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RESEARCH ARTICLE

DISTRIBUTION AND SEVERITY OF SORGHUM COVERED KERNEL SMUT IN NORTH WESTERN ETHIOPIA

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ABSTRACT

Field survey for sorghum covered kernel smut incidence and severity were done in two districts of North Gondar Administrative zone, Amhara National Regional State in North western Ethiopia, during the main crop season. In each district eleven representative Peasant Administrations (PAs) were selected randomly based mainly on sorghum area coverage. In each PA disease was assessed in ten randomly selected farmer fields. In Gondar Zuria district, the disease was highly distributed through out the surveyed areas and disease incidence ranged from 10.5 to 29.2%. The highest (29.2%) and the lowest disease incidence (10.5%) were recorded at Tach Teda and Sarwuha PAs respectively. The severity was the highest (54.66%) at Bahiriginb and the lowest (26.57%) at Sarwuha PAs. In Alefa Takussa district, the disease was found to be distributed with mean disease incidence of 12.25%. The higher disease incidence (17.43%) was at Goy while it was the lowest (5.5%) at Chima Lembez PAs. The Highest disease severity (48.35%) was encountered at Ayibiga and it was the lowest (31.05%) at Chima Lembez.

INTRODUCTION

Sorghun [*Sorghum bicolor* (L.) Moench] is one of the major foods and feed crops of the world and ranking fourth the world cereal crops wheat, rice and maize (FAO, 1998; Singh, 1983). Sorghum crop was first domesticated in Africa and all the cultivated and weedy races and varieties of the crop are found in the continent. Due to this, genetic diversity of sorghum is greatest in the African continent (Berhane, 1979; Ghani Zadeh *et al*., 2011). Ethiopia is the largest sorghum producing country in Eastern and Southern Africa next to Sudan. Sorghum is one of the most important Ethiopian food crops, second to teff [Eragrositis tef (Zucc)], which is stable food of Ethiopia. This crop is grown in the highlands and intermediate elevation areas where rain fall is adequate and reliable as well as in the dry, hot low lands of the country (Abebe and Yilma, 1986; Berhane, 1979; Mengistu and Gebrekidan, 1980). It is also among the first four top cereal crops (teff, wheat, maize and sorghum) included in the Ethiopia Government Aggressive Extension program in an attempt to achieve food self sufficiency (Sasakawa Africa Association, 1996). Even though sorghum grows in different ecological zones throughout the country; the importance of the crop in order of priority varies from region n to Region (Abebe and Yilma, 1986). In dry areas, which constitute 46% of the arable land of the country and where moisture is a limiting factor, sorghumm is the number one crop (Reddy and Kidane, 1993). Sorghum is grown in Amhara National Regional State all over North Western Ethiopia as the second major crop exceeded only by teff [Eragrositis tef (Zucc)] (TANRS BOPED, 2000). The productivity of the crop is impeded by various production constraints, including diseases. Among the diseases covered kernel smut caused by the fungus *Sphacelotheca sorghi* (Link.) Clinton is the most important one (A.A.U.C.A., 1981; S.S.E.A.D., 1997; Ammar and El-Naggar, 2011). Covered kernel smut has been reported to be endemic in many sorghum fields from year to year and has side distribution in all sorghum growing areas of the country (Mengistu, 1982). In Ethiopia the extent of loss of grain sorghum due to smuts may reach up to 30% (IAR, 19983; S.S.E.A.D. 1997)

North Western Ethiopia comprises five Administrative zones, namely East Gojam, West Gojam, North Gondar, South Gondar and Awi zones, in which North Gondar exceeded in coverage and production. In all sorghum growing districts; of these zones, covered kernel smut have been reported to be severe and widely distributed (BPHC, 1994; S.S.A.E.D., 1997). In North Western Ethiopia, the incidence of covered kernel smut is currently increasing. Recently Bahirdar Plant Health Clinic, in the spot survey in two administrative zones of three districts has indicated the incidence of this disease from 0 to 50 percent. In spite of an increase in sorghum covered kernel smut in North Western Ethiopia, the distribution, incidence, and severity due to this disease has not been so far quantified. Therefore, the present study has been undertaken with the objective, To determine, incidence and severity of covered kernel smut of sorghum in some major growing areas in North Western Ethiopia.

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MATERIALS AND METHODS

Field Surveys

Survey for sorghum covered kernel incidence and severity was done in North Gondar administrative zone of the Amhara National Regional State (A.N.R.S) in North Western Ethiopia, during the main crop season "Meher" (an Amharic terminology denoting maturity and harvesting time for most of the field crops including sorghum in Ethiopia that normally starts in December). In the selected administrative zone two districts namely, Gondar zuria and Allefa Takusa (Fig. 1) were selected based on accessibility, available time and logistics. In each district eleven representative peasant administration (PAs) were selected at random based on sorghum area coverage. In each PA, ten randomly selected farmers' fields were assessed.

Disease assessment

In each field, disease incidence was scored on hundred randomly selected plants by diagonally moving in the field from one and to other in an "X" fashion. Plants were recorded as either infected of not infected (Cochran, 1972; Dennis and. Geoffrey, 2011). Disease severity was determined on fifteen randomly selected plants in each field using the 1 to 5 disease scoring scale, where 1 = no damage/highly resistance/, 2 = 1-10% damage/resistance/, 3 = 11-25% damage/moderately resistance/, 4 = 36-40% damage/moderately susceptible/, 5 = more than 40% head damage/susceptible/ (House, 1985; Madhusudhan, *et al*., 2011).

Data Collection

1. Incidence and severity of covered kernel Smut
2. Varietal differences with respect to incidence and severity of the disease

Data Analysis

The incidence and severity of covered Kernel smut, in a zone with in districts and localities in the survey area were expressed using descriptive statistics (Gomez, 1984).

RESULTS AND DISCUSSION

The field survey covered one administrative zone, two districts, twenty-two peasant administrations and 220 sorghum farmer fields (Table 1). The altitude of the surveyed area ranged from 1700 to 2200m above sea level. In all the surveyed peasant farms, only land races of sorghum were encountered with low to high levels of covered kernel smut infection (Table, 2). These local cultivars of sorghum might have contributed to the high level of infection in some fields as reported earlier in Somalia (Abadi *et al.,* 1988; Merkuz *et al.,* 2011a)). Altitude and climate did not seem to be factors limiting distribution of covered kernel smut (Mengistu, 1982; S.S.E.A.D., 1997; Merkuz *et al*., 2011b) as in the present study disease was found to be distributed in almost all the surveyed areas.

Distribution, Incidence and Severity of Covered Kernel Smut in Surveyed Areas

Gondar Zuria district

In this district a total of 11 localities (PAs), 110 formers fields and five land races wee assessed. All assessed fields were positive for the occurrence of the disease, indicating that the disease was widely distributed in the district (Table 2). It is evident from Table 2 that all the five land n races were susceptible to covered kernel smut with different level of infection. In Gondar Zuria district, Covered kernel smut was highly distributed through out the surveyed areas and the disease incidence ranged from 10.5 to 29.2%. Among the 11 PAs surveyed in this district, higher disease incidence (29.2%) was recorded at Tach Teda while the lowest incidence (10.5%) was recorded at Sarwuha (Table 2). Disease incidence in Lemba, Lay Teda and Tikara was 23.38, 19.2 and 17% respectively. In the rest of the localities, disease incidence was less than 17% (Table 2). In general, mean disease incidence in this district was found to be 17.13%. Comparing the present results with earlier report form some other African countries, one finds a similarity in disease incidence in peasant farms. For instance, Marley and Aba (1999) reported that covered kernel smut was predominant in farmer fields of major sorghum growing areas of Sudanian zone in the Nigerian Savannah regions and Northern Guinea Zone with incidence of 24.8 and 29.5% respectively. The mean disease severity, in Gondar Zuria district, was 44.5% with severity ranges of 26.57 to 54.66% considering the 11 surveyed PAs, the highest disease severity 54.66% was recorded at Bahir Ginib and the lowest (26.57%) was at Sarwuha. Differences in disease severities among localities could be due to the variation of the pathogen population (Table 2).

Allefa Takussa district

In this district as in Gondar Zuria district, covered kernel smut was found to be highly distributed through out the surveyed areas with mean disease incidence of 12.25% (Table 3). The disease incidence ranged from 7.50 to 17.43% was recorded at Goy while the lowest (7.5%) was at Chima Lembez locality (Table3). The second higher disease severities were recorded at Amchahwa and Endona Chiba with 16.20 and 16.0% respectively. In rest of the PAs, the disease incidence was less than 13% (Table 3). Average disease severity, in this district, was 38.38% with a range of 31.05 to 48.35%. The highest disease severity (48.35%) was encountered at Ayibiga and the lowest (31.05%) was at Chima-Lmbez (Table 3).

Summary and Conclusion

The survey results showed covered kernel smut caused by *Sporisorium sorghi* to be an important disease and caused heavy reduction in the yield of sorghum in the surveyed areas (Merkuz *et al.,* 2011c). In addition to yield reduction, it also adversely affected the quality of grains, when the black masses of chlamydospores contaminated the grain at the time of harvesting and threshing. The disease was found to be prevalent in all the cultivars grown. Surveyed area was found to have only local land race. In Gondar Zuria district, irrespective of the cultivars, the highest disease incidence (29.2%) of covered kernel smut was observed at Tach Teda and highest severity (54.66%) was recorded at Bahri Ginib. The lowest disease incidence (10.5%) and the lowest severity (26.57%) were recorded at Sarwuha. In Allefa-Takussa district, irrespective of cultivars, the highest (17.43%) and the lowest (7.5%) disease incidence and the highest (48.35%) and the lowest (31.05%) disease severity were recorded at Goy, Chima Lembez, Ayibiga and Chima-Lembez respectively.

Table 1. Surveyed areas including localities and altitudes for covered kernel smut

Administrative Zone	Districts	Sub-districts	Localities (PAs)	Altitude range in m
North Gondar	Gondar Zuria	Enfiraz Area	Mitrha-Abawarka	1750 - 1790
			Sarwuha	1800 - 1900
			Tikara	1790 - 1850
		Macksegnit Area	Bahiri-Ginib	1850 - 1950
			Chinchaye	1800 - 1900
			Lemba	1800 - 1900
			Maniterino	1850 - 1950
			Seguaj-Tsion	1850 - 1950
		Teda Area	Lay-Teda	1890 - 1950
			Minziro Teklehaimanot	1850 - 1950
			Tach-Teda	1890 - 1950
	Allefa Takussa	Atsede-Mariam	Atsede-Mariam	2000 - 2200
			Chima-Lembez	1750 - 1850
			Endona-Chiba	1900 - 2050
			Kezen-Tara	2000 - 2200
		Delgi Area	Ayibiga	2000 - 2050
			Chemera-Bambarwa	1800 - 1880
			Delgi-Mekonita	1800 - 1880
			Sebi-Serako	1700 - 1900
		Goy Area	Amchahwa	1900 - 2050
			Dikularva-Kurabas	1900 - 2050
			Goy	1900 - 2050

Table 2. Incidence and severity of covered kernel smut in Gondar Zuria district, North Gondar Administrative zone.

No	Localities	Varieties	Incidence %	Mean Incidence %	Severity %	Mean Severity %
		Zengada	12.5	15.27	63.67**	54.66**
1	Bahri Ginib	Bulie	16.0		43.48	
		Amedo	17.3		56.84	
		Zengada	11.5	13.25	42.8	42.4
2	Chinchaye	Bulie	16.5		38.49	
		Amedo	7.0		30.3	
		Aysham-Demozie	18.0		58.0	
		Zengada	9.0	19.2	31.0	51.7
		Bulie	28.0		60.0	
3	Lay Teda	Amedo	22.0		76.8	
		Aysham-Demozie	19.0		56.4	
		Kuche/Tabir	18.0		34.3	
		Zengada	29.0	23.38	52.84	49.0
		Bulie	18.5		60.8	
4	Lemba	Amedo	20.0		39.5	
		Aysham-Demozie	26.0		42.8	
		Zengada	10.0	12.33	36.67	33.76
5	Materino	Bulie	13.0		28.3	
		Amedo	14.0		36.3	
		Zengada	15.0	15.54	52.0	43.13
6	Miniziro	Bulie	19.67		50.5	
	Teklehaimanot	Amedo	13.5		40.0	
		Kuche/Tabir	14.0		30.0	
		Zengada	10.0	16.6	45.15	53.0
		Bulie	24.0		48.49	
7	Mitirha Abawarka	Amedo	16.0		48.59	
		Aysham-Demozie	16.0		64.8	
		Kuche/Tabir	27.0		58.0	
		Zengada	6.5*	10.5*	24.1*	26.57*
8	Sarwuha	Bulie	11.0		35.3	
		Kuche/Tabir	14.0		20.27	
		Zengada	15.5	16.13	39.65	41.7
9	Seguaj Tsion	Bulie	15.6		39.29	
		Amedo	17.3		46.2	
		Zengada	19.0	29.2**	46.8	53.3
		Bulie	25.5		62.15	
10	Tach Teda	Amedo	42.0**		46.67	
		Aysham-Demozie	40.5		53.15	
		Kuche/Tabir	19.0		58.8	
		Zengada	11.0	17.0	39.19	40.31
11	Tikara	Kuche/Tabir	23.0		41.42	
	Average Incidence		17.13*			
	Average Severity				44.5*	

Remark: - ** = Highest, * = Lowest

In Gondar Zuria district irrespective of localities, the highest disease incidence (42%) on cultivar Amedo, and the lowest incidence (6.5%) were on cultivar Zengada. The highest disease severity (76.8%) was observed on Amedo, while lowest severity (20.27%) was on Kuche (Tabir). Similarly in Allefa Takussa district, irrespective of localities, the highest

Table 3. Incidence and severity of covered kernel smut in Allefa-Takussa district North Gondar Administrative Zone

No	Localities	Varieties	Incidence %	Mean Incidence %	Severity %	Mean Severity %
		Aysham-Demozie (Tembelta)	21.5	16.20	40.0	36.38
1	Amchahwa	Bulie	10.0		38.0	
		Gumbrit	11.0		36.9	
		Kuche/Tabir	27.5*		40.0	
		Zengada/saha	11.0		27.0	
		Aysham-Demozie (Tembelta)	16.3	12.76	45.5	36.41
2	Atsede-Mariam	Bulie	13.0		17.0	
		Gumbrit	16.5		15.5*	
		Kuche	11.0		68.9	
		Zengada/saha	7.0		35.3	
		Bulie	20.0	11.50	56.5	48.35**
3	Ayibiga	Gumbrit	12.0		58.9	
		Jihola	8.0		53.0	
		Zengada	6.0		25.0	
		Bulie	12.0	11.0	42.99	35.63
4	Chemera-Bambarhuha	Gumbrit	15.0		40.00	
		Zengada/saha	6.0		21.90	
5	Chima-Lembez	Jihola	11.0	7.50*	37.8	31.05*
		Tetron	4.0		24.3	
		Bulie	10.5	7.75	33.9	33.85
6	Delgi-Mokonita	Gumbrit	13.0		39.1	
		Zengada/Dinkosh	1.5		23.3	
		Zengada/saha	6.0		39.1	
		Bulie	14.5	11.82	38.4	38.1
		Gumbrit	8.0		40.0	
7	Dikularva-Kurabas	Jihola	9.3		39.1	
		Kuche	18.3		46.1	
		Zengada/saha	9.0		26.9	
		Bulie	15.0	16.00	32.7	38.30
8	Endona-Chiba	Gumbrit	15.0		25.00	
		Jihola	21.0		47.80	
		Zengada/saha	13.0		47.70	
		Bulie	15.0	17.43*	30.00	33.78
9	Goy	Gumbrit	14.7		45.10	
		Kuche	27.0		40.00	
		Zengada/saha	13.0		20.00	
		Bulie	14.0	12.10	35.0	47.54
		Gumbrit	16.5		35.00	
10	Kezen-Tara	Kuche	14.0		49.00	
		Zengada/Dinkosh	7.0		45.90	
		Zengada/saha	9.0		72.80*	
		Aysham-Demozie (Tembelta)	17.5	10.7	48.00	42.73
		Bulie	14.0		46.67	
11	Sebi-Serako	Gumbrit	10.0		48.00	
		Tetron	2.0*		21.00	
		Zengada/saha	10.0		50.00	
	Average Incidence		12.25*			
	Average Severity				38.38*	

(27.5%) and the lowest disease incidence (1.5%) were observed on cultivar Kuche (Tabir) and Zengada (Dinkosh), where as the highest (72.8%) and the lowest (15.5%) disease severity were observed on Zengada (Saha) and Gumbrit cultivars, respectively. Disease incidence and severity in the two districts varied from cultivar to cultivar and from locality to .locality. The preference of the farmers was for yield, drought tolerance, maturity, bird tolerance, food quality, storability character rather than susceptibility. The kind of cultural practices may also be influencing the incidence and severity of the disease (Merkuz *et al*., 2011d). The wide distribution of the disease as recorded in the present study in the Amhara National Regional State, particularly North Western part might partly account for the poor yield often recorded (Merkuz *et al*., 2011d). Finally from the field survey result Tetron/land race was observed to be highly resistant for the disease.

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