location major sesame growing representative low land areas of western zone of Tigray. The study was conducted in consecutive three years (2015, 2016, and 2017) at different locations. The objectives of the study were (1) to assess and identify major sesame diseases and (2) to study the prevalence, incidence and severity of different sesame diseases. Bacterial blight (83.24%) recorded the highest diseases incidence followed by powdery mildew (78.13%), fusarium wilt (78%), phyllody (72.01%) and blight leaf spot (72%). Whereas blight leaf spot recorded highest severity (31.33%), followed by fusarium wilt (27.2%), phyllody (25.24%), bacterial blight (22.76%) and powdery mildew (22.6%). Maygaba and division locations recorded the highest diseases incidence (90.49%) and (86.76%) respectively while Lugudi recorded the lowest diseases incidence (48.055). Bacterial blight recorded 100% diseases severity in all locations followed by blight leaf spot in Doka- abagabyo (92%) and phyllody (81%), in Adi-usmanand fusarium wilt (61. 41%) in Adi usman. From the study recommended that appropriate control methods should be identified and recommended to prevent sesame yield loss and increases productivity. Field diseases assessment and inspection; diseases control should be from emergence to capsule formation and maturity.

Keywords: Constraints, Incidence, Prevalence, Severity

1. Introduction

Sesame commonly known as “till”, is the most Ancient oilseed crop domesticated and cultivated in Asia for more than 5000 years. The world production of sesame is over 3.84 million metric tons with India as the leading producer. Sesame suffers from many diseases like bacterial blight [1], leaf and stemsblight leaf spots, fusarium wilt [2], charcoal rot and root rot. Among the major constraints, bacterial blight leaf spot and bacterial spot caused by *Xanthomonascampestrispv. Sesami* (Xcs) and *Pseudomonas syringaepv. Sesami* respectively are very serious diseases in most sesame growing regions and dramatically decrease the sesame yields during monsoon season.

Sesame suffers from many diseases like leaf spot [3], (Ojiamboet *al.*, 2003), leaf and stem blights, fusariumwilt [4],

(El-Bramawy, 2006), charcoal rot and root rot. Among the major constraints, bacterial blight and bacterial spot caused by *Xanthomonascampestrispv. sesami* (Xcs) and *Pseudomonas syringaepv. Sesami* respectively are very serious diseases in most sesame growing regions and dramatically decrease the sesame yields during monsoon season

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]. In the present study 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 [3]. 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 [6]. 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 1 = 0.1-10%, 2 = 10.1-20%, 3 = 20.1-30%, 4 = 30.1-40%, 5 = 40.1-50% and 6 = more than 50%.

Fusarium wilts: Wilt caused by *Fusarium oxysporium* 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 [9]. As it is a soil borne disease and once noticed in the field cannot be easily controlled by any means, insulation of agronomically 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 [10]. *Fusarium oxysporium* f. *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. 1-5 rating 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 [11]. The powdery mildews have been reported to infect over 10,000 species of plants [12]. *Chrysanthemum* is a genus of plants in Asteraceae that has been found to be a host for powdery mildew. Powdery mildew rating scale is 0=0, 1=1%, 3, =1-5%, 5=5-25%, 7, =25-50%, 9 =100% reported [13].

Bacterial blight of sesame caused by *Xcs* was first reported in Pakistan by [13]. *Xcs* can affect crop at any growth stage. Bacteria infect plants through stomata and wounds, spreads in intercellular space outside plant cell wall [14]. Severity of bacterial blight is related to soil moisture and relative humidity. A study on disease assessment showed that 75.6% of the development of disease severity in sesame is contributed by *Xcs* and *Pseudomonas syringae* pv. *sesamei* [15].

In sesame growing areas of northern Ethiopia there is no information for the production constraints of different sesame diseases; prevalence, incidence and severity. Therefore; the study was designed with the following objectives (1) to assess and identify major sesame disease and (2) to study the prevalence incidence and severity of different sesame diseases in sesame growing areas

2. Materials and Methods

The survey was conducted at ten specific location major sesame growing representative low land areas of western zone of Tigray. Major diseases were assessed in the surveyed in consecutive three years (2015, 2016, and 2017) at different locations. Diseases data were collected by random sampling at 15 km difference from one location at twelve points (quadrants) in each specific location. Un identified sample were collected and pressed for further laboratory identification. Diseases severity, incidence, prevalence and geographical distribution of phyllody, powdery mildew, fusarium wilt, blight leaf spot and bacterial blight were identified. Ten sample plants were taken and checked diseases. Materials used during the study were, GPS, hand lence, camera, pressing box, magazine and glove.

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:

$$\text{Disease prevalence (PD\%)} = \frac{\text{total infected areas}}{\text{total assessed areas}} \times 100$$

Diseases incidence: is the proportion or percentage of diseased leaves in a plant, diseased stalks or tillers or diseased seedlings in a field. It is the diseased percentage of parts or plants 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

$$\text{Disease incidence (DI\%)} = \frac{\text{total number of infected plants}}{\text{total number of assessed plants}} \times 100$$

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].

$$\text{Disease severity} = \frac{\text{sum of all diseases ratings}}{\text{total number of ratings} \times \text{disease grade}} \times 100$$

Table 1. Description of the study areas in western zone of Tigray.

Region	Zone	District	Kushet	Latitude(N)/x/	Longitude(E)/y/	Altitude/m/Z/
Tigray	Western zone	Tsegede	Adi- usman (12)	13.57171°	36.77481°	686
			Division (12)	13.63785°	36.83264°	741
		Welkait	Kalema (12)	13.97425	37.51063	959
		k/humera	Dokaabagabyo (12)	14.07042	36.56902	623
		k/humera	Lugudi (12)	13.98959	36.39773	639
		k/humera	Mechach (12)	13.94972	36.46882	665
		Welkait	Maygaba (12)	13.77776	37.68234	896
		k/humera	Maykadra (12)	14.06251	36.57927	632
		Welkait	Maytetei (12)	13.80834	37.67482	879
		k/humera	Redem (12)	14.04926	36.49005	617

Sources: Description of the study areas in western zone of Tigray [17]

3. Result and Discussion

From each quadrant 10 random sample plants were taken in each point location. Sesame diseases were assessed and identified from the sampled plants during the consecutive three years (2015, 2016, and 2017). GenstatV16 software was used for data analysis as a result diseases incidence and severity showed significance difference among different diseases types, locations and districts [18]. From the assessment result different diseases appeared (100% prevalence) at different growth stages started from seedling, flowering and capsule formation. Bacterial blight

recorded highest incidence (83.24%) followed by powdery mildew (78.13%), fusarium wilt (78%), phyllody (72.01%) and blight leaf spot (72%). Whereas blight leaf spot recorded highest severity (31.33%), followed by fusarium wilt (27.2%), phyllody (25.24%), bacterial blight (22.76%), and powdery mildew (22.6%) indicated in table 2. [19] Reported that 17 white sesame genotypes were screened against Bacterial blight, fusarium wilt and phyllody diseases and found some genotypes resistant diseases sesame diseases. [20] Reported that bacterial blight is one of sesame production constraints in northern Ethiopia

Table 2. Prevalence, incidence and severity of different major sesame diseases.

diseases type	Scientific name	Local name	Percent diseases		
			Pre	DS	DI
Blight leaf spot	<i>Alternaria</i> spp.	<i>Kotsilinetebtab</i>	100	31.33	72.01
Fusarium Wilt	<i>Fusarium oxysporium</i> f. sp. <i>sesam</i>	<i>Atewulagi/</i>	100	27.2	78
Bacterial blight	<i>Xanthomonas campestris</i> sp. <i>sesami</i>	<i>Michi/ashayta</i>	100	22.76	83.24
Phyllody		<i>Mkosterseytan</i>	100	25.53	72.01
Powdery Mildew	<i>Sphaerotheca fuliginea</i> ,	<i>Hamekushay</i>	100	22.6	78.13

Where: Pre=prevalence, DI=diseases incidence, DS=diseases severity,

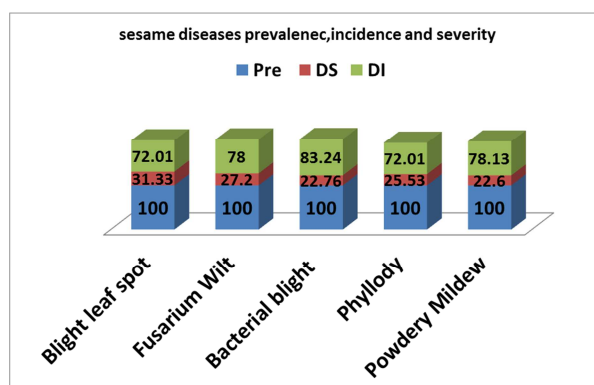


Figure 1. Prevalence, incidence and severity of different sesame diseases.

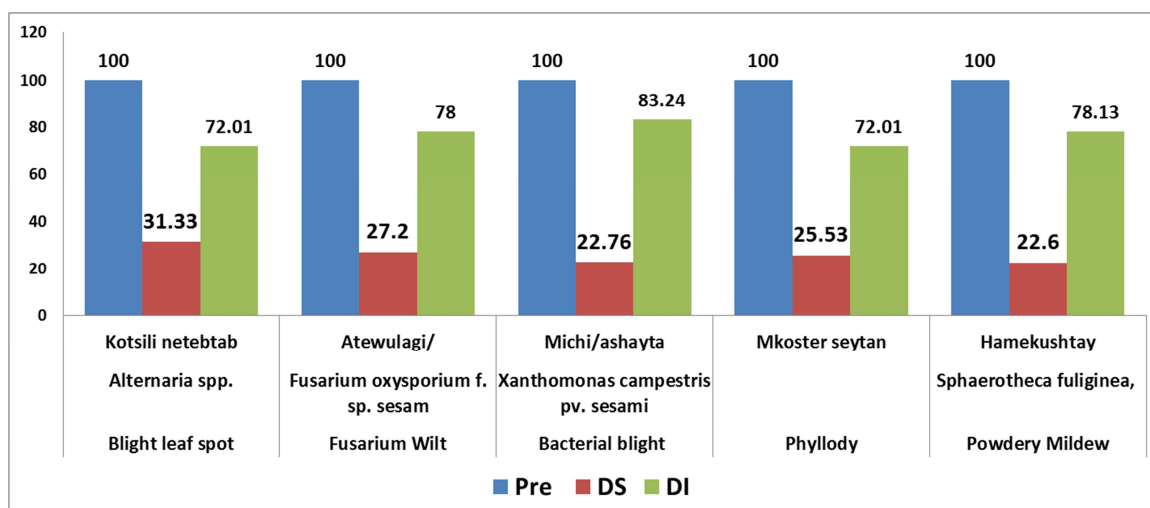


Figure 2. Scientific name, local name, prevalence, incidence and severity of different sesame diseases.

Table 3. Prevalence, incidence and severity of different diseases in the assessed specific locations.

Sn	District	Kebele	Kushet (Specific Location)	DS	DI	Prevalence
1	Tsegede	Mender -6 Werie	Adi- Usman	16.8 ^c	75.63 ^{ab}	100
			Division	29.6 ^{bc}	86.76 ^a	100
			Doka Abagabyo	17.97 ^c	68.36 ^{ab}	100
			My Kadra	18.53 ^c	83.3 ^a	100
2	k/Humera	May kadra	Lugudi	39.73 ^b	48.05 ^b	100
			Mechach	22.68 ^c	79.46 ^a	100
			Redem	21.67 ^{bc}	72.63 ^{ab}	100
			Kalema	25.69 ^{bc}	68.82 ^{ab}	100
3	Welkait	Korarit	My Tetei	22.6 ^{bc}	78.13 ^{ab}	100
		Maygaba	Maygaba	74.13 ^a	90.49 ^a	100
		Mean				28.94
LSD (<5%)				17.1	72.2	
CV (%)				38	21.8	

Phyllody Rating scale ((0-6) rating scale, where 0 = 0 1 = 0.1-10% 2 = 10.1-20% 3 = 20.1-30% 4 = 30.1-40%, 5 = 40.1-50% 6 = >50% [7], fusarium wilt rating scale(1-5, 20%=1, 20.01-40=2,40.01-60=3,60.01-80=4,80.01-100=5. [10]. Bacterial blight leaf spot rating scale (0-5), where 0=0,1= 1%, 2=1- 25%, 3=26-50%, 4=51-75%,5=>75%, [21]. Powdery mildew rating scale 0=0, 1=1%, 3, =1-5%, 5=5-25%, 7, =25-50%, 9 =100% reported (TNAU, 1980). [22]

Maygaba and division recorded the highest diseases incidence 90.49% and 86.76% respectively while Lugudi recorded the lowest diseases incidence (48.055). Bacterial blight recorded 100% diseases incidence in all locations followed by blight leaf spot in Doka abagabyo (92%), phyllody (81%) and fusarium wilt (61.40%) in adi-Usman respectively presented table 4.

Table 4. Sesame diseases incidence across the study areas.

Diseases	adiusman	division	Kalema	Doka abagabyo	Lugudi	Mechach	Maygaba	my kadra	my tetei	Redem
Blight leaf spot	78.98	33.59	84.49	92.89	84.94	81.09	81.13	72.32	-	62.82
Fusarium Wilt	61.41	63.51	34.00	31	36	32	28	26	33	29
Bacterial blight	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Phyllody	81.40	60	37	45	39	34	49	28	18	22
Powdery Mildew	33.90	22	15	10	5	6	5	4	4	7

Table 5. Sesame diseases severity across the study areas.

Diseases	adiusman	division	Kalema	Dokaabagabyo	Lugudi	Mechach	my gaba	my kadra	my tetei	Redem
Blight leaf spot	7.53	20.73	24.93	17.97	36.33	15.07	74.13	12.2	10	21.67
Fusarium Wilt	21.47	29	20	21.47	20	15	10	30	34	23
Bacterial blight	16.8	29	10	30	12	15	22	21	14	17
Phyllody	10.93	22	14	15	24	34	32	15	9	8
Powdery Mildew	22.6	2	2	3	1	5	1	2	1	3

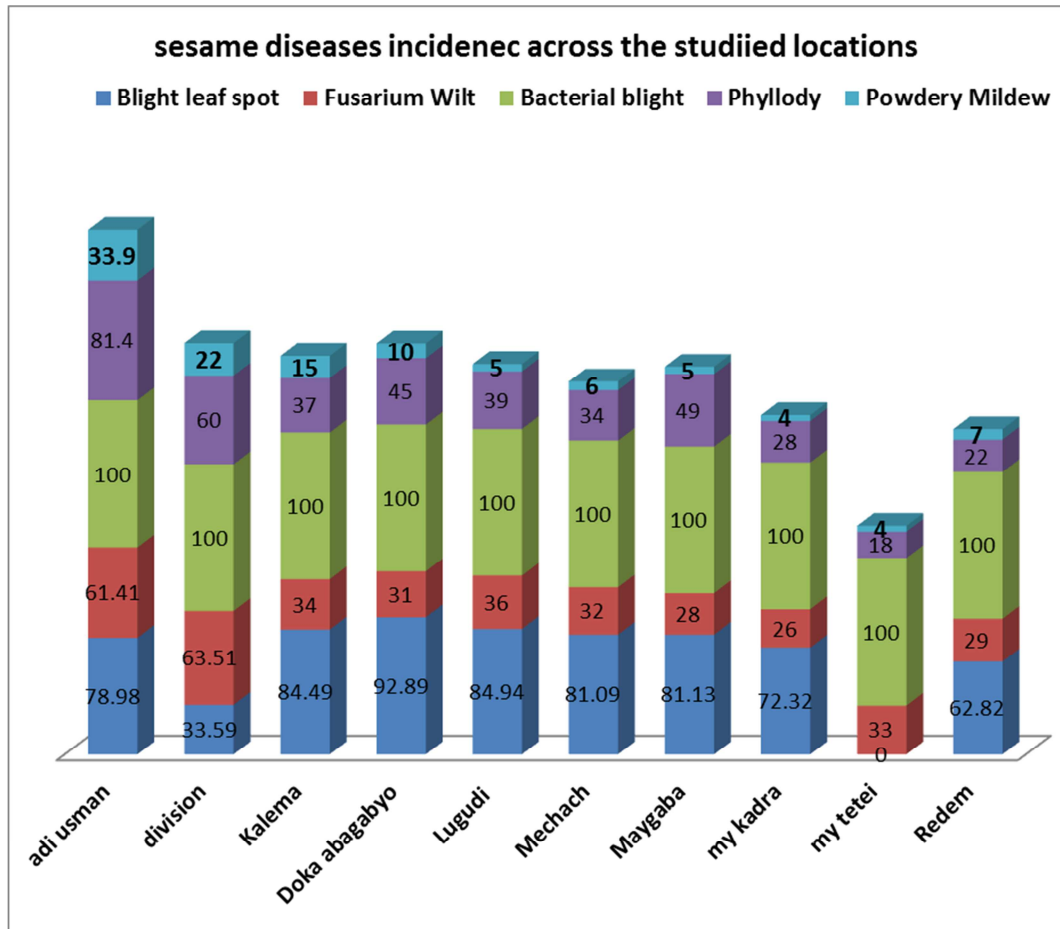


Figure 3. Incidences of different sesame diseases across the studied areas.

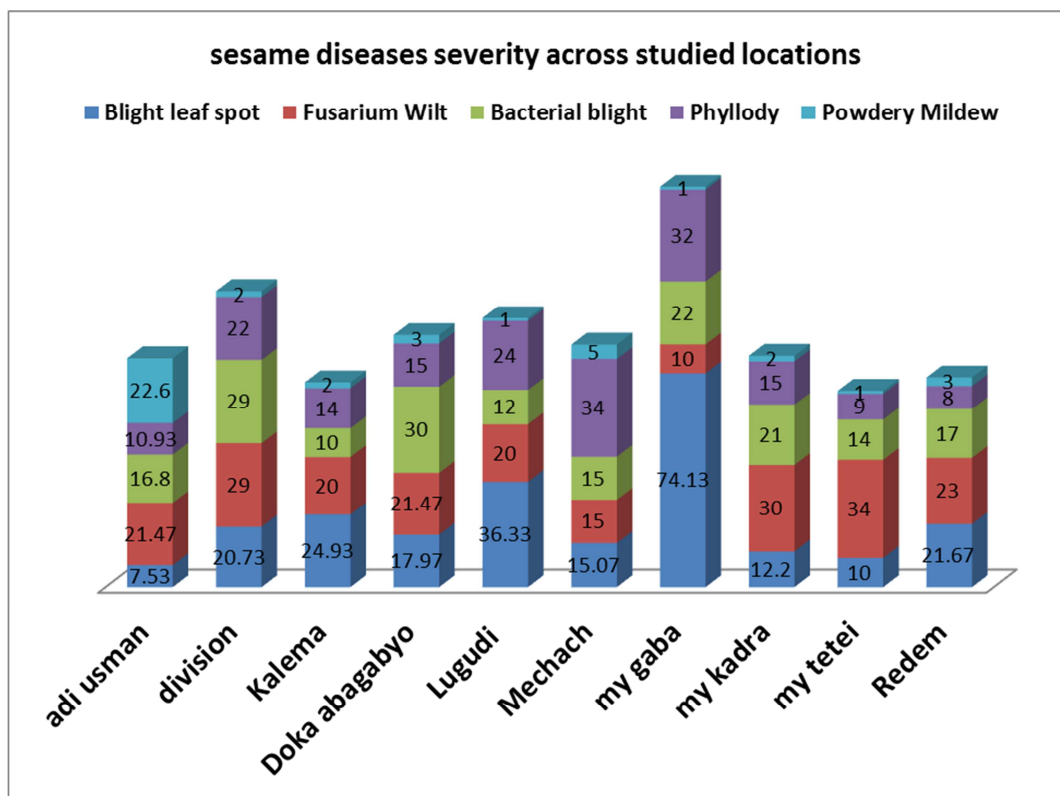


Figure 4. Severity of different sesame diseases across the studied areas.

4. Conclusion and Recommendation

Except powdery mildew in specific areas Blight leaf spot, fusarium wilt, Bacterial blight and phyllody sesame diseases were the major production constraints from year to year in western zone of Tigray. Because of those diseases farmers and investors losing their productivity and quality production from time to time. From the assessment result different diseases appeared at different growth stages started from seedling, to flowering, capsule formation and harvesting. Bacterial blight recorded highest diseases incidence (83.24%) followed by powdery mildew (78.13%), fusarium wilt (78%), phyllody (72.01%) and blight leaf spot (72%). Whereas blight leaf spot recorded highest severity (31.33%), followed by fusarium wilt (27.2%), phyllody (25.24%), bacterial blight (22.76%) and powdery mildew (22.6%). Maygaba and division areas recorded the highest diseases incidence 90.49% and 86.76% respectively while Lugudi recorded the lowest diseases incidence (48.055). Bacterial blight recorded 100% diseases incidence in all locations followed by blight leaf spot in Doka abagabyo (92%), phyllody (81%), and fusarium wilt (61.41%) in Adi usman. The study indicated that those diseases occurred at all sesame crop growth stages are the major diseases. From this study we recommended that according to this study and periodization of different diseases appropriate control methods should be identified and recommended to prevent sesame yield loss and increases productivity. Field diseases assessment and inspection; diseases control must be from emergence to capsule formation and maturity. Farmers and investors should be given continuous training how to assess, identify and control sesame diseases.

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