Research Article

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Faba bean (*Vicia faba* L.) cultivars response and effect of irrigation methods on leaf spot (*Ascochyta Fabae*) and rust (*Uromyces fabae*) diseases.

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Leaf spot and rust are one of the most important diseases Faba beans (*Vicia faba* L.) in Jordan. Present study was conducted to evaluate the effectiveness of two irrigation types (drip and sprinkler) and host resistance in three field bean genotypes on development of leaf spot and rust under Jordan valley conditions. The results provide evidence for a wide spread of diseases being the main cause of yield losses in faba beans. Chocolate spot was relatively important because of the rapid leaf loss and potential to cause yield losses, being most damaging during flowering stage. However, rust was an occasional problem in Jordan valley and occurred late in the season during podding stage. Cyprus irrigated with drip irrigation showed higher disease severity compared with other two cultivars and it showed 50% reduction in disease severity with sprinkler irrigation Minor Beck cultivar showed the least percentage of disease severity during the first two evaluations. Sprinkler irrigation markedly increased the disease severity of broad bean rust in all cultivars. Disease severity was increased from the first evaluation to the second about 165%, 96% and 140% for drip irrigated cultivars minor beck, equina and cyprus respectively, while it was increased by 140%, 90% and 75% for the same cultivars irrigated with sprinkler irrigation. In most disease severity ratings, minor beck cv. irrigated with both irrigation systems showed the highest disease severity compared with other cultivars.

Key words: Drip irrigation, Faba bean, Leaf spot, Leaf rust, Sprinkler irrigation

Faba beans (*Vicia faba* L.) are today one of the world's most important grain legumes crops. In the Middle East and North Africa is an important protein source for the people. In Jordan, the crop is grown under irrigation and rainfed for fresh pod utilization and for dry seed production. A wide range of pathogens attack Faba beans (*Vicia faba* L.). The most important Faba bean diseases in the Mediterranean region are chocolate spot (*Botrytis fabae*), and rust (*Uromyces fabae*). Although each of these diseases is quite distinctive, when two or more interact on the same plant, their combined effect becomes greater. This situation is complicated further by the presence of several races.

Serious crop losses can occur in some seasons due to leaf rust as high as 31% in non-treated verses fungicide- treated broad bean plots. The pathogen requires high humidity from 8-10 hours for spore germination and disease development. In the infection process, a germ tube grows into the stomata and from it mycelium develop inter cellularly which forms haustoria within living cells plants, eventually erupting as uredosorous (Jakupovic *et al.* 2006).

Control of broad bean rust depends primarily on host resistance, but because the pathogen has high genetic diversity and ability for new race development, resistance has not been long lasting. Protectant fungicides are registered in Jordan and used against broad bean rust but require timely and repeated application. A large number of fungi have been identified as

hyper parasites of rust fungi (Jeffries and young, 1994).

Broad bean rust caused by Uromyces fabae is one of the most important diseases in Jordan. The pathogen survives in soil and stubble and attacks all above ground plant parts (Emeran, *et al.* 2005). Different broad bean cultivars showed different responses and disease infections with rust (Bond *et al.* 1994). Leaf spot was another foliar disease and caused by *Alternaria tenuis*. The disease spread by conidiospores, is common and serious in regions with heavy rainfall, high humidity and high temperatures (24-29 ^{o}C) (Peralta *et al.* 2005). Another new leaf spot disease of Broad bean was reported in Japan and caused by Alternaria tenuissima (Rahman *et al.* 2002). The initial Symptoms were brown lesions, water soaked, circular to slightly irregular. Then the lesion enlarged and became concentric. Older leaves of the plant were particularly affected. Leaves become blighted from the margin to the center and most of the diseased plants defoliated.

Symptoms are observed on the aerial plant parts with leaves near the apical buds, dark spotted and twisted (Agrios, 2005). The extent of damage depends on the duration of the favorable conditions. Epidemics can also occur in semi-arid climates where frequent and prolonged nightly dews occur (Rotem and Reichert, 1964). Resistant cultivars are potentially the most economical control measure because they can extend the intervals between fungicide sprays while maintaining control of the disease (Keinath *et al.* 1966).

In Jordan, the disease is wide spread and relatively important because of the rapid leaf loss. The objectives of this study were to examine the effect of cultivar type and irrigation system on infection and development of leaf spot and broad bean rust under field conditions.

MATERIALS AND METHODS

The effect of drip irrigation and sprinkler irrigation on severity of broad bean rust and leaf spot was examined using 3 cultivars. These cultivars were Cyprus (large seed), Equina-Syria-1 (medium seed) and Minor Beck- Giza (small seed). These three bean cultivars were used in the experiment with 2 irrigation types distributed with factorial arrangement in a randomized complete block design with 4 replicates. Sowing was done on 9/11/2007 in 4 m long rows and the distance between rows and plants were 80 and 25 cm respectively. Each plot contained five rows. Plants were harvested on 15 May 2008. The experiment was conducted at the University farm under Jordan valley conditions. Plants were supplementary irrigated twice a week for 4 hours with sprinkler irrigation and for 12 hours for drip irrigation. Plants were naturally inoculated and infected with broad bean rust and leaf spot. After four and half months from planting, disease severity of leaf spot and broad bean rust were evaluated and repeated on weekly and biweekly basis for three times. Disease severity was measured using a scale from zero to 10 (give reference).

RESULTS

Effect of irrigation and cultivars types on leaf spot disease: Cyprus cultivar irrigated with drip irrigation and mulched with black plastic showed higher disease severity from the first evaluation compared with other two cultivars and severity decreased gradually till the last rating (Fig. 1). The same cultivar irrigated with sprinkler irrigation showed 50% reduction in disease severity compared with drip irrigation system (Fig. 1). Minor Beck cultivar showed the least percentage of disease severity during the first two evaluations. Leaf spot developed slowly on all broad bean cultivars with sprinkler irrigation, then showed spontaneous increase with no significant differences between cultivars and in respect to both irrigation methods.

In general, disease severity of leaf spot was increased at an increased rate during the evaluation period for Cyprus and Equina cultivars irrigated with sprinkler irrigation, while drip irrigation showed no consistent effects.

Effect of irrigation and cultivars types on Broad bean rust: Sprinkler irrigation markedly increased the disease severity of broad bean rust for all three cultivars and during the whole evaluation dates (Fig. 2). Disease severity was increased from the first evaluation to the second about 165%, 96% and 140% for drip irrigated cultivars minor beck, equina and cyprus respectively, while it was increased by 140%, 90% and 75% for the same cultivars irrigated with sprinkler irrigation (Fig 2). Plants irrigated with sprinkler irrigation showed an increased disease severity with an increasing rate compared with non-consistent results for drip-irrigated cultivars. In most disease severity ratings,

Figure: 1. Effect of drip and sprinkler irrigation methods on disease severity of leaf spot of three Broad bean cultivars. Each data point represents the mean of at least four replicates.

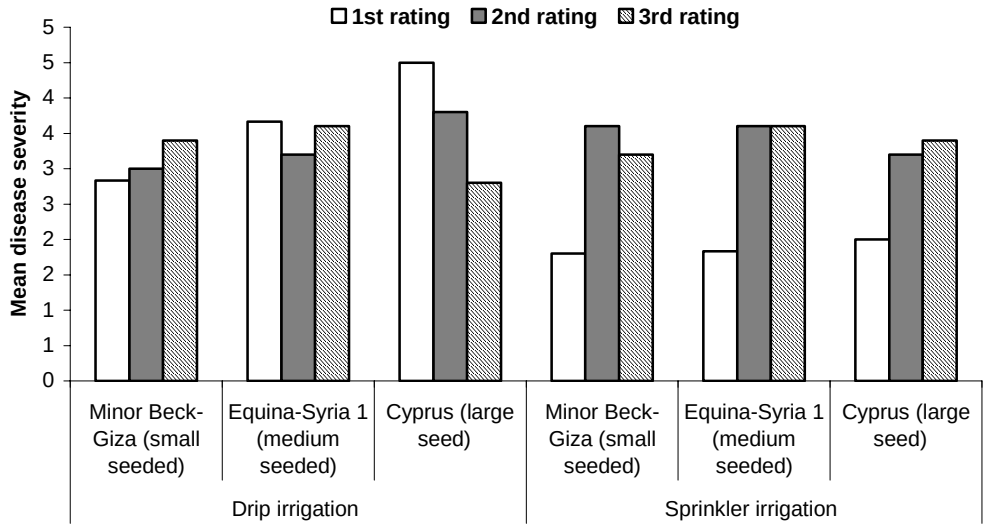
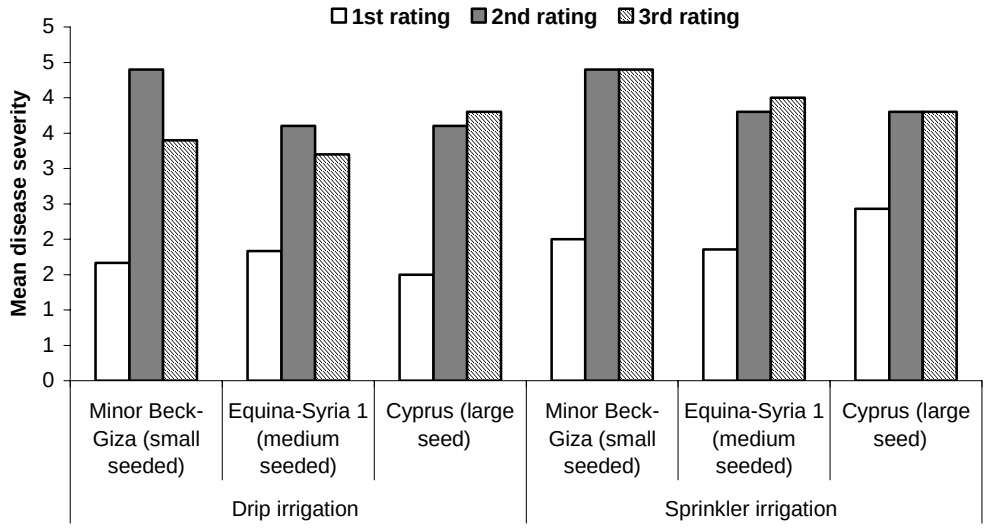


Figure: 2. Effect of drip and sprinkler irrigation methods on disease severity of Rust of three Broad bean cultivars. Each data point represents the mean of at least four replicates.



minor beck cv. irrigated with both irrigation systems showed the highest disease severity compared with other cultivars but the differences between cultivars were not at significant levels.

DISCUSSION

Disease severity of broad bean rust and leaf spot as measured by lesion numbers and it was significantly affected by irrigation type and also differ among cultivars. Wetness after disease onset was critical for broad bean rust, but the duration had little effect on subsequent development of both diseases. Sprinkler irrigation was efficient to effect pre-penetration development and penetration but probably had little effect on post penetration and fungal development. Although, lesions appeared faster and pathogen reproduction occurred faster with sprinkler irrigation than with drip irrigation treatments. The tolerance of the three cultivars to both leaf spot and rust was variable and it was reflected by variations in infection on frequency. The level of resistance for leaf spot in Cyprus cv. was lower than that in Minor Beck and Equina and was not always evident, particularly at

the last evaluation date. Previously, it has been suggested that the resistance of some lentil cultivars breaks down at late podding stage (Gosserv and Morrall 1983; Tay, 1989). An increase in susceptibility with increasing plant age has also been reported for broad bean rust (give reference). Resistance appeared to be related to tissue age. The disease attacks the youngest tissues that normally slow down during pod filling as the proportion of young tissues in the plant reduce at this stage. The apparent build up of resistance in cyprus cv. to leaf spot at the podding stage in drip irrigation is probably related to cultivar maturity. Due to early maturity this cultivar reaches the podding stage earlier and becomes more resistant than the other two cultivars. Early and late assessments of rust disease led to differential estimation of resistance under field conditions. The critical time occurred when disease severity on the susceptible genotype had crossed 90% but was less than 20% on the resistant genotype (Kushwaher *et al.* 2007). The disease assessment at critical time revealed precise differentiation between resistance and susceptible reactions in the F2 generation. Leaf spot developed much earlier on broad bean cultivars irrigated with drip irrigation than on plants irrigated with sprinkler irrigation because of the size of plant and the growth stage. Plants irrigated with drip irrigation were taller and growing much faster than the other treatments irrigated with sprinkler method. Wetness after disease onset was critical for leaf infection in case of sprinkler-irrigated plots, but after that, the irrigation type had little effect on subsequent development of leaf spot. Cyprus cultivar showed a decreased disease severity for leaf spot from the first to the last evaluation due to heavy leaf drop and fast growing habit. Infection rarely occurred in the young tissues of the plants, it was almost exclusively restricted to tissues below the top four or five nodes of the main stem and secondary branches. Irrigation type, cultivar and their interactions significantly affected disease severity.

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