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ITEMS FROM ITALY

CONSIGLIO PER LA RICERCA E LA SPERIMENTAZIONE IN AGRICOLTURA, Unità di ricerca per la valorizzazione qualitativa dei cereali (CRA–QCE), Via Cassia, 176, 00191 Rome, Italy.

Behavior of wheat cultivars in organic farming tested at the seedling stage with Stagonospora nodorum.

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The Septoria disease complex is caused by two pathogens, *Phaeosphaeria nodorum* (anamorph *Stagonospora nodorum*) and *Mycosphaerella graminicola* (anamorph *Septoria tritici*) that frequently occur together on the same plant in Italy. Both the fungi attack the epigeous parts of the plant with similar symptoms and can cause quantitative and qualitative damage. *Septoria nodorum* also infects the kernels with damage to the grain. Because *S. nodorum* is a seedbome fungus, infected seed is an important source of primary inoculum and can be a more dangerous vehicle of infection for organic farming than in conventional agriculture.

The agronomic, qualitative, and phytopathological aspects concerning National Organic Network of many cultivars of durum and bread wheat have been studied in Italy for some years (Perenzin et al. 2010; Quaranta et al. 2010, Iori et al. 2010). In 2009–10, data collected from field surveys again showed the prevalence of Septoria disease complex on both durum and bread wheats, confirming an increase in the economic importance of this plant disease already observed in recent years. Data related to naturally acquired diseases were reported by Iori et al. (2010).

Our aim was to analyze the behavior of same wheat cultivars at the seedling stage artificially inoculated with *S. nodorum* in greenhouse that were previously observed in field for Septoria disease complex. Seventeen bread wheat and

20 durum wheat cultivars were tested. Seedlings were grown in greenhouse at 20°C with a 12-hour photoperiod. Artificial inoculations were made using four isolates of *S. nodorum* (Sn 16268, Sn 16271, Sn 16357, and Sn 16165). These isolates were collected from naturally infected durum and bread wheat plants collected in different regions of Italy. The method of isolation and preparation of isolates followed that of Iori and L'Aurora (2010). The fungal suspension was prepared immediately before inoculation at a concentration of 1 x 10^6 conidia/mL plus the addition of Tween 20. For each cultivar, 20 seedlings at the second-leaf stage were inoculated and 20 seedlings were used as noninoculated controls. After inoculation, the seedlings were put in a humidity chamber for 72 hours and then returned to the greenhouse. Disease severity was evaluated at 5, 7, and 10 days on the first leaves using the scale of Liu et al. (2004).

The results of the durum wheat cultivar screening are given in Table 1. All cultivars were resistant to isolate Sn 16268. All cultivars were susceptible to Sn 16271, except Anco Marzio. Claudio, Normanno, and San Carlo were resistant to both bread wheat isolates and one isolate from durum wheat.

The bread wheat cultivars showed a different behavior with the isolates (Table 2). Cultivars Adelaide, Antille, Aubusson, Azzoffe, Bramante, Egizio, PR22R58, Saigemma, and Sirtaki were resistant or moderately resistant to all wheat isolates tested. Only Blasco and Genesi were susceptible or moderately susceptible to the four isolates used. Other bread wheat culitvars showed a behavior ranging from resistant to susceptible with the different isolates.

The *S. nodorum* resistance in bread and durum wheats at the seedling stage is interesting, because some authors reported a high relationship between seedling and field tests (Karyalainen 1986; Wicki et al. 1999; El-Bana and Galal 2007). Consequently, our seedling results inform us about cultivar resistance to *S. nodorum*, which is especially important in organic farming.

Acknowledgements. Cultivars were provided by Dr. M. Perenzin and F. Quaranta from material used in National Organic Networks.

Table 1. Durum wheat cultivars artificially inoculated at the seedling stage with *Stagonospora nodorum* isolates collected from durum (^{D}) and bread (^{W}) wheat leaves. Symptom severity was evaluated using a 0–5 scale (Liu et al. 2004), where 0 = highly resistant; 1 = resistant, 2 = moderately resistant, 3 = moderately susceptible, 4 = susceptible, 5 = highly susceptible, and — = missing data. Average values based on repeated trials are reported.

Cultivar	Sn 16268^D	Sn 16271^D	Sn 16357^W	Sn 16165^W
Anco Marzio	1.0	2.5	3.5	2.2
Ciecio	2.0	3.5	1.5	3.0
Claudio	1.0	4.5	2.5	2.5
Colosseo	2.0	4.0	4.0	4.0
Creso	1.5	4.0	4.0	3.0
Duilio	1.0	3.0	1.5	3.6
Dylan	2.0	3.2	3.0	3.0
Iride	2.0	3.7	4.0	2.5
Karalis	—	3.5	—	2.5
Latinur	1.0	3.0	2.5	3.0
Meridiano	1.5	2.7	0.5	3.0
Neolatino	1.5	3.2	3.0	2.7
Norrnanno	1.0	3.7	1.5	2.5
San Carlo	2.0	3.7	2.5	2.5
Saragolla	1.5	3.7	2.0	3.5
Severo	1.5	3.5	1.5	2.9
Simeto	1.5	4.5	2.5	3.7
Svevo	—	3.7	2.5	3.0
Tirex	2.0	4.0	3.5	3.2
Vinci	1.5	4.5	3.0	3.2

Table 2. Bread wheat cultivars artificially inoculated at the seedling stage with *Stagonospora nodorum* isolates collected from durum (^{D}) and bread (^{W}) wheat leaves. Symptom severity was evaluated using a 0–5 scale (Liu et al. 2004), where 0 = highly resistant; 1 = resistant, 2 = moderately resistant, 3 = moderately susceptible, 4 = susceptible, 5 = highly susceptible, and — = missing data. Average values based on repeated trials are reported.

Cultivar	Sn 16268^D	Sn 16271^D	Sn 16357^W	Sn 16165^W
Adelaide	1.5	2.0	2.0	2.5
Albachiara	3.5	2.0	4.0	3.0
Antille	2.5	2.0	1.5	2.5
Aquilante	1.5	2.5	1.5	4.0
Aubusson	2.0	1.5	1.0	1.0
Azzoffe	2.0	2.5	2.0	2.5
Blasco	3.5	3.0	3.5	4.0
Bolero	3.0	3.5	3.0	2.0
Bramante	0.5	1.0	0.5	2.5
Egizio	0.5	1.5	0.5	2.5
Enesco	2.5	3.0	2.5	2.0
Epidoc	2.5	3.5	3.5	3.0
Genesi	3.0	4.0	4.0	3.5
Lilliput	3.0	3.0	2.0	3.5
PR22R58	2.5	1.0	1.0	2.5
Salgemma	1.5	1.5	1.5	1.0
Sirtaki	1.5	2.0	2.5	2.0

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Effects of Stagonospora nodorum on durum wheat cultivars artificially inoculated in the field.

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Phaeosphaeria (syn. *Leptosphaeria*) *nodorum* (E. Müll.) Hedjar (anamorph *Stagonospora* (syn. *Septoria*) *nodorum* (Berck.) Castell. & Germano) is a necrotrophic fungal pathogen that is the causal agent of *Stagonospora nodorum* blotch (SNB) on durum and bread wheat. A widespread disease in various parts of the world, SNB is generally observed every year on wheats in Italy. The first symptoms of fungal attack are chlorotic spots. As the disease develops, oval leaf lesions with a yellow border surrounding the necrotic area appear. Finally, large leaf portions die, damaging the photosynthetic capacity of the plant.

This preliminary study was to assess some characteristics related to the behavior of eight durum wheat cultivars in the field and evaluate the effects of the disease on some quantitative and qualitative traits. Eight durum wheat cultivars were artificially inoculated in field with *S. nodorum* during the 2009–10 crop season using an isolate obtained from a naturally infected plant. The spore suspension (1 x 10^6 conidia/mL) was prepared immediately before use from 7-day-old cultures followed by the addition of Tween 20. The trials were carried out in an experimental field located in Montelibretti (Rome). The cultivars were sown in the field in '1 x 1.5-m' plots replicated twice. The plots were artificially inoculated and a control plot was treated with fungicides. Inoculation was at spike emergence. Inoculated plants were covered for 48 h with a transparent plastic film to retain moisture; a bucket with water also was placed under the plastic. The control plots were sprayed with commercial fungicides (once with Horizon and twice with Folicur). Plots were harvested at maturity. Disease assessments were made considering the percentage of flag leaf and spike area affected by *S. nodorum*. The following qualitative and quantitative traits were analyzed: grain yield, kernel weight, hectoliter weight, protein content, and SDS sedimentation test.

During the first months of 2010, high humidity favored the development of *S. nodorum* and inoculated plants showed significant attacks on both the flag leaf and spike. The highest disease were observed in cultivars Ciccio and Svevo (Table 3). Inoculated samples had lower grain yield, hectoliter weight, and 1,000-kernel weight than the control, but this was not observed in grain yield for cultivars Ciccio and Normanno. The hectoliter weight of Simeto was similar in both inoculated and treated samples. All the inoculated cultivars, with the exception of Dylan, showed 1,000-kernel weight lower than that obtained from the control plots. Grain protein content and SDS sedimentation test, which is related to the gluten strength in durum wheat samples, were higher in inoculated samples compared with the controls. In particular, the protein content of the inoculated samples had an average value of 14.7%, whereas it was 12.7% in the treated controls. The highest protein content was in Creso, and Saragolla had similar values for bothe the inoculated and treated samples. For the SDS sedimentation test, the inoculated samples and treated controls were equal only the cultivar Simeto. The data is summarized in Table 3, p. 40.

Table 3. Effects of *Staganospora nodorum* infection on yield, heading date, plant height, hectoliter weight, 1,000-kernel weight, protein content, and SDS sedimentation test on eight durum wheat cultivars artificially inoculated in field. I = inoculated cultivar, means of duplicate plots; T = treated cultivar; — = missing data.

Cultiar	*S. nodorum* on flag leaf (%)	*S. nodorum* on spike (%)	Grain yield (kg/plot)	Heading date (days after 1 April)	Plant height (cm)	Hecto-liter (kg/hl)	1,000-kernel weight (g)	Protein content (%)	SDS sedimen-tation (mL)
Ciccio I	60	50	0.345	20	72	60.1	38.7	15.8	41
Ciccio T	0	0	0.322	22	65	66.2	41.8	12.5	40
Creso I	60	5	0.299	31	72	69.6	41.7	17.1	42
Creso T	0	0	0.575	31	70	73.8	43.5	12.4	40
Dylan I	50	5	0.479	28	72	71.1	42.3	13.7	48
Dylan T	0	0	0.707	28	75	73.8	40.1	12.6	40
Iride I	60	20	0.636	20	70	70.0	41.6	13.4	47
Iride T	0	0	0.707	21	75	77.5	43.6	12.3	43
Nonnanno I	60	20	0.672	26	75	73.5	40.9	14.7	47
Normanno T	0	0	0.360	27	70	74.6	43.1	10.6	44
Saragolla I	—	—	0.400	19	70	66.8	46.9	13.6	44
Saragolla T	0	0	0.700	20	75	76.5	48.4	13.5	42
Simeto I	50	20	0.338	22	70	67.1	43.2	15.0	41
Simeto T	0	0	0.380	24	70	66.8	49.5	14.1	41
Svevo I	90	90	0.478	19	75	72.0	42.4	14.3	40
Svevo T	0	0	0.649	20	75	77.7	46.4	13.7	32

The results of this study highlight the susceptibility of these cultivars after artificial inoculation with *S. nodorum* at the adult-plant stage. Grain yield, 1,000-kernel weight, and hectoliter weight of the inoculated samples were lower than those of the treated controls, and this is consistent with the expectations (Karialainen and Salovaara 1988; Gilbert and Tekauz 1992; Bhathal et al. 2003). The protein content and SDS sedimentation tests of the inoculated samples weregenerally higher than those of the controls. The highest protein content in the inoculated samples agrees with previous reports that severe infection increases the protein content (Karyalainen and Salovaara 1988). This preliminary study examined some effects of *S. nodorum* infection on durum wheat cultivars grown in an experimental field in Italy. Currently, we are in the second year of field tests, which will allow us to optimize the experimental conditions with a better assessment of the effect of the same pathogen on durum wheat quality.

Acknowledegment. The authors thank Dr. M.G. D'Egidio for his helpful suggestions.

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