OCCURRENCE, LOSSES AND CONTROL OF IMPORTANT CEREAL AND FOOD LEGUME DISEASES IN WEST ASIA AND NORTH AFRICA

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ABSTRACT

The mandate crops of ICARDA: wheat, barley, chickpea, lentil and faba bean suffer from a wide range of diseases. Important diseases of cereals are septoria blotch, rusts, smuts and barley yellow dwarf virus; in food legumes ascochyta blight, wilt, chocolate spot, bean yellow mosaic virus, bean leaf roll virus and nematodes. Some are endemic and others occur epiphytotically. Data on crop losses due to these diseases are rare. Available data on losses caused by smuts, leaf blotch, leaf rust on cereals, ascochyta blight and chocolate spot on food legumes is presented. In addition, results from experimental trials at the Center on crop loss estimates of wheat yellow rust, chickpea blight and three faba bean viruses are discussed. Chemical control measures of the diseases are economically not feasible; chemical seed treatment is effective but not commonly used. Emphasis is on the use of genetic resistance. Reliable screening techniques have been developed to identify resistant material for use in breeding programs. Sources of resistance are derived from cultivars, landraces, wild relatives and progenitors of the mandate crops.

Introduction

The International Center for Agricultural Research in the Dry Areas (ICARDA) is one of 13 international research centers governed by the Consultative Group on International Agricultural Research (CGIAR). The Center operates in the region of West Asia and North Africa (WANA) extending from Pakistan in the East to Morocco West and from Turkey in the North to Ethiopia South. Four programs, supported by several units, carry out research on cereals; food legumes; pastures, forage crops and farm management. The Cereal Improvement Program focuses on the development of stable, high-yielding cultivars with tolerance to biotic and abiotic stresses. Emphasis in the Food Legume Improvement Program is placed on the development of well-adapted, faba bean, chickpea and lentil cultivars with resistance to chocolate spot, ascochyta blight and wilt, respectively. The Pasture, Forage and Livestock Improvement Program concentrates its activities on the replacement of fallow with pasture and forage crops.

The mandate crops of ICARDA, wheat, barley, chickpea, lentil and faba bean suffer from a wide range of diseases. Diseases of these crops are among the major constraints affecting the stability of production in the region.

Occurrence and distribution

Important diseases of cereal and food legume crops can be classified according to their occurrence as epidemic (epiphytotic) and endemic diseases (Table 1).

Yellow rust of wheat (*Puccinia striiformes* West.), is an important disease in the WANA region and occurs epidemically once in 3-4 years. Leaf rusts (*P. recondita* Rob. ex Desm; *P. hordei* Otth.), net blotch (*Pyrenophora teres* Drechs.), *Septoria tritici* blotch (*Mycosphaerella graminicola* (Fuckel) Sand.) and barley yellow dwarf virus are epidemic diseases of North Africa; however, septoria blotch is

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Table 1 Occurrence of important cereal and food legume diseases in the WANA region

Disease	Occurrence endemic	Occurrence epiphytotic
Cereals		
- Yellow rust		WANA
- Leaf rust		North Africa
- Net blotch		North Africa
- Septoria blotch	West Asia	North Africa
- Loose smuts	WANA	
- Barley stripe	WANA	
- Scald	WANA	
- Covered smut	West Asia	
- Powdery mildew	North Africa	
- Tan spot	Turkey, Morocco	
- Dwarf bunt	Turkey, Iran	
- Root rot	Morocco, Tunisia	
- Bacterial leaf streak	Syria	
- Flag smut	Syria	
- Barley stripe mosaic virus	WANA	
- Barley yellow dwarf virus	WANA	North Africa
Legumes		
Chickpea		
- Ascochyta blight		WANA
- Fusarium wilt	North Africa	
- Stunt =(BLRV)	WANA	
- Cyst nematode	West Asia	
Faba bean		
- Ascochyta blight		WANA
- Chocolate spot		WANA
- Rust		WANA
- Stem nematode	WANA	
- Bean leaf roll virus	WANA	Syria (coastal area)
- Bean yellow mosaic virus	WANA	Sudan
- Broad bean mottle virus	WANA	Sudan
- Broad bean stain virus	WANA	
Lentil		
- Fusarium wilt	West Asia	
- Rust	Morocco	

endemic in irrigated, and high rainfall areas of West Asia.

Endemic diseases of cereals in the WANA region are: loose smuts (*Ustilago tritici* (Pers.) Rostr.; *U. nuda* (Jens.) Rostr.) barley stripe (*Pyr. graminea* S. Ito et Kuribay) and scald (*Rhynchosporium secalis* (Ouid.) J.J. Davis). Covered smuts (*Tilletia foetida* (Wallr.) Liro and *T. caries* (DC) Tul; *U. hordei* (Pers.) Lagerh) are important diseases in Syria, Jordan, Turkey and Iran. Powdery mildew (*Erysiphe graminis* DC. ex Merat), is endemic in North Africa, more on barley than on wheat. Tan spot (*Pyr. trichostoma* (Fr.) Fckl. —*repentis* Died.) occurs in the high altitude areas of Morocco and Turkey; dwarf bunt (*T. controversa* Kuehn) also in the high altitude areas of Turkey and Iran. Root rot (*Fusarium*; *Cochliobolus*) occurs in Morocco and Tunisia. Bacterial leaf streak

(*Xanthomonas campestris* pv. *translucens*) is endemic in irrigated areas of Syria; and flag smut (*Urocystis agropyri* (Preuss) Schroet) which gained importance in the last three years in some locations in Syria. Barley yellow dwarf virus (BYDV) is endemic in all cereal-growing areas of the WANA region but reaches epidemic levels in Tunisia and Morocco (Makkouk *et al.*, 1987), whereas barley stripe mosaic virus (BSMV) is endemic, mainly in barley, in all countries of the WANA region.

Over 50 pathogens have been reported on chickpea from different parts of the world (Nene *et al.*, 1984). Some of them, fusarium wilt, *Fusarium oxysporum* Schlecht. emend. Snyd. et Hans. f. sp. *ciceri* (Padwick) Snyd. et Hans; ascochyta blight, *Ascochyta rabiei* (Pass) Labrousse and stunt are widespread and internationally important. In West Asia and North Africa ascochyta blight occurs in epiphytotic form, causing heavy yield losses in chickpea. A notable success of ICARDA's Food Legume Improvement Program has been to demonstrate the feasibility of switching chickpea in WANA from the commonly practiced spring-planted to a winter-planted crop, which doubles the yield, provided the chickpea cultivars used, are resistant to ascochyta blight.

In the drier areas of North Africa, fusarium wilt of chickpea is a serious disease. It is endemic in Tunisia and part of Pakistan. Recently it has been observed in Syria and Lebanon (Table 1). Chickpea stunt virus (= bean leaf roll virus) was observed to severely affect chickpea in Algeria, Morocco, Tunisia and Lebanon. The host range of the virus appears to be confined to leguminous plants and is spread by the aphids *Aphis craccivora*, *A. faba* and *Acyrthosiphon pisum*. Sclerotinia stem rot (*Sclerotinia sclerotiorum* (Lib.) de Bary) was observed in Algeria and Morocco during the surveys in 1988. The chickpea cyst nematode (*Heterodera ciceri* Vovlas, Greco Di Vito) causes considerable damage mainly to chickpea and lentil in Syria.

In faba bean, ascochyta blight (*Ascochyta fabae* Speg.), chocolate spot (*Botrytis fabae* Sardina) and rust (*Uromyces vicia-fabae* Pers. (Schroet.) are important fungal diseases in the WANA region (Hebblewaite, 1983). Surveys conducted in faba bean in Syria, Cyprus and Egypt during 1981–82 revealed that about 45% of the fields surveyed in Syria were infested with the stem and bulb nematode, *Ditylenchus dipsaci* (Kuehn) Filipev, and 32% of the fields in Cyprus (Augustin, 1985). This nematode is both soil- and seed-borne. Bean leaf roll virus (BLRV) (= pea leaf roll virus) and bean yellow mosaic virus (BYMV) affect faba bean in most countries of the WANA region (Bos, 1982; Kaiser, 1972 and 1973; Makkouk *et al.*, 1988; Reddy *et al.*, 1980). In few locations (e.g. coastal region of Syria) BLRV could cause complete failure of the crop (Makkouk *et al.*, 1988). BLRV infection on faba bean and chickpea is often mistaken with plant senescence and consequently its economic importance is underestimated. In addition, bean yellow mosaic virus (BYMV), broad bean mottle virus (BBMV) and broad bean stain virus (BBSV) are endemic on faba bean in the WANA region (Makkouk *et al.*, 1988).

In lentil, *Fusarium* wilt is widely spread in the WANA region. Rust, though may ocour sporadically in several areas, is endemic in Morocco.

Crop losses

Crop losses caused by cereal and food legume diseases are mainly field estimates (Hussain *et al.*, 1980; Hoffmann, 1982), however, some are based on the percentage incidence of the disease, like in smuts, where the incidence is equated to the percentage losses (Mamluk, 1981). Examples of such losses due to important diseases in the region are summarized in Table 2.

The wheat leaf rust epidemic of 1978 in Pakistan reduced the national yield by 10% (Hussain *et al.*, 1980). The septoria tritici blotch in North Africa (Saadaoui, 1987; Saari and Wilcoxon, 1974) during the season of 1968/69 caused yield losses of about 10–20% in the local wheat cultivars in Morocco whereas the 'mexican' cultivars suffered 40–50% yield losses; and similar losses (50%) were caused by the disease in 1972 in Tunisia (unpublished data). Losses due to common bunt of wheat in the WANA region are estimated to be 5–7% (Hoffmann, 1982). The quantitative survey in 1986 in collaboration with the Syrian national program revealed a loss of 5.7% due to common bunt in the country. The net blotch epidemic of 1972 in Tunisia caused 50% yield loss (unpublished data),

Table 2 Crop losses caused by important cereal and food legume diseases in the WANA region

Disease	Country	Estimated yield loss (%) or US$	Reference
Wheat			
Leaf rust	Pakistan	10	Hussain *et al.*, 1980
Septoria blotch	Morocco	10-20 (local cv)	-
		40-50 (Mexican cv)	
	Tunisia	50	-
Common bunt	(WANA)	5-7	Hoffmann, 1982
Common bunt	Syria	5.7	-
Barley			
Net blotch	Tunisia	50	-
Smuts	Jordan	5.6	Mamluk, 1981
Chickpea			
Ascochyta blight	Morocco	US$10 Mil.	Kamal 1984
	Pakistan	46-48%	Malik, 1986
	Syria	30%	El-Mott, 1984
	Tunisia	40%	Mlaiki and Hamdi, 1984
Fusarium wilt	Pakistan	US$1 Mil. (yearly)	Sattar *et al.*, 19853

whereas yield losses due to barley smuts: loose smut, covered smut and semi-loose smut in Jordan are estimated to be 5.6 (Mamluk, 1981).

A trial to assess crop loss induced by yellow rust of wheat was conducted in the 1987/88 season for the first time at the principal station of the Center in Tel Hadya. Ten promising lines of wheat, 7 durum and 3 bread wheat, were tested using a chemical treatment (Bayfidan EC 250, Triadimenol 2 L/ha) to keep the control plots free of the disease (Table 3). The objective of this trial was to determine the actual losses in each cultivar, since yield in wheat cultivars is affected differently even at the same level of yellow rust infection.

The analysis of variance revealed significant cultivar effects on all traits and significant treatments effects (infected versus controlled) and cultivar x treatment interaction on grain yield only. The susceptible cultivar Mexipak suffered 29% loss in grain yield due to the disease. This yield loss may result from a reduced number of tillers/m^2 (21%), seed/spike (9%) or kernel weight (6%) though these losses were not statistically significant. Nesser, also a susceptible cultivar, suffered a 19% loss resulting from a lesser degree of infection. Haurani, Belikh, Douma 6102, and Douma 6914, seemed to tolerate the disease differently as indicated by their Average Coefficient of Infection (ACI) of 17.3, 4.0, 5.3 and 34.3, respectively. The remaining cultivars, Lahn, Hazar, Om Rabi, Douma 6056 were found to be resistant cultivars with ACI < 4.

Although the results are preliminary, they clearly indicate that yellow rust can drastically affect yield in susceptible cultivars.

Even though BYDV is reported from all cereal-growing areas of the WANA region, the only data available on crop losses are from experiments carried out in Morocco (Makkouk *et al.*, 1987). Early BYDV inoculation (early tillering) of the bread wheat cultivar Nesma 149 using *Rhopalosiphum padi* as vector, led to 44% yield loss as compared to 30% loss when inoculated at the stem elongation stage. With the high incidence of BYDV on cereals in North Africa (Makkouk *et al.*, 1987) losses due to this virus could reach high values. In a recent survey in Morocco, where BYDVwas detected serologically (El-Yamani, unpublished data), BYDV incidence in 45% of the fields surveyed in the Chaoia region was 20% or higher. Based on previous loss assessment studies (Gill, 1980) a yield loss of 15% or higher

Table 3 The effect of yellow rust (*Puccinia striiformis*) on grain yield and yield components of different wheat cultivars (Tel Hadya, Syria, 1988)

Cultivar	Treatment	Yellow rust score/ACI		Yield kg/ha	No. tillers per m^2	No. seeds per spike	1000 KW (g)
1. Haurani	infected	33MR	17.3	3166	347	38	45.3
	controlled	5R	1.0	3632	350	35	39.3
2. Lahn	infected	2R	0.5	5780	297	43	53.7
	controlled	1R	0.2	5220	307	41	51.4
3. Belikh 2	infected	15MR	0.4	4827	327	37	44.4
	controlled	1R	0.2	5440	383	45	41.5
4. Hazar	infected	4MR	1.1	5417	390	38	44.4
	controlled	4R	0.7	4808	370	35	44.4
5. Om Rabi 9	infected	8MR	3.3	4771	397	38	39.4
	controlled	2R	0.5	5072	410	37	43.0
6. Douma 6102	infected	8MS	5.3	5771	370	43	42.4
	controlled	4R	0.7	5516	350	45	42.4
7. Douma 6056	infected	5MS	2.3	5014	343	40	45.6
	controlled	5R	1.0	5525	393	39	45.1
8. Mexipak	infected	73S	69.0	3574	353	40	32.1
	controlled	10R	2.0	5048	440	44	34.1
9. Nesser	infected	65S	65.0	4425	463	37	30.9
	controlled	2R	0.5	5477	557	35	31.2
10. Douma 6914	infected	52MS	34.3	5705	390	40	37.2
	controlled	4R	0.7	5607	450	42	37.2
LSD (0.05) between treatments for the same cultivars				913	103 n.s	6.9 n.s	7.9 n.s

Figures = mean of 3 rep., each $6.3m^2$; harvested $3.6m^2$
Experimental design = split plot (treatments as main plot factor)
Infected = artificial inoculation applied once
Controlled = Bayfidan EC 250 (Triadimenol) 2 L/ha applied twice

is expected for that region.

Several reports of serious losses caused by ascochyta blight in chickpea are found in the literature. Labrousse (1930) reported that the disease damaged chickpea in Morocco. Losses due to the disease in recent years (1980, 1981 and 1982) in Pakistan have been very extensive (Table 2). The damage in Pakistan resulted in a severe shortage which led to the importation of US$ 7.43 million worth of pulses in 1982–83 (Malik, 1986).

Crop loss assessment trial on chickpea blight conducted at Tel Hayda revealed the significant effect of disease intensity on yield. The susceptible cultivar ILC 1929 was completely destroyed. The reduction in yield in resistant cultivars (ILC-183 and 202) was due to leaflet infection. However, the reduction in yield was less than 10% (Table 4).

No precise information on losses caused by fusarium wilt in chickpea is available. According to a rough estimate an annual loss of US$1 million was reported from Pakistan (Sattar *et al.*, 1953). At ICRISAT, attempts were made to estimate losses in yield on a plant basis. Early wilting caused a heavier loss than late wilting. Seed harvested from late-wilted plants was lighter, and duller than those from healthy plants (Haware and Nene, 1980).

Relationship between population density of *Heterodera ciceri* and yield of chickpea was studied (ICARDA, 1986). The tolerance limit of chickpea to *H. ciceri* was estimated to be about 1 egg/cc soil. Complete loss in yield was obtained in fields infested with more than 32 eggs/cc soil.

Bulb and stem nematode (*D. dipsaci*) mainly attacks stems and leaves of faba bean close to the soil surface causing tissue necrosis. The loss in yield varies depending on the nematode density in the soil (Hanounik, 1983). The yield was reduced significantly as the population density of *D. dipsaci* increased to 100 larvae/1000 cc soil (Table 5).

Table 4 Ascochyta blight severity and yield loss relationship in chickpea in a field trial (Tel Hayda, Syria, 1984)

Cultivar	Disease(1) intensity	Yield (kg/ha) Infected	Healthy	Percent reduction in yield
ILC 183	3.7	2060	2205	6.5
ILC 202	3.7	1510	1652	8.6
ILC 215	8.3	152	2295	93.4
ILC 484	4.7	1962	2757	28.8
ILC 1929	9.0	0	2469	100

(1) Disease severity scored on 1-9 scale.

Table 5 Effect of population density of *Ditylenchus dipsaci* on faba bean yield (Lattakia, Syria, 1984)

Nematode density larvae/1000 cc soil	Plants affected	Infected seeds	Yield dry seed m^{2}*	% loss
0	0	0	528 a	0
100	7.0	60.6	448 b	15.15
300	17.0	10.3	364 c	31.06
720	37.0	13.3	312 d	40.90
6500	65.7	20.0	170 e	67.80

* Means followed by different letters are statistically different (P = 0.05) according to Duncan's Multiple Range Test.

Few reliable data are available on loss assesment on viruses affecting food legumes in the WANA region. Loss estimates are based mainly on information on incidence of infection. It would be difficult then to present in this paper accurate figures on food legume losses due to virus diseases. Potential losses could be derived from experimental data on losses. In Iran, bean yellow mosaic virus induced 44 and 42% loss in faba bean yield when plants were inoculated at the pre-bloom and full-bloom growth stages, respectively (Kaiser, 1973). In Syria, when experiments were carried out in 1987 and 1988 to evaluate the losses induced by three mechanically transmissible viruses of faba bean, 17–39% yield loss was induced with late inoculation, 20–22 weeks after sowing (Table 6). In countries where

Table 6 Experimental evaluation of yield loss in faba bean (cv. Syrian Local) when inoculated with three viruses at three different growth stages during two growing seasons (Tel Hadya, Syria)

	Yield loss %					
	1986-87			1987-88		
	Inoculation time (days after sowing)			Inoculation time (days after sowing)		
Virus	76	107	140	76	115	155
BYMV	80.8	55.6	38.7	93.8	17.1	25.2
BBMV	54.5	84.1	37.5	45.5	8.1	16.8
BBSV	83.8	17.5	18.3	93.4	47.5	29.5

BYMV = bean yellow mosaic virus
BBMV = broad bean mottle virus
BBSV = broad bean stain virus

100% infection with bean yellow mosaic virus and broad bean mottle virus, singly or mixed, is common such as in central and northern Sudan, losses similar to those presented in Table 6 could represent actual losses in the field. Certain viruses, such as broad bean stain virus, greatly affect faba bean seed quality for canning purposes.

Control measures

Chemical control of cereal foliar diseases, such as septoria blotch, rusts and powdery mildew is not feasible nor economically practical in the region. The chemical control as one single seed-treatment against seed-borne disease, such as smuts, is effective and highly recommended. However, only 40% of the wheat seeds sown in the region is treated (Hoffmann, 1982). Occasionally copper compounds (e.g. copperoxyquinolate) are used because systemic fungicides are considered expensive. The use of plant resistance, mainly genetic resistance, remains the most feasible measure to control diseases of cereal crops in the WANA region.

The development of high-yielding cultivars with resistance or multiple disease resistance in the region is achieved by screening advanced germplasm in 'hot-spots' under natural field infection or artificially enhanced disease development. In order to include as many pathogens as possible in this screening and to expose the germplasm to the different pathotypes of the pathogens, screening is done also at several sites in the WANA region and beyond. Lines with resistance to specific diseases

Table 7 Selected sources of resistance available for cereal and food legume diseases

Disease	Resistance sources
Cereals	
1. Septoria	In durum wheat: *Haynaldia vilosa*; Maghrebian landraces (Kyperounds, Zeramik, Zenati bouteille, Ben bachir, Selbera); Iberian landraces (Lobeiro, Preto amarelejo, Rojal de Alicante); *Triticum turgidum* ssp. *dicoccoides*. In bread wheat: Cultivars carrying 1B/1R translocation (Veery's', SNB 'S'; BOW'S'); South American wheat: (Alondra, LAJ).
2. Common bunt	In durum wheat: Senatori Cappelli; Middle East and Syrian Landraces. In bread wheat: Local cultivars: (Kirac Moldova, Khyber, Burgas, Carpentero).
3. Yellow rust	In durum wheat: Cultivars (Flamingo, Gaviota, Sham 1); Dicoccoides and Aegilops. In bread wheat: Cultivars selected in national programs (C183.24-C186.3/3/Cno/7C*//Cc/Tob, KVZ//CGN, Veery 'S', BOW 'S'.
Legumes	
Chickpea	
1. Ascochyta blight	ILC-72, 196, 201, 202, 2506, 3274, 3279, 3956, 4421.
2. Fusarium wilt	ICC-3634, 4200, 4248, 4368, 5124, 6981, and ICC lines (over 100), ICCC 32, ICCV-2, 3, 4 and 5.
3. Stunt	ICC-403, 591, 685, 2385, 2546, 3718, 6433, 6934, 10495, 10596
Faba bean	
1. Ascochyta blight	BPL 2485 and Sel. 80 Lat.
2. Chocolate spot	ILB-938
	BPL-710, 261, 266, 678, 43, 470

together with other sources of resistance are used in the crossing programs to upgrade the level of resistance. Table 7 summarizes the diversity of sources of resistance used in the wheat crossing program at ICARDA to upgrade the resistance level of wheat germplasm to major diseases.

Use of chemicals in the control of food legume diseases is not popular in the region; nor is it economical. Use of fungicides to control seed-borne infection in chickpea and faba bean is very effective. Calixin M (11% tridemorph + 36% maneb) and Tecto 60 (thiabendazole) seem to eradicate seed-borne inoculum of *A. rabiei* effectively (Reddy and Kabbabeh, 1984). Chickpea wilt seed-borne inoculum can be eradicated by seed dressing with Benlate T (benomyl 30% + thiram 30%) at 1.5g/kg of dry seed (Haware *et al.*, 1978). Since the fungus can survive in the soil for as long as 6 years and has symptomless carriers, it is not possible to control the disease through normal crop rotation.

Attempts in the past to identify useful sources of resistance to faba bean diseases (Papayan, 1970; Bond and Pope, 1980) resulted in the detection of few genes which did not seem effective enough to develop acceptable disease resistant cultivars. Recently, however, several sources of general and specific types of resistane to *B. fabae* and *A. fabae* have been identified at ICARDA (Hanounik and Maliha, 1986; Hanounik and Robertson, 1988).

The use of resistant cultivars remains the most practical approach to supplement other preventive measures to control food legume virus diseases. Gadh and Bernier (1984) in Canada and Rohloff and Stulpnagel (1984) in West Germany reported a number of faba bean lines resistant to bean yellow mosaic virus, where two different recessive genes may be involved. At ICARDA, screening for bean yellow mosaic virus resistance in faba bean during 1986-88 identified a number of faba bean lines with a very long latency period (up to 40 days) upon inoculation with BYMV. Such resistance will be evaluated further during the 1988–89 growing season.

Resistance to BLRV was reported in the Netherlands (Huiberts and Bos, unpublished results, 1983). However, when three BLRV-resistant faba bean cvs. were tested at ICARDA, Syria, they were completely killed. On the other hand, chickpea lines identified at ICRISAT, India as resistant to chickpea stunt (=BLRV) were killed by the isolate occurring in the Netherlands (Huiberts and Bos, unpublished results, 1983). The above is an example on how much variation exists in what we call bean leaf roll virus.

The various methods for controlling legume diseases can be placed in categories such as cultural, physical, chemical and legal. When these are used collectively, the disease can be brought under control.

The development of disease resistant high-yielding cultivars in chickpea and faba bean (Table 7) has been achieved by screening germplasm, effective selections and breeding for resistance. The resistant lines are tested and are used in the crop improvement by national programs.

References

1) Augustin, B. (1985): Aggregated distribution of *Ditylenchus dipsaci* on broad bean seeds. Annals of Applied Biology, 92, 271–274.
2) Bond, D. A., and Pope, M. (1980): *Ascochyta fabae* on winter beans (*Vicia faba*): Pathogen spread and variation in host resistance. Pl. Path., 29, 59–65.
3) Bos, L. (1982): Virus diseases of faba beans. *In*: . Faba Bean Improvement. Edited by Hawtin, G. and Webb, C. Martinus Nijhoff Publ., pp. 233–242.
4) El-Mott, M. S. (1984): Chickpea production in Syria. *In*: Ascochyta blight and winter sowing of chickpeas. Edited by Saxena, M. C. and Sing, K. B. Martinus Nijoff/Dr. W. Junk, Publishers, Hague, the Netherlands, pp. 201–206.
5) Gadh, I. P. S. and Bernier, C. C. (1984): Resistance in faba bean (*Vicia faba*) to bean yellow mosaic virus. Plant Disease, 68, 109–111.
6) Gill, C. C. (1980): Assessment of losses on spring wheat naturally infected with barley yellow dwarf virus. Plant Disease, 64, 197–203.
7) Hanounik, S. B. (1983): Effects of aldicarb on *Ditylenchus dipsaci* in *Vicia faba*. *In*: Proceedings of

the Tenth Int. Cong. of Plant Protection. The Lavenham Press Ltd., Suffolk, U.K., p. 1228.
8) Hanounik, S. B. and Maliha, N. (1986): Horizontal and vertical resistance in *Vicia faba* to chocolate spot caused by *Botrytis fabae*. Plant Disease, 70, 770-773.
9) Hanounik, S. B. and Robertson, L. D. (1988): Resistance of *Vicia faba* germplasm to blight caused by *Ascochyta fabae* (accepted for publication in Plant Disease under No. 4757).
10) Haware, M. P. and Nene, Y. L. (1980): Influence of wilt at different stages on the yield loss in chickpea. Tropical Grain Legume Bulletin, 19, 38-44.
11) Haware, M. P., Nene, Y. L., and Rajeshwari R. (1978): Eradication of *Fusarium oxysporum* f.sp. *ciceri* transmitted in chickpea seed. Phytopathology, 68, 1364-1367
12) Hebblethwaite, P. D. (1983): The Faba Bean. Butterworths, London, p. 573
13) Hoffmann, J. A. (1982): Bunt of wheat. Plant Disease, 66, 979-989.
14) Hussain, M., Hassan, S. F. and Kirmani, M. A. S. (1980): Virulences in *Puccina recondita* Rob. ex. Desm. f. sp. *tritici* in Pakistan during 1978 and 1979. *In: Proceedings, Fifth European and Mediterranean Cereal Rusts Conference.* Bari and Rome, Italy, 28 May — 4 June 1980.
15) ICARDA. (1986): Studies on nematodes of feed legumes. Progress Report. 1985/86. Food Legume Improvement Program, ICARDA., pp. 16.
16) Kaiser, W. J. (1972): Diseases of food legumes caused by pea leaf roll virus in Iran. FAO Plant Protection Bulletin, 20, 127-133.
17) Kaiser, W. J. (1973): Biology of bean yellow mosaic and pea leaf roll viruses affecting *Vicia faba* in Iran. Phytopath. Z., 78, 253-263.
18) Kamal, M. (1984): The status of chickpea production and research in Morocco. *In*: Ascochyta blight and winter sowing of chickpeas. Edited by: Saxena, M. C. and Sing, K.B. Martinus Nijhoff/Dr. W. Junk, Publishers, Hague, The Netherlands, pp. 247-254.
19) Labrousse, F. (1930): Anthracnose of chickpea (*Cicer arietinum*) Rev. Path. Veg. et Ent. Agr., 27, 174-177. (In French).
20) Makkouk, K. M., Azzam, O. I., Skaf, J., El-Yamani, M. Cherif, C., and Zouba, A. (1987): Situation review of barley yellow dwarf virus in West Asia and North Africa. Barley Yellow Dwarf. *In*: *Proceedings of the Workshop*, CIMMYT (In press).
21) Makkouk, K. M., Bos, L., Azzam, O. I., Koumari, S. and Rizkallah, A. (1988): Survey of viruses affecting faba bean in six Arab countries. Arab Journal of Plant Protection, 6, 53-61.
22) Malik, B. A. (1986): Breeding for ascochyta blight resistance in chickpeas in Pakistan. *In*: ICARDA, Ascochyta Blight Resistance in Chickpeas. *In*: *Proceedings of a Training Course*, PARC/ICARDA, 3-10 March 1984, Islamabad, Pakistan. ICARDA, Aleppo, Syria., pp. 83-92.
23) Mamluk, O. F. (1981): Review of smut diseases in Jordan. Pages *In*: *Proceedings, Barley Diseases and Associated Breeding Methodology Workshop.* USAID, ICARDA CIMMYT, April 20-23, 1981. Rabat, Morocco., pp. 192-198.
24) Mlaiki, A. and Ben Hamd, S. (1984): Chickpea improvement in Tunisia. *In*: Ascochyta blight and winter sowing of chickpeas. Edited by: Saxena, M. C. and Singh, K. B. Martinus Nijhoff/Dr. W. Junk, Publishers, Hague, the Netherlands, pp. 255-257.
25) Nene, Y. L., Haware, M. P. (1980): Screening chickpea for resistance to wilt. Plant Disease, 64, 379-380.
26) Nene, Y. L., Sheila, V. K. and Sharma, S. B. (1984): A world list of chickpea (*Cicer arietinum* L.) and pigeonpea (*Cajanus cajan* (L) Millsp.) pathogens. ICRISAT Pulse Pathology Progress Report, 32. pp. 19.
27) Papayan, F. A. (1970): Susceptibility of various varieties of forage broadbean to Ascochyta, rust, and powdery mildew. Referativnyi Zhurnal Abst., 11, 55, 455.
28) Reddy, M. V., Gridley, H. E., and Kaack H. J. (1980): Major disease problems of chickpea in North Africa. International Chickpea Newsletter, ICRISAT (3), 13-14.
29) Reddy, N. V., and Kabbabeh, S. (1984): Eradication of *Ascochyta rabiei* from chickpea seed with thiabendazole. International Chickpea Newsletter, 10, 17-18.
30) Reddy, M. V., and Singh, K. B. (1984): Evaluation of a world collection of chickpea germplasm for

resistance to Ascochyta blight. Plant Disease, 68, 900-901.
31) Rohloff, H. and Stulpnagel, R. (1984): Resistance to bean yellow mosaic virus in *Vicia faba*. FABIS Newsletter, 10, 29.
32) Saadaoui, E. M. (1987): Physiologic specialization of *Septoria tritici* in Morocco. Plant Disease, 71, 153-155.
33) Saari, E. E., and Wilcoxson, R. D. (1974): Plant disease situation of high-yielding dwarf wheats in Asia and Africa. Ann. Rev. Phytopath., 12, 49-68.
34) Sattar, A., Arif, A. G. and Mohy-ud-din, M. (1953): Effect of soil temperature and moisture on the incidence of gram wilt. Pakistan Journal of Scientific Research, 5, 16-21.

Discussion

Nagarajan, S. (India): Does the program for breeding for resistance to yellow rust take care of the avirulent and virulent genes of the pathogens that occur in the area?

Answer: I am not certain. It seems not. We are still in the process of improving and standardizing the screening procedures. Germplasm pools are developed for sources of resistance for identifying the genetic basis we are working with.