Research Papers

Preliminary Screening of Lentil for Resistance to Downy Mildew

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Abstract

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Downy mildew, caused by *Peronospora* sp., is a major problem of lentil in North Egypt. A natural infection of downy mildew was observed during late vegetative growth in breeding nurseries at ICARDA Tel Hadya in 1994 following a period of cool, wet weather in February and March. A total of 106 lines in replicated trials were scored for disease reaction. Resistance was found in eight lines, providing the first report of genetic variation in disease reaction. Previously, control strategies for downy mildew were based on fungicide application and on crop management. Although the results obtained require confirmation, they suggest that disease control through host-plant resistance is a possible alternative.

Key words: Downy mildew, lentil, Genetic resistance.

Introduction

Downy mildew, caused by *Peronospora* sp., is a lentil disease causing concern in newly-reclaimed and irrigated parts of Egypt (1). The disease, spread by sporangiospores (conidiospores), is common and serious only under cool and humid conditions. Symptoms are observed on the aerial plant parts with leaves near the apical buds, curled, dwarfed and twisted (3). Fine, dirty pinkish tufts of fungal growth develop on the under-side of leaves. The extent of damage depends on the duration of cool and wet conditions. In Syria, the disease is widespread (2, 4) but relatively unimportant because of the rapid rise in temperature in the spring. However, the 1993/94 season at ICARDA's Tel Hadya station provided a unique opportunity to screen breeding material for resistance to downy mildew.

Materials and Methods

Two lentil trials (I & II) were sown at Tel Hadya, Syria (36° 01' N, 37° 20' E, 280 m elevation) in the 1993/94 cropping season to test advanced lines for agronomic traits. The test material was F_4-derived bulked lines in the F_7 generation selected at Tel Hadya from simple crosses targeted for West Asia. The material may be considered random samples of lentils adapted to West Asia. Trials I and II contained 81 and 25 entries, respectively.

Phosphorus fertilizer was soil-incorporated at the rate of 50 kg P_2O_5/ha before seeding. A randomized block design was used with four replications and two check cultivars. Sowing was at 250 seeds/m^2 with 0.3-m apart and 3-m long rows in early December, 1993; Trial I contained plots of 10 rows, whereas Trial II had plots of 5 rows for each line. Inoculation with *Rhizobium* was not undertaken in the trials but good nodulation was observed throughout.

Observations were made of the period from sowing to 50% flowering and to 90% pod maturity on a plot basis, and of plant height and the height above ground of the lowest pod on the basis of three plants per plot. At maturity, the plants in the central rows were hand-pulled, air-dried in bags, weighed and then threshed and the clean seed were weighed.

Disease reaction was assessed in the first week of April by disease incidence and severity as follows: Disease incidence = (no. infected plants/total no. of plants) x 100. Disease severity was scored on a 0-9 scale, which was developed to take into account the following: a) percentage of infected foliage; b) infection occurring on leaves of the main stem alone or also on leaves of branches; c) infection occurring on leaves alone or on both leaves and stems; d) intensity of fungus sporulation and e) stunting.

0 = No symptoms.
3 = Infection on newly opened leaves on almost all branches with conspicuous sporulation on the lower surface of the leaves.
5 = As infection proceeds basipetally, the upper third of the aerial plant parts are infected with sporulation on the lower surface of the leaves.
7 = The upper three-quarters of the aerial plant parts are infected with sporulation on the lower surface of the leaves, accompanied by stunting.
9 = Severe stunting, drying out of the plant and finally plant death.

Results and Discussion

At Tel Hadya in 1994, downy mildew infection was observed on lentil in late March. In the preceding period (late February and early March) when the disease was developing, precipitation was higher than average and temperatures were around average with a monthly mean of 7.6 °C in February and 10.9 °C in March (Figure 1). Disease development was halted in mid-April by the onset of hot weather with maximum daily temperatures crossing 30 °C.

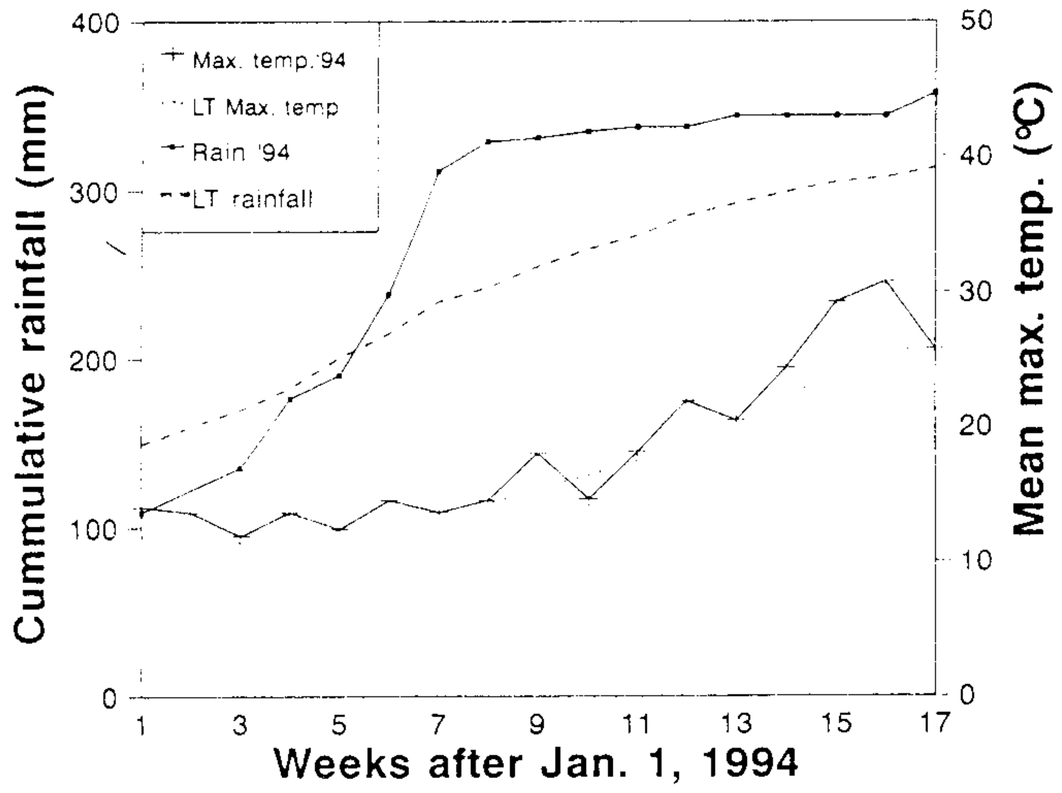

Figure 1. Data on climate from the long-term average (LT) and the 1993/94 growing season for seasonal cumulative rainfall (mm) and average maximum temperature (°C).

The disease ratings of common checks were very similar in different replicates and trials, indicating uniformity of infection. For example, the check ILL 4605 was scored at a rating of 1 in both Trials I and II and the other check ILL 4401 scored a mean of 2.25 in Trial I and 2.0 in Trial II. The correlation between the incidence and severity of downy mildew was highly significant at $r = 0.89$ ($P < 0.001$) in Trial I and $r = 0.88$ ($P < 0.001$) in Trial II.

There were significant differences among genotypes in their reaction to the disease with the percentage of affected plants varying over genotypes from 5 to 94% and the disease score ranging from 1 to 5 (Table 1). Resistant lines (rating 1) were ILL 2581 (12% infected plants), ILL 4605 (11%), 91S89718 (17%), 92S70433 (9%), 92S70499 (14%), 92S74555 (11%), 92S74689 (9%) and 92S75734 (11%).

Table 1. Number of test entries in different resistance groups based on mean downy mildew score over replicates together with the Least Significant Difference (LSD) of score means in Trials I and II.

Score	Trial I*	Trial II*
1	6	3
> 1-2	12	37
> 2-3	4	27
> 3-4	1	8
> 4	2	6
$LSD_{P=0.05}$	0.9	1.0

* includes checks common to both trials (ILL 4401 & ILL 4605)

Table 2. Correlation coefficients of downy mildew score and percentage foliage affected with other plant traits. Upper line Trial I and lower line Trial II.

Character	Downy mildew score	Downy mildew percentage
Time to flower (d)	0.056	0.097
	0.245*	0.274**
Time to maturity (d)	-0.011	0.010
	0.150	0.155
Plant height (cm)	-0.274***	-0.258***
	-0.263**	-0.236*
Height above ground	-0.157**	0.109*
of lowest pod (cm)	-0.186	-0.191
Grain yield (kg/ha)	0.031	0.047
	0.105	0.152
Biomass yield (kg/ha)	-0.024	-0.005
	0.112	0.151
Straw yield (kg/ha)	-0.016	-0.005
	0.112	0.165

* $0.01 < P < 0.05$; ** $0.001 < P < 0.01$; *** $P < 0.001$

Associations of disease reaction (incidence and severity) with other plant traits were examined by correlation (Table 2). The downy mildew ratings were negatively correlated with plant height in both trials indicating the stunting effect of the disease on the vegetative canopy. Correlations of disease reaction with grain, straw and biomass yields were not significant. The period of cool, wet weather in March was interrupted by a hot, dry spell in April, which limited disease spread at flowering. In these circumstances damage was confined to the vegetative canopy.

Control strategies for downy mildew in the past were based on fungicide application and on crop management to reduce humidity levels in the crop canopy (3). This is the first report of genetic variation in reaction to downy mildew. Although the results require confirmation, they suggest that disease control through host-plant resistance is also a possibility for areas where downy mildew causes serious losses.

الملخص

أبو زيد، ناجي، ويلي إرسكين وبسام بياعة. 1995. تقويم أولي لبعض مدخلات العدس لمقاومة مرض البياض الزغبي. مجلة وقاية النبات العربية. 13(1): 17-19

يعتبر مرض البياض الزغبي الذي يحدثه الفطر *Peronospora* sp. مشكلة رئيسة تعتري زراعة العدس في شمالي جمهورية مصر العربية. وقد لوحظت في عام 1994 إصابة طبيعية بالفطر في مشاتل تربية العدس المزروعة في محطة بحوث ايكاردا- تل حديا خلال طور النمو الخضري المتأخر. وذلك عقب ظروف جوية باردة ورطبة سادت في شباط/ فبراير وآذار/ مارس. وقد تم تقويم التفاعل المرضي لـ 106 مدخلات، في تجارب مكررة. وتشير النتائج إلى وجود ثمانية مدخلات مقاومة. ويعتبر هذا أول تسجيل لوجود تنوع وراثي في العدس لصفة مقاومة مرض البياض الزغبي. ورغم أن النتائج المتحصل عليها تحتاج إلى تأكيد إلا أنها تظهر إمكانية استخدام المقاومة الوراثية كطريقة بديلة لمكافحة المرض.

كلمات مفتاحية: البياض الزغبي، عدس، مقاومة وراثية.

References

1. **Abou-Zeid, N. M.** 1987. Downy mildew (*Peronospora* sp.) of lentil. A new disease in Egypt. Egypt. J. Phytopath. 19:157.
2. **Bellar, M. and S. Kebabeh.** 1983. A list of disease, injuries, parasitic weeds of lentils in Syria (Survey 1979-80). LENS Newsletter 10(1):30-31.
3. **Beniwal, S.P.S., B. Bayaa, S. Weigand, K. Makkouk and M.C. Saxena.** 1993. Field Guide to Lentil Diseases and Insect Pests. International Center for Agricultural Research in the Dry Areas (ICARDA), Aleppo, Syria. 107 pp.
4. **Mamluk, O.F., O. Tahhan, R.H. Miller, B. Bayaa, K.M. Makkouk, K.M. and S.B. Hanounik.** 1992. A checklist of cereal, food legume and pasture and forage crop diseases and insects in Syria. Arab J. Pl. Prot. 10(2):166-225.