EFFECT OF IRRIGATION FREQUENCY ON THE DISEASES INCIDENCE OF SOME LEGUME CROPS IN UPPER EGYPT

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Abstract

Disease incidence (root-rot/wilt) increased 2-3 folds as the number of irrigations of legume crops (chickpea, lentil, and faba bean) was increased.

The population density of bacteria, and fungi, and of *Fusarium* spp. were lower in the rhizosphere and surrounding soil of tested with the decrease in irrigation frequency.

Fusaruim solani, F.oxysporum, Rhizoctonia solani, and *Sclerotinia sclerotiorum* were the most frequently isolated fungi from diseased stem and root samples of faba bean, lentil and chickpea receiving more irrigation.

INTRODUCTION

Food legume crops (faba bean, lentil, and chickpea) are important human food and animal feed in Egypt and in many other countries in the world. They are attacked by numerous diseases, which cause tremendous quantitative and qualitative losses in yield in the field. (Yahia et al, 1994).

Number of irrigations affects the cultivation and growth of the plants as well as the root-rot/wilt disease complex, which is considered the most important disease affecting the productivity of these crops in Egypt (Abou- Zeid *et al.*, 1997).

Plants grown in highlly wet soil were more susceptible to infection by many disease causing agents. Arafa (1965) found that infection of cumin by wilt (*F.oxysporum f.sp. cumini*) was favored by decreasing the periods between irrigation. Also, El-Shabrawy *et al.* (1987) showed that excess of nitrogen and irrigation increased susceptibility of onion bulbs to neck rot caused by *Botrytis allii.*

The present work was designed to study the effect of irrigation frequency on some legume crops and population density of microflora in the rhizosphere with respect to disease incidence.

MATERIAL AND METHODS

Field experiments were carried out in 2000/2001 season at the Experimental farm of Shandeweel Research Station, Sohag. Three winter legume field crops (*i.e.* faba bean, cvs. Giza 402, Giza 674 and Giza 429; lentil, cvs. Giza 9 and Sinna 1; and chickpea, cvs. Giza 1, Giza 2, and Giza 88) were grown in naturally infested soil using a split plot design with 3 replicates. Each Plots, 3.5 m^2, consisted of 5 ridges, 15 cm apart. Normal methods of legume crops cultivation were used. Natrually infested soil was then heavily watered, winter crops were sown five days after soil irrigation and subjected to the following treatments.

Irrigation:

_ Faba bean, four irrigation treatments *i.e.*, 4, 5, 6, and 7 irrigations at 30 to 35 days for the first irrigation after sowing, followed by other irrigations at 14 days interval were carried out during the growing season.

_ Chickpea, four irrigation treatments, 1, 2, 3 and 4 irrigation at 30 days intervals, but the first and second treatments, seedlings chickpea were sprayed with water at the rate 3000 liter/ feddan water for each.

_ Lentil, three irrigation treatments i.e., 0, 2, and 3 irrigation at 21 days intervals, but seedlings not irrigated were sprayed with water three times at the rate 3000 liter/ feddan for each.

_ The disease incidence of each crop were counted weekly during the growing season and also precentage of survival plants were recorded after 120 days.

The population density of bacteria, fungi and *Fusarium* spp. was estimated per/g dry weight of soil. These estimations were carried out on 3 replicates at the three stages of plant growth, *i.e.* seedling, vegetative and flowering stages (30, 60, and 90 days after planting, respectively) in the rhizosphere of legume crops plants and surrounding soil with different number of irrigation. For determinations of soil microflora, soil extract yeast agar medium (Johnson and Curl, 1972) was used for bacterial flora, Martin's medium for fungi (Martin, 1950) and PCNB agar medium (Papavizas, 1967) for *Fusarium* spp.

Isolation and identification:

Roots and basal stem of diseased legume crops receiving higher number of irri-

gation, and showing typical symptoms of root-rot and wilt diseases in each crop were washed carefully with running tap water. Plants in the diseased sample were cut into small pieces, surface sterilized in 2% sodium hypochlorite for 3 min, then washed twice in sterilized distilled water. The sterilized plants were dried between two sterilized filter papers, and directly plated on PDA medium, (5 pieces/ Petri dish), then incubated at 25°C for 7 days. Emerged fungi were isolated and purified on PDA slants, then identified according to their morphological characters using compound microscope and based on the descriptions of Smith (1965), Booth (1971), Alexopoulos and Mims (1979) and Nelson *et al.*, (1983).

RESULTS AND DISCUSSION

Percentage of disease incidence increased with all tested cultivars of chickpea, as the number of irrigation during the growing season was increased (Table1). Lowest percent was noted when chickpea received one or two irrigations during the plant growth. Highest infection percentages were recorded when chickpea plants were irrigated three or four times, during the growing season. Increasing irrigation from 1 to four time increased percent of disease and decreased percent of survival plants. Cultivars tested differed as to their behavoir under different irrigation regimes. The percentages of disease were lower in Giza 88 and Giza 2 chickpea cultivars than cv. Giza 1 with all treatments used. These results are in line with those obtained by Arafa (1985) for cumin wilt and El-Shabrawy *et al.* (1987) with respect to garlic storage diseases.

Table (1): Effect of irrigation number on disease reaction of chickpea cultivars in the naturally infested soil.

No. of irrigation	Chickpea cultivars					
	Giza 1		Giza 2		Giza 88	
	Disease incidence %	Survival Plants %	Disease incidence %	Survival Plants %	Disease incidence %	Survival Plants %
1	22.4	77.6	20..3	79.7	16.0	84.0
2	32.5	67.5	22.6	77.4	14.8	85.2
3	49.3	50.7	40.7	59.3	31.1	68.9
4	51.3	48.2	46.0	54.0	36.8	63.2
LSD at 5%	8.1	6.7	7.9	5.7	4.3	5.1

Data presented in table (2) indicate that lowest percentage of diseases incidence (root-rot/wilt) were recorded when lentil was not irrigated during the growing season, but lentil seedlings were sprayed with water three times at the rate 3000 liter/ feddan for each. However, two or three irrigations increased incidence of disease and decreased the percentage of survivals. Giza 9 lentil cultivar gave the lower percentage of disease incidence and higher survival plants compared wich cv Sinna 1 under all irri-

Table (2): Effect of irrigation frequency on disease incidence of lentil cultivars in the naturally infested soil.

No. of irrigation	Lentil cultivars			
	Giza 1		Sinna 1	
	Disease incidence %	Survival Plants %	Disease incidence %	Survival Plants %
1	14.8	85.2	19.8	80.2
2	27.2	72.8	29.2	70.8
3	42.5	57.5	48.4	51.6
LSD at 5%	8.8	5.5	9.1	7.9

Table (3) indicates that disease incidence (root-rot/ wilt) of faba bean increased with increasing irrigation during the growing season. Lowest percent of disease incidence was noted when faba bean received four or five irrigations during the growth season. However, highest infection was recorded when faba plants were irrigated six or seven times. Increasing irrigation number from 4 to 7 increased percent of disease incidence 2 folds for Giza 429, 3 folds for Giza 674 and 4 folds for Giza 429 faba bean cultivars.

Data also showed that the effect of irrigation differed in faba bean cultivars. Giza 429 was the least effected followed by Giza 674 than Giza 402 faba bean cultivars when all rates of irrigation tested were used. Therefore, it could be concluded that increasing irrigation up to six or seven times increased infestation by pathogenic fungi and the incidence of faba bean diseases (Kaiser and Horner, 1980).

Table (3): Effect of irrigation frequency on the disease incidence of faba bean cultivars in the naturally infested soil.

No. of irrigation	Faba bean cultivars					
	Giza 402		Giza 674		Giza 429	
	Disease incidence %	Survival Plants %	Disease incidence %	Survival Plants %	Disease incidence %	Survival Plants %
4	22.4	77.6	18.6	81.4	11.4	88.6
5	26.7	73.3	29.2	70.8	22.8	77.2
6	45.2	54.8	41.0	59.0	29.8	70.2
7	52.9	47.1	54.4	45.6	46.2	53.8
LSD at 5%	6.3	5.1	9.4	7.7	8.9	6.6

Data in table (4) show the relation between increased irrigation and population density of fungi, bacteria, and *Fusarium* spp in the rhizosphere of crops tested and surrounding soil. The population density of rhizosphere microflora was low with the three crops tested when received less irrigation during the growing season, but increased with increased number of irrigation. Increase water around roots of the plants could contribute to the increase of both density of soil- borne pathogens and susceptibility plants to infection. These results agree to some extent with those of Arafa (1985), who showed that increasing irrigation increased populations of *Fusaruim oxysporum f.sp cumini* in the rhizosphere and soil of cumin plants. Some bacteria increased during the growing test crops, produced gibberellin or auxin or soluble phosphate, while others have been shown to alter the rhizosphere microbial flora. Yahia *et al.*, (1994) and Guy and Baker (1977) found that these by-products in the rhizosphere have shown effectiveness in transforming unavailable mineral and organic compounds into forms available to plants. It is also obvious that the increase in microbial density in the rhizosphere was, in almost all cases, greater than such an increase in the soil in response to increased irrigation. This resulted in higher R/S ratios with higher irrigation frequencies indicating more microbial activity in the rhizosphere.

Table (4): Population density of bacteria, fugi and *Fusarium* spp./g dry weight of the rhizosphere and surrounding soils of faba bean, lentil, and chickpea root grown in naturally infested soils with different irrigation.

Crop	No. of irrigation	Bacterial 1x 10^7			Fungal 1x 10^4			Fusarium 1x 10^4		
		R	S	R/S	R	S	R/S	R	S	R/S
Lentil	0	3.2[a]	4.2[a]	0.8	1.9[a]	2.1[a]	0.9	1.2[a]	1.5	0.8
	3	8.1	6.6	1.2	7.9	7.2	1.1	8	5.1	1.6
Chickpea	2	4	3.1	1.3	4	4.9	0.8	0.5	0.8	0.6
	5	6	5.4	1.1	6.8	5.6	1.2	1.1	1.5	0.7
Faba bean	4	5.5	3.3	1.6	5	3.8	1.3	0.6	0.9	0.6
	7	10	4.9	2	11	6	1.8	0.9	1	0.9

R= Rhizosphere S= Soil R/S= Ratio

i) Mean number of propagules averaged over four replications and three sampling dates.

Data in table (5) show that the most important isolated fungi from diseased root and stem when faba bean was irrigated seven times, were *Fusarium solani, F.oxysporum, Rhizoctonia solani, F. moniliforme, Verticillium albo - atrum,* and *Fusarium* spp.; and their respective occurrence frequency were 34.2, 30.4, 20.1, 6.1, and 5.0.%

Also, data clearly show that the occurrence of the most important isolated pathogens from root and stem samples when lentil received three irrigations, were *F.oxysporum* (42.4), *F. solani* (26.8), *R. solani* (22.2), *Fusarium* spp., and *F. moniliforme* (4.1). Finally, data in table (5) show that the most important root fungi and basal stem when chickpea was irrigated four times, were *Sclerotinia sclerotiorum* (29.4), *F.moniliforme* (20.5), *R.solani* (18.4) *F.solani* (16.6), *F. oxysporum* (12.2) and *Fusarium.spp.* (2.9).These results are in agreement with those obtained by El-Garhy (1994) for lentil; Nene and Sheila (1992) for chickpea and Abou-Zeid *et al.* (1997) for faba bean.

Accordingly , combined use of resistant plants and management of irrigation especially for Lentil or Chickpea crops might contribute positively to even higher degree of resistance (or tolerance) and subsequently increased yield.

Table (5): Fungi isolated from stem and root of legume crops receiving more irrigation.

Crop	Frequency (%) of isolated fungi from root and stem						
	Fusarium spp	*F. solani*	*R. solani*	*F. moniliforme*	*S. sclerotiorum*	*F. oxysporum*	*V. alboatrum*
Lentil	4.5	26.8	22.2	4.1	-	42.4	-
Faba bean	5	34.2	20.1	10.3	-	30.4	6.1
Chickpea	2.9	16.6	18.4	20.5	29.4	12.2	-
LSD at 5%	1.9	6.6	2.2	5.1	-	4.8	-

i) Mean number of times isolated from 100 root and stem segments averaged over four replications and nine sampling dates.

Some other fungi were isolated from diseased legume crops in lower frequencies, *i.e. Cephalosporium* spp, *Macrophomina phaseolina* and *Alternaria* sp.

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تأثير الرى على حدوث المرض لبعض المحاصيل البقولية فى مصر العليا

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الملخص العربى

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* الفطريات فيوز اريم سولانى، فيوزاريم أوكسيسبورم ، ريزوكتونيا سولانى، سكلير وتينيا سكليروشيورم كانت أكثر تكراراً فى العزل من العينات المريضة لسيقان وجذور كل من الفول البلدى - العدس - الحمص مع العدد الأعلى من الريات .