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Survey of wheat diseases in Morocco during three consecutive seasons 1997, 1998 and 1999

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SUMMARY – Diseases survey has been conducted during three consecutive wheat-growing seasons 1996-97, 1997-98 and 1998-99. It has been carried out by the end of April, period during which growth stages of wheat ranged from anthesis to physiological maturity. Prospected regions are Saïs, Gharb, Loukkos, and Zaïr plains, and also Rif and middle Atlas mountains. All along roads, we stopped every 15 to 20 kilometers to inspect bread and durum wheat fields. The data collected were host species and its growth stage, and incidence and severity of fungal diseases identified on the basis of symptoms. Giving the fact that it is almost impossible to distinguish between symptoms induced by *Septoria* spp. and those induced by *Pyrenophora tritici-repentis* which causes the tan (yellow) spot disease, impossibility accentuated by the scarcity of pycnidia of *Septoria* spp., and to be practical in the quantification of severity, we did the notation of the complex Septoria/Tan spot. The total number of inspected fields ranged from 30 to 50 for bread wheat and from 20 to 40 for durum wheat. The results of this survey showed that the complex septoria/tan spot and leaf rust were the most prevalent diseases in prospected areas. However, stripe (yellow) rust, powdery mildew, stem rust, loose smut, and root rot have been identified on some fields of both durum and bread wheat but with a prevalence (% of contaminated fields) and severity that varied from year to year.

Key words: Survey, wheat, fungal disease, Morocco.

RESUME – *"Surveillance des maladies du blé au Maroc pendant trois années consécutives 1997, 1998 et 1999". La surveillance des maladies des blés a été conduite durant trois années consécutives 1996-97, 1997-98 et 1998-99. Elle a été menée vers la fin d'Avril, période pendant laquelle le stade végétatif des blés variait de la floraison à la maturité physiologique. Les régions prospectées sont Saïs, Gharb, Loukkos, Zaïr, Rif et Moyen Atlas. Des arrêts ont été effectués tous les 15 à 20 kilomètres tout au long des routes pour prospecter les champs de blé dur et de blé tendre. Les données collectées ont été l'espèce hôte et son stade végétatif, ainsi que l'incidence et sévérité des maladies fongiques identifiées sur la base des symptômes. Etant donné la quasi-impossibilité de distinguer entre les symptômes causés par* Septoria *spp. et ceux causés par* Pyrenophora tritici-repentis, *agent induisant la maladie de la tache bronzée, impossibilité accentuée par la rareté des pycnides de* Septoria *spp. et pour être pratique dans la quantification de la sévérité, nous avions noté le complexe septoria/tache bronzée. Le nombre total de champs prospectés varie entre 30 et 50 pour le blé tendre et entre 20 et 40 pour le blé dur. Les résultats de cette surveillance ont montré que le complexe septoria/tache bronzée et la rouille brune ont été les plus fréquentes dans les régions prospectées. Cependant, la rouille jaune, l'oïdium, la rouille noire, le charbon nu, et la pourriture racinaire ont été identifiées sur quelques champs de blé dur et blé tendre mais avec une prévalence (% de champs contaminés) et sévérité variant d'une année à l'autre.*

Mots-clés : *Surveillance, blé, maladie fongique, Maroc.*

Introduction

Bread wheat (*Triticum aestivum* L.) and durum (*T. turgidum* L.) are vulnerable to attack by many different pathogens (Jones and Clifford, 1983; Zillinsky, 1983; Shaner, 1987). Some of these pathogens have a broad range of occurence whereas others may be very localized; some are extremely damaging to crop production whereas others cause relatively little damage despite widespread occurrence (McIntosh, 1998). Rajaram (1994) and Rajaram and Van Ginkel (1996) summarized the main biotic stresses that occur in each of the 12 mega-environments. They exemplified about 12 fungal diseases. Allowing for a few more, this number totals about 20 (McIntosh, 1998).

Under Moroccan conditions wheats are subjected to attack by many pathogens able to cause considerable reduction in grain yield and quality (Lyamani, 1990). Yield losses assessment studies showed that the major foliar diseases are reducing grain yield by 30% under normal growing conditions whereas total crop failure can be observed when high infections are combined with drought (Amri *et al.,* 1998). The disease surveys conducted since 1987 showed that many diseases are encountered in Morocco but the

major and the most damaging ones are septoria/tan spot complex, leaf rust, stripe (yellow) rust and root rot (Ezzahiri *et al.,* 1996; Ramdani and Jlibene, 1996; Ramdani, 1997; Amri *et al.,* 1998).

Survey of wheat diseases should be an on going process in order to have updated information and to develop appropriate control measures. It is of paramount interest to have updated information on the most damaging pathogens and to control the eventual occurrence of knew diseases, such as Karnal bunt (*Tilletia indica* Mitra), that are a major threat to countries and regions in which they are absent (McIntosh, 1998).

Although there is genetic variation in response to most diseases (McIntosh, 1998), resources available to national programs limit the number that can be included as a breeding objectives. As a matter of consequence, breeders and pathologists should focus on the most damaging pathogens.

Materials and methods

Diseases survey has been conducted during three consecutive wheat-growing seasons 1996-97, 1997-98 and 1998-99. It has been carried out by the end of April, period during which growth stages of wheat ranged from anthesis to physiological maturity. Inspected regions are Saïs, Gharb, Loukkos, Tadla and Zaïr plains, and also Rif and middle Atlas mountains. Stops were made every 15 to 20 kilometers throughout the regions to inspect bread and durum wheat fields. The traditional method of data collection, field book or “paper and pencil”, was used. The data collected were host species and its growth stage, and incidence and severity of fungal diseases by using appropriate scoring scales. Fungal diseases were identified on the basis of their symptoms. Giving the fact that it is almost impossible to distinguish between symptoms induced by *Septoria* spp. and those induced by *Pyrenophora tritici-repentis* which causes the tan spot disease, impossibility accentuated by the scarcity of pycnidia of *Septoria* spp., and to be practical in the quantification of the severity, we did the notation of the complex septoria/tan (yellow) spot. The total fields inspected were 31, 40, and 47 for bread wheat and 19, 28, and 37 for durum wheat, during 1997, 1998 and 1999 respectively. The scales adopted to estimate the severity were the percentage of infected tissues for septoria/tan spot, rusts and powdery mildew, the percentage of plants presented the symptoms of root rot, and the percentage of spikes infected by smuts.

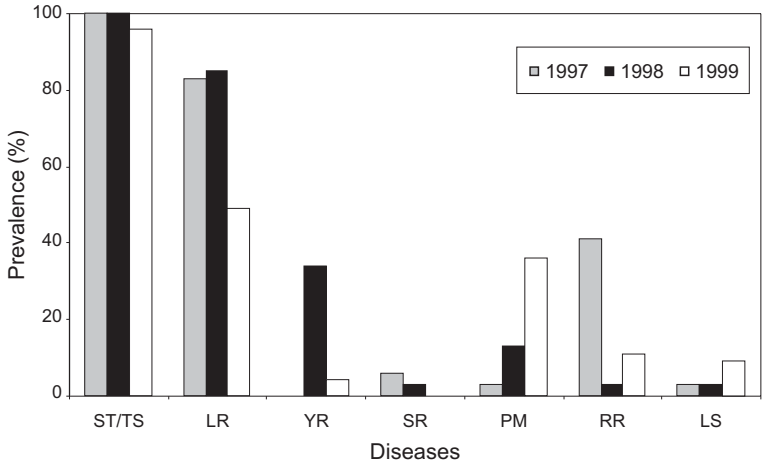
Results and discussion

The most prevalent diseases on both bread and durum wheat were septoria/tan spot complex and leaf rust, followed by root rot, powdery mildew and stripe rust. Stem rust and loose smut were less frequent (Figs. 1 and 2). These results are in complete agreement with what has been reported by Ezzahiri *et al.* (1996), Ramdani and Jlibene (1996), Ramdani (1997) and Amri *et al.* (1998), with the exception of powdery mildew that has not been reported as a major disease but it has been encountered during the 1999 season in 36 and 40% of bread and durum wheat, respectively. According to McIntosh (1998), powdery mildew occurs very widely throughout wheat-growing areas of the world and is most damaging in cooler moister regions such as China, Europe, South America, southeast USA and some WANA (West Asia and North Africa) countries. The increased incidence and severity (Table 1) of this disease in Moroccan prospected regions may be due to climatic conditions and/or to the breakdown in resistance. The microscopic observations of pycnidia of septoria revealed the presence of two species, *Septoria tritici* and *S. nodorum*. The relative importance of each septoria species on durum and bread wheat is an object of an other communication that will be published elsewhere.

It might be inferred from Figs 1 and 2 the wide variation among seasons in the prevalence (% of fields infected) of diseases, except the septoria/tan spot complex that has been encountered during the three seasons in almost all fields. Stripe rust has been more prevalent during 1998 season, mainly on bred wheat. Root rot and powdery mildew, however, have been more prevalent on both bread and durum wheat during 1997 and 1999 respectively. This inter-annual fluctuations of diseases occurrence were presumably due to the variation of climatic conditions among seasons. Hence, regardless the resources constraints and in order to ensure yield stability over years, we should consider the resistance to stripe rust, to powdery mildew and eventually to root rot as objectives in wheat-breeding programs.

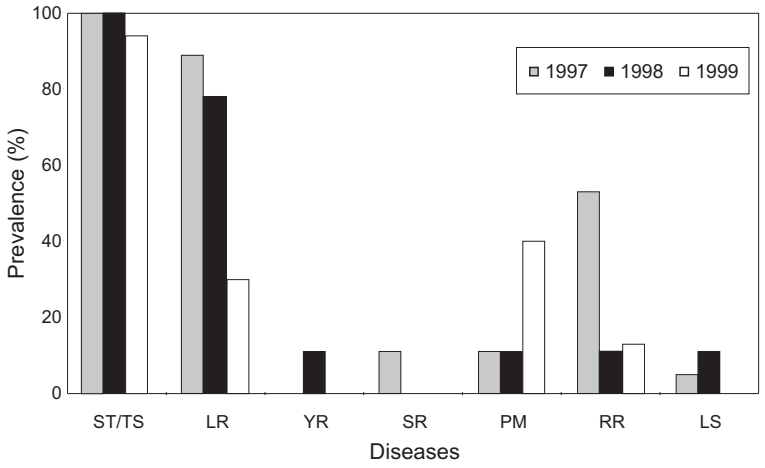
Detailed results of wheat diseases survey (Table 1) showed that only one field of bread wheat has been highly infected (>50%) by septoria/tan spot complex during both 1997 and 1998 seasons. Two bread wheat fields during 1997 and three during both 1998 and 1999 presented a severity between 31 and 50%.

Durum wheat has been relatively less vulnerable to attack by this complex, since its level of infection did not exceed 50% and only one field during the three seasons presented a severity between 31 and 50%. Traces to 30% of attacks were recorded in 90% of bead wheat fields and in 91 to 96% of durum wheat fields, during the three seasons. Two fields of bread wheat and one of durum were highly infected by leaf rust (severity more than 50%) during 1997. A moderately high infection by powdery mildew (severity between 31 and 50%) was recorded during 1999 in two fields of each host species. The light to medium infection of no less than 90% of fields of both wheat species was presumably due to the severe drought coupled with high temperatures that prevailed from February till harvest and that did not allow high infections by the septoria/tan spot complex and the other diseases.



ST/TS: Septoria/tan (yellow) spot complex
LR: Leaf rust *Puccinia recondita tritici*
YR: Yellow (stripe) rust *Puccinia striiformis*
SR: Stem rust *Puccinia graminis tritici*
PM: Powdery mildew *Erysiphe graminis tritici*
RR: Root rot
LS: Loose smut *Ustilago tritici*

Fig. 1. Prevalence of bread wheat diseases in Morocco during 1997, 1998 and 1999 seasons.



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LS: Loose smut *Ustilago tritici*

Fig. 2. Prevalence of durum wheat diseases in Morocco during 1997, 1998 and 1999 seasons.

Recommendations

The future success of crop surveillance systems depends on the quality of observations so that analytical interpretation of the information can be made. Such interpretation is hindered by the extremely complex interactions of host crops with plant pathogens and environmental parameters. Also, regular quantitative estimates of the occurrence and the abundance or incidence of organisms in space and time are essential if we are ever to predict future pathogen and crop events. Field observations

collected over wide areas can assist in determining regional trends in pathogen population change and enable the detection of newly introduced and/or occurred pathogens.

Table 1. Bread and durum wheat diseases in Morocco during 1997, 1998 and 1999 seasons

Diseases	Severity classes	Bread wheat						Durum wheat					
		1997		1998		1999		1997		1998		1999	
		No.†	%††	No.	%	No.	%	No.	%	No.	%	No.	%
Septoria and tan spot	Tr-10	15	48	24	60	14	30	8	42	15	53	15	40
	11-30	13	42	12	30	28	60	10	53	12	43	19	51
	31-50	2	6	3	8	3	6	1	5	1	4	1	3
	> 50%	1	3	1	2	0	0	0	0	0	0	0	0
	Total	31	100	40	100	45	96	19	100	28	100	35	94
Leaf rust	Tr-10	22	71	23	58	19	40	14	73	20	71	9	24
	11-30	1	3	7	17	4	9	2	11	2	7	2	6
	31-50	1	3	4	10	0	0	0	0	0	0	0	0
	> 50%	2	6	0	0	0	0	1	5	0	0	0	0
	Total	26	83	34	85	23	49	17	89	22	78	11	30
Stripe rust	Tr-10	0	0	10	25	2	4	0	0	3	11	0	0
	11-30	0	0	1	3	0	0	0	0	0	0	0	0
	31-50	0	0	1	3	0	0	0	0	0	0	0	0
	> 50%	0	0	1	3	0	0	0	0	0	0	0	0
	Total	0	0	13	34	2	4	0	0	3	11	0	0
Stem rust	Tr-10	2	6	1	3	0	0	2	11	0	0	0	0
Powdery mildew	Tr-10	1	3	3	8	9	19	2	11	3	11	9	24
	11-30	0	0	2	5	6	13	0	0	0	0	4	11
	31-50	0	0	0	0	2	4	0	0	0	0	2	5
	Total	1	3	5	13	17	36	2	11	3	11	15	40
Root rot	Tr-2	11	35	1	3	4	9	9	48	3	11	5	13
	3-5	2	6	0	0	1	2	0	0	0	0	0	0
	6-10	0	0	0	0	0	0	1	5	0	0	0	0
	Total	13	41	1	3	5	11	10	53	3	11	5	13
Loose smut	Tr-2	1	3	1	3	4	9	1	5	3	11	0	0
Total fields inspected		31		40		47		19		28		37	

†*Number of fields presenting a given severity classe.*

††*Percentage of fields presenting a given severity classe.*

The diseases-survey method adopted in this report allowed collection of data on the occurrence and severity of wheat diseases over wide areas, but allowed only one observation during the host growing cycle. Hence, it didn't allow information on the progression of diseases. Other drawbacks of this method were the almost impossibility to recognize the variety used in each field, the non-uniformity of growth cycle within and over regions, and the impossibility to have climatic data of each region. So, in order to allow reliable and analytical interpretations of the complex interactions of host crops (cultivar) with plant pathogens and environmental parameters, we recommend to substitute or to complement this method by field experiments over the country. As long as our Institution (INRA-Maroc) has field-experimental stations equipped with automatic weather stations throughout the country, it is of paramount interest to carry out field-experiment in each experimental station, every or at least every other year, by sowing all durum and bread wheat cultivars according to an appropriate experimental design. These experiments will allow collection of more reliable information on the progression of each disease. Analytical

interpretation of the interaction cultivar*pathogen*environment will be possible and the eventual breakdown in resistance of a given cultivar to a given pathogen can be extracted. To make this disease survey approach as efficiently and as cheaply as possible, one to two observers from each experimental station should be instructed and trained to regularly rate the severity of each disease on each cultivar.

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