

Current status of sunflower rust (*Puccinia helianthi* Schw.) in Iran

Madjidieh- Ghassemi Sh. and M. Torabi

Plant Pests and Disease Research Institute, Tehran, Iran .

ABSTRACT

To identify the physiologic races of sunflower rust, several isolates were collected from four hot spot zones in the country and tested them on differential varieties, CM-90RR , 29-3 , S37-388 and HA-RI-R5 in the greenhouse . The preliminary results revealed the prevalence of races 4 and 3 in the North and North-Western provinces of Iran . To select the most tolerant cultivars for growing in the hot spot zones, twenty different hybrids and cultivars existing in the country, were grown in rust nurseries in Khoy and Moghan under natural infection in 1994, using a complete randomized blocks design with four replications. According to the results obtained, cultivars R-43 and Gabor showed a satisfactory tolerance to the disease in North-Western regions. These cultivars were also tested in the greenhouse under favourable controlled conditions (18-22°C and 90% RH) with different isolates collected from these regions, to compare the results with those obtained in the field. The surveys done in 1993 and 1994 by measurement of leaf area infected%, showed that due to the appearance of rust at early phenologic growth stages in 1994, the yield loss caused by the disease was 3-4% higher than that occurred in 1993, despite the less severity of rust in 1994.

INTRODUCTION

Sunflower is one of the most important oil seed crops in Iran , grown on an area of 136 thousand hectares, mostly in North, North-East and North-Western parts of the country .

Sunflower rust (*Puccinia helianthi* Schw.) reported for the first time in Iran in 1962 (Ershad , 1972), is now the most important disease of this crop because of the widely cultivation of susceptible cultivars. The disease appears as periodical epidemics, the most serious one occurred in 1993 and caused

quantitative and qualitative losses on the crop. The loss caused by the rust on sunflower yield in 1994 has been estimated as 10% of the total yield and 9.8% reduction in oil contents.

P. helianthi is composed of races differing in pathogenic characters. Four races (1,2,3 and 4) was identified in North America on three standard Canadian sunflower rust differential lines (Sackston, 1962). Kochman and Goulter (1984) reported races 1 and 3 from Australia. Yang *et al.* (1987) reported a new isolate of sunflower rust (Bushland isolate), which was virulent on all resistance sunflower genotypes. In Argentina, four North American races plus other race with different virulence patterns have been reported (Antonelli,1985).

Introduction of hybrids with resistance to races 1 and 2 resulted in increase in frequency of races with virulence on resistance genotypes. Race 4 which is virulent on genes R1 and R2 was predominant in 1982 and 1984, while race 3, which is virulent on R1 was present in only one field (Yang and Gulya,1986). Recently, a sharp increase in the incidence and severity of sunflower rust and a change in virulence in the rust population have been reported in Western Canada (Rashid,1991) and North Dakota (Gulya *et al.*, 1989). The main objectives of the present study were to determine the races of sunflower rust in Iran and evaluate the resistance of some sunflower hybrids and cultivars.

MATERIALS AND METHODS

1. Disease incidence and severity: Several commercial sunflower fields were inspected in the infected areas in North-West and North-Eastern parts of the country during 1993 and 1994.

Rust incidence and severity were assessed from May until the harvesting time. Disease incidence was recorded for presence or absence of pustules, and severity was estimated as the percent leaf area infected on randomly selected plants.

2. Race identification : During years 1993 and 1994 several rust isolates were collected from infected sunflower plants in different parts of Iran. Each

isolate was inoculated separately on the primary leaves of susceptible cultivar Ajili in the greenhouse. Spores of a single pustule were collected and after multiplication on the susceptible cultivar were used for race identification.

Seedlings of three Canadian differential cultivars CM-90RR (R1 resistance gene), Cross 29-3 (R2 resistance gene) and S37-388 (Universal susceptible), and five USA inbred lines HA-R1, HA-R2, HA-R3, HA-R4, and HA-R5 were inoculated with urediniospores of each isolate using spray or dusting method. Seedlings were atomized with distilled water before and after inoculation, and incubated in darkness at 22°C day, 18°C night and saturated RH. for 24 hours. The plants were removed to the greenhouse and maintained at the same temperatures and 12 hours photoperiod with 12000 lux supplementary light.

Infection types of differentials were assessed 12 - 14 days after inoculation based on: 0 = immune reaction, 0₁ = flecking or hypersensitive reaction, 1 = very small uredia of 0.1-0.2mm, 2 = small uredia of 0.3-0.4 mm, 3 = medium sized uredia of 0.5-0.6mm and 4 = large uredia of 0.6mm in diameter. Isolates were classified into different races according to their reaction types (0-2=R; 3-4=S) on the differentials and comparison with the four known races of sunflower rust.

3. Resistance evaluation: A total of 20 commercial sunflower hybrids were evaluated for rust reaction under natural infection in Moghan and Khoy and also in the greenhouse under controlled environmental conditions with races 3 and 4 of *P. helianthi*. In field experiments, all entries were evaluated in a randomized complete block design with four replications.

RESULTS AND DISCUSSIONS

1. Rust incidence and severity: The results of the rust assessment showed that disease incidence and severity varied between 1993 and 1994. Rust was present in all inspected fields in these two years.

The first incidence of rust in 1994 was earlier than that in 1993, but disease severity was higher in 1993, thus due to the appearance of rust at earlier

phenologic stages in 1994, the yield loss caused by the disease was 3-4% higher than that occurred in 1993, despite the less severity of rust in 1994.

2. Race identification: Race 4 was identified in 6 isolates from Khoy, 7 isolates from Golidagh and 8 isolates from Kalaleh. Race 3 was identified only in Moghan, in 9 isolates (Table 1). The preliminary results of sunflower rust race identification in Iran presented here, showed the presence and prevalence of race 4 in large area of sunflower growing in the country, mainly in Mazandaran, Gorgan and West Azarbaijan, while race 3 was present only in North- West of Iran.

Table 1. Reaction of sunflower rust differentials to different isolates of *Puccinia helianthi* from different parts of Iran and the identified races

Insolate		Sunflowers rust differentials								Race
Location	No	CM-90RR	29-3	S37-388	Ha-R1	HA-R2	HA-R3	HA-R4	HA-R5	
Khoy	6	S	S	S	R	R	R	R	R	4
Moghan	9	S	R	S	R	R	R	R	R	3
Golidagh	7	S	S	S	R	R	R	R	R	4
Kalaleh	8	S	S	S	R	R	R	R	R	4

S= Susceptible R= Resistant

3. Resistance evaluation : Reaction of 20 sunflower hybrids to races 3 and 4 of *P. helianthi* in the greenhouse and in field has been shown in Table 2. In the greenhouse test, Gabor and R.43 showed resistance to race 3 and moderately resistance to race 4. These hybrids showed also good tolerance in field condition. Four other hybrids were moderately resistant to race 4 and six with the same reaction to race 3. The remaining hybrids were susceptible or moderately susceptible to each of the races. The reactions of hybrids obtained in the field condition were very well correlated with those obtained in the greenhouse, indicating that both methods can be used successfully for resistance evaluation and selection.

Table 2. Reaction of sunflower commercial hybrids to races 3 and 4 of *P. helianthi* in the greenhouse and their reaction in field under natural infection

Sunflower hybrids	Reaction			
	Greenhouse		Field	
	Race 4	Race 3	Khoy	Moghan
Vnimk	MS*	MR	5.00	3.50**
Zaria	MS	MR	2.30	1.25
Mehr	S	MR	10.00	0.75
Chernianka	S	MS	5.33	2.00
Armaversky	MR	MS	1.80	2.00
Progress	S	MS	10.00	5.00
Record	MS	MS	3.80	4.25
Predovik	MR	MS	1.80	1.37
Gabor	MR	R	5.00	0.62
Shafagh	S	MR	5.00	0.87
Armaverec	MS	MS	1.66	2.75
LUC	S	MS	5.00	2.75
CMS 15xR-46	MS	MS	4.00	2.00
CMS 24 x R-46	S	S	4.33	2.25
R-43	MR	R	1.66	0.10
R-28	MR	MR	1.66	0.87
R-46	MS	MS	2.00	1.75
N.S.P.317	S	S	5.60	4.25
CMS 15 x R-28	MR	MR	2.00	0.62
CMS 31xR-28	MS	MR	5.00	5.00

* R= Resistant, MR= Moderately resistant, MS= Moderately susceptible, S=Susceptible.

** Average percentage of leaf area infected.

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