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SCREENING OF *VICIA FABA* FOR RESISTANCE TO THE “GIANT RACE” OF *DITYLENCHUS DIPSACI* IN MOROCCO

by

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Summary. Screenings for resistance to *Ditylenchus dipsaci* in *Vicia faba* were conducted in the field from 1990 to 1998 in Morocco. Two hundred thirty two cultivars of INRA-Morocco collection, seven resistant lines of germplasm of ICARDA (Syria), the line 29H of the INRA France and several landraces material from the collection of faba bean of Algeria, Morocco and Tunisia were evaluated for their resistance to Moroccan populations of the nematode in field experiments with artificial inoculation. Seven cultivars of the collection of INRA-Morocco and eight landraces of faba bean of Maghreb region collection were resistant to the nematode. The resistant lines from ICARDA and the line INRA 29H were susceptible to the population of the “giant race” of *D. dipsaci* from Dar Bouazza.

The stem and bulb nematode *Ditylenchus dipsaci* (Kühn) Filipjev causes severe yield losses to faba bean (*Vicia faba* L.) in Morocco and elsewhere. Nematicides are effective in the control of this pathogen but they are costly and may cause environmental pollution. Resistant cultivars is an alternative method but no commercial varieties of faba bean resistant to the nematode are available. However, a source of resistance to the nematode was identified in a Moroccan landrace line of *Vicia faba minor* (Schreiber, 1978). This line can reduce the reproduction rate of the nematode by 70% (Gastel, 1990). In France the line of faba bean INRA 29H showed resistance to a “giant race” population of *D. dipsaci*. Augustin (1985) obtained low reproduction of the nematode with the cv. Diana in Germany while this cultivar was very susceptible in field experiment in Morocco. Eleven lines of faba bean of ICARDA germplasm were resistant to some populations

of the nematode from Syria and Tunisia (Hannounik *et al.*, 1986). Resistance sources of faba bean to *D. dipsaci* were also identified in faba bean material from INRA (France) and ICARDA (Syria) (Caubel and Leclercq, 1989a; 1989b).

Because of these promising findings, a screening programme for resistance to the Moroccan populations of the nematode in faba bean was started at the beginning of 1990 in Morocco. Results are reported in this paper.

Materials and methods

Six trials were conducted during 1990-1998 (Table I): trial A tested 232 cultivars (30 landrace populations, 32 cultivars introduced from different international collections, 65 hybrids, 42 mutant cultivars, 33 from Moroccan collections and 30 while hilum type) of INRA-Morocco collection in a field at Rabat from 1990 to 1992; tri-

TABLE I - Location of the trials and characteristics of *Vicia faba* germplasm used in the screening to *Ditylenchus dipsaci*.

Trial	Period	Region	Number and origin of cultivars	Inoculum used	Mode of inoculation
A	1990-1992	Rabat	232 INRA-Morocco	Mixture	Water suspension with 400 nematodes poured at collar of plants at 4 to 6 leaf stage
B	1993	Kenitra	8 ICARDA; INRA-France	Dar Bouazza	
	1992	Kenitra	60 Algeria; Morocco; Tunisia	Mixture	
C	1996-1998	Kenitra	168 Algeria; Morocco; Tunisia	Mixture	Pieces of infested stems distributed at sowing and at 4 to 6 leaf stage

al B screened seven genotypes of 11 resistant lines of ICARDA (Hanounik *et al.*, 1986) and the line INRA 29H of INRA France at Kenitra; the trial C was also carried out at Kenitra in 1992, 1996, 1997 and 1998, using a total of 231 landraces of faba bean collected in Algeria, Morocco and Tunisia.

The cv. Aguadulce of faba bean was used as a susceptible control in all experiments while the line INRA 29H was used only as a resistant control in trial C after the confirmation of its resistance in trial B.

The inoculum used in trials A and C was a mixture of several populations of the "giant race" obtained from infested stem of faba bean collected from different regions of the country. A population of *D. dipsaci* "giant race" collected at Dar Bouazza was used in trial B. Preadult and adult length measurements were used for the "giant race" characterisation. To maintain the mixture of population inoculum in trials A and C, attacked plants were harvested at the end of each experiment, cut into small pieces, mixed and stored in bags to be used for inoculum reinforcement for the following experiment.

Faba bean was artificially inoculated at the 4-6 leaf stage by pouring around the basal part of each plant a water suspension of about 400 preadult stages of the nematode. Pieces of in-

festes stems, obtained from the previous faba bean crop, were also distributed in the seed bed at sowing and again at the 4-6 leaf stage of the plants in trial C. Supplementary irrigation was made in the dry season to permit nematode reproduction and development.

Ten seeds of each cultivar were sown in rows 1 m long and spaced 0.5 m apart at the beginning of November. The cv. Aguadulce was sown every five rows. The line INRA 29H was, instead, planted only in trials B and C every six rows. The plots were distributed in a randomized block design with two replications.

At the podding and maturity stage of plants the severity of attack of the nematode was assessed according to a scale 1-9 (Hanounik and Sikora, 1980), where 1 = no visible attack of the plant, 3 = traces of necrosis at base of the stem, 5 = leaves and stems deformed on 10 to 25% of plants, 7 = stem with necrosis, swelling and distortion with 75% of plants, and 9 = all plants dead.

A faba bean cultivar was considered resistant with severity of attack < 3, moderately resistant with severity of 3, moderately susceptible with 5, susceptible with 7 and very susceptible with 9. Nematodes were also extracted (Abbad Andaloussi *et al.*, 1990) from 5 g samples of stem tissues of three plants of each genotype classified resistant or moderately resistant.

Results and discussion

The reproduction and development of the nematode in the different experiments, with the exception of some particular year, was satisfactory and germinability, emergence and growth of faba bean lines and cultivars was generally good.

Light necrosis appeared, for the first time, at the collar of plants of cv. Aguadulce two weeks after plant emergence. Stem and leave distortion and swellings were clearly evident in plots of susceptible genotypes ten days later, but localised and very little necrosis, at the basal part of the plant, were observed in resistant material. These symptoms are due to hypersensitivity reaction of the resistant plants.

Seven genotypes in the trial A were classified moderately resistant because rated 3 (Table II and III) the remaining genotypes were from moderately susceptible to very susceptible (rated 5 to 9).

In trial C, the lines T41, T42, T52, T110, M83, LPF 126 and LPF 157 of *V. faba minor* L. and the line S82033-3 of *V. faba major* L. of the Maghreb germplasm were moderately resistant to the nematode with an infestation of 204, 483, 111, 149, 223, 228, 114 and 316 specimens/plant, respectively, but the cv. Aguadulce, the lines 2/1/15 and INRA 29H were very susceptible, susceptible and moderately resistant, respectively, with an average of 27,000, 16,787 and 67 nematodes per plant, respectively (Table II and IV). All lines of the collection of ICARDA and the line INRA 29H were susceptible in experiment B (Table V).

The results of this investigations confirm the resistance to the stem nematode *D. dipsaci* obtained by other authors and allow to identify a new sources of resistance to the nematode in faba bean. Till now most of sources of this resistance were identified in *V. faba minor*, faba bean with small seeds used for animal feed, therefore, it is very difficult to use it in breeding of faba bean for human food such as *V. faba major*. In our investigation, the line S82033-3 of

V. faba major from Tunisia resulted moderately resistant to the nematode. This result is very important because it could be used in the future breeding programmes for resistance in faba bean for human consumption.

The Dar Bouazza, "giant race" population of *D. dipsaci*, was able to break the resistance of the resistant line INRA 29H and this response was confirmed in other experiments conducted under controlled conditions with the same population (Abbad Andaloussi *et al.*, 1995). This re-

TABLE II - Reaction of *V. faba* cultivars of INRA-Morocco (Trial A) and of Maghreb collections (Trial C) depending on severity of attack of *D. dipsaci*.

Trial	Period	Severity of attack				
		1	3	5	7	9
A	1990-1992	0	7	32	108	85
C	1992	0	4	13	15	28
"	1996	0	1	1	40	18
"	1997	0	3	18	37	2
"	1998	0	0	2	32	15

TABLE III - Severity of attack and specimens of *D. dipsaci* in the plants of some cultivars of faba bean from the collection of INRA-Morocco (Trial A).

Cultivar	Pedigree	Severity of attack (scale 1-9) and reaction type	Nematodes/plant
Aguadulce	Check	9 S*	27,700
F 1032	Hybrid	3 MR	8,207
F 805	"	3 MR	3,072
F 308	Landrace	3 MR	419
F 356	Mutant	3 MR	177
F 1356A	Landrace	3 MR	112
F 1752	"	3 MR	112
F 1734	"	3 MR	40

* S: Susceptible: severe stunting, giant necrotic stem swellings and severe defoliation on more than 75% of the plants.

MR: Moderately resistant: Few stem infections on less than 20% of the plants.

TABLE IV - Response to *D. dipsaci* of some moderately resistant cultivars of faba bean of the Maghreb collection (trial C).

<i>Vicia faba</i> sub spp. and cultivar	Pedigree	Severity of attack (scale 1-9)	Nematodes/plant
<i>V. faba minor</i> T 41	Landrace	3	204
<i>V. faba minor</i> T 42	"	3	483
<i>V. faba minor</i> T 52	"	3	111
<i>V. faba minor</i> T 110	"	3	149
<i>V. faba minor</i> M 83	Line	3	223
<i>V. faba minor</i> LPF 126	"	3	228
<i>V. faba minor</i> LPF 157	"	3	114
<i>V. faba minor</i> 2/1/15	"	7	16,787
<i>V. faba minor</i> INRA 29H	"	3	67
<i>V. faba major</i> S82033-3	"	3	316
<i>V. faba major</i> cv. Aguadulce	Landrace	9	27,000

TABLE V - Infestation of cultivars of faba bean, previously reported resistant, inoculated with a population of the "giant race" of *D. dipsaci* from Dar Bouazza (trial B).

Line and cultivar	Origin	Severity of attack (scale 1-9)	Nematodes/plant
BPL 1	ICARDA	9	9,311
BPL 11	"	7	3,305
BPL 12	"	9	17,293
BPL 21	"	7	3,914
BPL 63	"	9	1,096
BPL 88	"	7	4,636
BPL 183	"	9	11,799
INRA 29H	INRA-France	9	32,656
Aguadulce	Landrace	9	27,629

sult confirms the remarkable genetic variability of the nematode even within the "giant race". Therefore, more investigations are needed on the host range and genetic variability of *D. dipsaci* with traditional methods or by molecular and biochemical techniques (Bossis *et al.*, 1994; Caubel *et al.*, 1998) before any breeding programme for resistance and for controlling the nematode by crop rotation is proposed.

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