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Survey of barley and wheat diseases in the central highlands of Eritrea

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Summary. Annual surveys of barley and wheat diseases were conducted in Eritrea from 2000 to 2002. The surveys covered six zones of the central highlands where barley and wheat are grown. The main diseases of barley were net-form net blotch, spot-form net blotch, leaf rust and scald. Other, less important diseases were loose smut, covered smut, barley stripe and septoria leaf blotch. Wheat was mainly affected by yellow rust and leaf rust. Loose smut, septoria leaf spot and tan spot diseases were less prevalent. The average incidence of these diseases varied according to the zone. Among barley diseases, net blotch incidence was high in four of the six zones surveyed. Leaf rust occurred at medium incidence in five zones. Loose smut was more severe in the southern highland plains, while covered smut was more common in the south-eastern highland terraces. For wheat, yellow rust incidence was high in two zones. Areas with a high incidence of yellow rust were not necessarily those with a high incidence of leaf rust. Leaf rust was important in the south-eastern and western highland terraces and in the western highland plains. The number of diseases found in the same field varied from 2 to 5. The south eastern highland terraces, the western highland terraces and the northern highland terraces had the highest proportions of individual barley fields with three or more diseases.

Key words: incidence, severity, hanfetse.

Introduction

Agriculture in Eritrea is based on smallholder traditional agriculture characterized by subsistence farming and low productivity. Cereal crops cover about 95% of the area cultivated with over half a million hectares in 1998 (Ministry of Agriculture, Department of Land Resources and Crop Production). Wheat (*Triticum aestivum* L.) and barley (*Hordeum vulgare* L. emend. Bowden) are grown in the central highlands, at an altitude of over 1,500 m. The growing season extends from June until December. Annual rainfall is bimodal, starting with a little rain in April/May, followed by a dry period and another wet period again in July-October, during which time most of the rainfall occurs. Production of wheat and barley in Eritrea remains very low; the national average yield for cereal crops does not exceed one ton per hectare. This is due to the lack of adequate agronomic practices

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and to various biotic stresses. Identifying the most common diseases and their importance is a necessary first step in the establishment of a management strategy integrating good cultural practices, healthy seed and genetic resistance to reduce losses and improve productivity of both wheat and barley.

Disease surveys are a useful means to provide information on common diseases on cereal crops, their distribution in space (agro-ecological zones) and over time (years), according to their incidence and severity. The information generated from surveys can be utilized to determine disease resistance levels of cultivars or land races. The type of disease that is most common (seed-borne, straw-borne or air-borne) and their association may help in designing the management practices needed for each zone (Zadoks *et al*., 1979). Disease surveys were conducted in Eritrea to identify the most common diseases of wheat and barley and to help establish management practices better adapted to national needs.

Materials and methods

Annual surveys were conducted from 2000 to 2002. The survey was planned for October each year when barley and wheat were between the flowering and the grain filling growth stages. Farmers' fields were assessed for disease incidence and severity following the procedure described by Stubbs *et al*. (1986) and Zadoks *et al*., (1979).

The zones surveyed are part of the central highlands, the only areas where barley and wheat are grown. Theses zones can be described as follows:

- Zone 1: South-Western Highland Plains (SWHP). Crops are dominantly barley and wheat in either pure stands or as hanfetse (a mixture of barley and wheat). Other crops cultivated in this zone are tef, sorghum, maize and food legumes.
- Zone 2: Southern Highland Plains (SHP). In this zone tef, sorghum, finger millet and maize are by far the most important crops because of the higher rainfall. Barley and wheat are cultivated mostly in pure stands.
- Zone 3: South-Eastern Highland Terraces (SEHT). Hanfetse is more common here than barley and wheat as pure stands; sorghum, finger millet and legumes are grown to a much lesser extent.
- Zone 4: Western Highland Terraces (WHT). Pure-stand barley is the main crop, followed by wheat and hanfetse. Sorghum, finger millet and legumes are grown much less frequently.
- Zone 5: Western Highland Plains (WHP). Barley and hanfetse are more frequent than pure-stand wheat. Other crops (wheat, pea, chick-pea, sorghum) are less common because soils in this zone tend to be shallow.
- Zone 6: Northern Highland Terraces (NHT). Barley followed by wheat are the main crops, with hanfetse in third place. Other crops are potato and faba bean. In this zone 6-row barley types are more prevalent than 2 row types. The zone is characterized by better rainfall, especially in the higher terraces.

A total of 53, 89 and 41 fields were surveyed in 2000, 2001 and 2002 respectively (Table 1). Fields had a minimum area of 0.5 hectare and the minimum distance between fields was kept to 4–6 kilometers. Disease assessment was by walking at random through a field and recording any disease observed. The severity of each disease was determined using incidence and severity parameters (James, 1971; Stubbs *et al*., 1986).

Results and discussion

The most common diseases of barley and wheat in Eritrea in 2000–2002 are shown in Tables 2 and 3. The main diseases of barley were net-form net blotch (*Pyrenophora teres* f. sp. *teres* Sacc.), spot-form net blotch (*Pyrenophora teres* f. sp. *maculata* Sacc.), leaf rust (*Puccinia hordei* Oth.) and scald (*Rhyncosporium secalis* Oud.). Less important diseases were loose smut (*Ustilago nuda* [Jens] Rostr.), covered smut (*Ustilago hordei* Pers.), barley stripe (*Pyrenophra graminea* S.Ito & Kuribay) and Septoria leaf blotch (*Septoria passerini* Sacc). Wheat was mainly subject to yellow rust (*Puccinia striiformis* f. sp. *tritici*) and leaf rust (*Puccinia triticina* Eriks). Less common diseases on wheat were loose smut (*Ustilago tritici* [Pers] Rostr.), Septoria leaf spot (*Mycosphaerella graminicola* [Fuckel] Schroeter; anamorph *S. tritici* in Dems) and tan spot (*Pyrenophora tritici repentis* [Died] Dreschs).

The main diseases on hanfetse (mixed barley and wheat) were leaf rust and net blotch for the barley component and yellow rust and leaf rust for

Table 1. Number of fields grown with barley, wheat or hanfetse, in each region in 2000–2002.

Survey zone[a]	2000				2001			2002			
	Barley	Bread wheat	Durum wheat	Hanfetse	Barley	Bread wheat	Hanfetse	Barley	Bread wheat	Durum wheat	Hanfetse
SWHP	2	6	1	4	4	10	10				
SWHP	11	9	2	1	1	2	3	10	9	1	2
SEHT					7	7	2				
WHT					6	3	3				
WHP					4	2	2				
NHT	10	7			12	11		8	7	1	3

[a] SWHP, South-Western Highland Plains; SWHP, Southern Highland Plains; SEHT, South-Eastern Highland Terraces; WHT, Western Highland Terraces; WHP, Western Highland Plains; NHT, Northern Highland Terraces.

Table 2. Main barley diseases in Eritrea in 2000–2002.

Disease	Year										
	2000			2001						2002	
	SWHP[a]	SHP	NHT	SWHP	SHP	SEHT	WHT	WHP	NHT	SWHP	NHT
Loose smut	1 /2[b]	7/11	-	-	1/1	2/7	1/6	1 /4	-	2/10	2/8
Covered smut	-	-	-	-	-	2/7	5/6	-	2/12	3/10	-
Barley stripe	-	-	-	-	-	-	-	-	-	4/10	1/8
Net blotch	-	8/11	6/10	4/4	1/1	7/7	6/6	4/4	12/12	3/10	-
Scald	-	3/11	10/10	-	-	-	2/6	-	12/12	4/10	3/8
Septoria leaf blotch	-	-	1/10	-	-	2/6	2/6		3/12	3/10	4/8
Leaf rust	-	6/11	-	4/4	1/1	7/7	6/6	4/4	12/12	-	1/8

[a] For abbreviations see Table 1.
[b] Fields with disease/Total fields surveyed.

Table 3. Main wheat diseases in Eritrea in 2000–2002.

Disease	Year										
	2000			2001						2002	
	SWHP[a]	SHP	NHT	SWHP	SHP	SEHT	WHT	WHP	NHT	SWHP	NHT
Loose smut	1/7[b]	-	-	3/10	2/2	1/3	1/3	-	-	2/10	4/10
Septoria leaf blotch	-	-	5/7	4/10	2/2	1/7	1/3	-	-	1/10	-
Tan spot	-	-	-	2/10	1/2	-	-	-	2/11	-	-
Leaf rust	6/7	8/11	3/7	8/10	2/2	7/7	3/3	2/2	11/11	2/10	-
Yellow rust	7/7	9/11	6/7	8/10	2/2	7/7	3/3	2/2	11/11	7/10	3/10

[a] For abbreviations see Table 1.
[b] Fields with disease/Total fields surveyed.

the wheat component (Table 4). The incidence of net blotch on barley and yellow rust on wheat was higher than the incidence of the other foliar diseases. The average incidence varied according to the zone surveyed (Tables 5 and 6). Among barley diseases, net blotch incidence was high in four zones (SHP, SEHT, WHT, and WHP), medium in one, SWHP, and low in one, NHT. The second most important disease of barley, leaf rust, occurred at medium incidence in five zones, and at low incidence in one. Loose smut was most common in the southern highland plains, while covered smut was most common in the south-eastern highland terraces. For wheat, the incidence of yellow rust was high in two zones, and medium in three others. Areas with a high incidence of yellow rust do not necessarily also have a high incidence of leaf rust. Leaf rust was common in the south-eastern highland terraces, the western highland terraces and the western highland plains. The number of

Table 4. Average incidence (%) of some diseases (net bloch, leaf rust, barley yellow rust and wheat leaf rust) on hanfetse (barley+wheat) fields in Eritrea in 2001.

Hanfetse component	Disease	Surveyed zones					
		SWHP[a]	SHP	SEHT	WHT	WHP	NHT
Barley	Net blotch	50	60	50	50	65	-
	Leaf rust	35	40	45	40	35	-
Wheat	Yellow rust	45	40	25	60	45	-
	Leaf rust	25	25	30	30	20	-

[a] For abbreviations see Table 1.

Table 5. Average incidence (%) of barley diseases in fields in Eritrea in 2001.

Zone surveyed[a]	Loose smut	Covered smut	Net blotch	Scald	Septoria leaf blotch	Leaf rust
SWHP	-	-	35	-	-	25
SHP	5	0.3	70	-	-	20
SEHT	1	3.5	70	-	5	30
WHT	1	0.2	60	2.5	2	30
WHP	0.2	0.1	60	-	-	35
NHT	-	-	6	60	4	2

[a] For abbreviations see Table 1.

Table 6. Average incidence (%) of wheat diseases in fields in Eritrea in 2001.

Zone surveyed [a]	Loose smut	Septoria leaf blotch	Tan spot	Leaf rust	Yellow rust
SWHP	0.3	3.5	5	20	35
SHP	5	15	10	25	70
SEHT	0.2	3	-	65	60
WHT	2	2	-	50	40
WHP	-		-	65	40
NHT	0.1	50	0.1	2	2

[a] For abbreviations see Table 1.

Table 7. Number of diseases per field found on barley and wheat in Eritrea in 2001.

Crop	Number of diseases	Zone					
		SWHP[a]	SHP	SEHT	WHT	WHP	NHT
Barley	2	4/4	-	2/7	1/6	_	-
	3	-	1/1	4/7	1/6	-	5/12
	4	-	-	1/7	3/6	_	6/12
	5	-	-	-	1/6	-	1/12
Wheat	2	6/10		5/7	2/3	2/2	
	3	2/10		2/7			8/11
	4	1/10	_		1/3		1/11
	5	1/10	_				2/11

[a] For abbreviations see Table 1.

diseases found in the same field varied from 2 to 5 (Table 7). The south-eastern highland terraces, the western highland terraces and the northern highland terraces had the highest proportion of barley fields with three or more diseases. In the case of wheat, fields with less than three diseases were not uncommon.

The main cereal diseases in Eritrea are seed-borne (particularly for barley) stubble transmitted or wind-borne. To reduce the incidence of seed-borne diseases farmers must use healthy seed. A wide range of stubble-borne blotch diseases affect barley landrace cultivars and these diseases have evolved to epidemic levels. Good management, combining good cultural practices with the selection of resistant cultivars is necessary to control these diseases. Regarding the rusts, it is well known that there is a wide range of virulent rust pathotypes that are causing the break down of widely utilized sources of resistance in wheat. To reduce the impact of cereal diseases such as the rusts on wheat and leaf blotch diseases on barley, farmers have adopted mixtures of wheat and barley, known as hanfetse. Hanfetse cultivation is common in many cereal-growing areas and is one way of reducing disease epidemics, which are common both on wheat and on barley. However, the benefits of hanfetse in reducing disease is often lost by combining low-quality cereal crop species. It is therefore important to develop new mixtures of barley and wheat based on the selection of resistant components with appropriate agronomic characters for greater yield.

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