

Screening of chickpea (*Cicer arietinum* L.) genotypes for earliness, yield, yield components and resistance against fusarium wilt

El – Garhy, A. M.¹ and Rahhal, M. M. H.²

¹ - Food Legumes Crop Research Section, Field Crop Research Institute, ARC, Egypt.

²-Plant Pathology Research Institute, ARC, Egypt.

Abstract

Twelve chickpea (*Cicer arietinum* L.) genotypes were evaluated for earliness, yield, yield components and resistance against fusarium wilt under field and laboratory conditions through two successive seasons; 2009/2010 and 2010/2011. Under field conditions, generally for both seasons, L 138 had the first grade in case of number of days for flowering (earliness), number of days for maturity, seed weight / plant (g), 100 seed weight (g) and seed yield / feddan (ardab). Also, the four Egyptian genotypes (Giza 88, Giza 1 and 2 and L 138) had better values than the eight ICARDA genotypes for the parameters mentioned before. At the first season the least total fusarium wilt for both seedling and podding stages were noticed in case of L 138 followed by G88 and F 97 – 195 C with averages of 11.52, 12.78 and 15.65%, respectively. At the second season it was the least with L 138 followed by F 97 – 195 C, G 88 and F 98 – 58 C with averages of 8.36, 9.55, 11.88 and 12.80%, respectively. Under laboratory conditions, chickpea genotypes leaf extracts (CLE) decreased *Fusarium oxysporum* f.sp. *ciceris* linear growth than chickpea genotypes root extracts (CRE) with averages of 3.79 and 5.88 cm., respectively. The least linear growth in case of (CLE) cleared with L 138 and F 97 – 195 C with averages of 2.05 and 2.53 cm., respectively but F 98 – 58 C had the highest value with an average of 4.84 cm. Using CRE, also L 138 and F 97 – 195 C had the best effect in reducing the fungal linear growth with averages of 2.86 and 3.62 cm. respectively.

Keywords: chickpea, *Cicer arietinum*, genotypes, fusarium wilt, earliness

Introduction

Chickpea (*Cicer arietinum* L.) is the third most important food legume grown annually on an area of about 10 m ha in about 50 countries and over 95% of its production and consumption is in the developing countries (FAOSTAT data, 2006). Its pulses have 11-28% proteins depending on the variety, 3% fiber, 3% ash, 4.8 – 5.5% oil, 38 – 59% carbohydrate, 0.3 % phosphorus and 0.2 % calcium (Hulse, 1991; Huisman and Vanderpoel, 1994; Bhatti and Soomro, 1996 and Emenky and Khalaf, 2008). Although chickpea can fix up to 140 kg N ha⁻¹ in growing season, reported values usually range from 20 to 60 kg N ha⁻¹ (Ryan, 1997).

The crop cycle in most of its traditional growing areas is completely different from the autumn germination, spring flowering and summer maturity. Reduced crop duration may also help chickpea escape damage by the major biotic- and abiotic stress that mostly affect the crop at flowering and podding stages (Kumar *et al.*, 1996; Johansen *et al.*, 1997 and Kumar and Abbo 2001). Also, Sabaghpour *et al.* (2003 and 2006) reported that, selection for early maturity chickpea line is the most important objective for escaping terminal drought stress which is the major abiotic stress for reducing chickpea productivity. In this respect, Kumar *et al.* (1996) mentioned that chickpea growing season is generally too longer for obtaining meagre mean seed

yield of about 0.8 t ha⁻¹ and this could be produced in a much shorter period. Therefore, it is dangerous to let such an attractive crop remain in the field for longer period than is necessary.

Chickpea wilt caused by *Fusarium oxysporum* f.sp. *ciceris* is one of the major yield limiting factors in chickpea. The disease caused 10 – 90% yield losses annually (Sharma and Muehlbauer, 2007). The pathogen is facultative saprophyte and can survive in soil up to six years in the absence of susceptible host (Haware *et al.*, 1986 a and b). Earlier wilting caused more loss than late wilting and seeds harvested from wilted plants were lighter and duller than those from healthy plants (Haware and Nene, 1980). In this respect, Navas - Corte's *et al.* (2000) reported that fusarium wilt reduced chickpea yield by decreasing both seed yield and seed weight. Considering the nature of damage and survival ability of the fungus, use of resistant varieties is the only economical and practical solution (Nene and Haware, 1980; Bakhsh *et al.*, 2007 and Mahmood *et al.*, 2011). So, Chaudhry *et al.* (2007) reported that progress has been made in identifying sources of resistance to wilt disease of chickpea through screening of germplasm and inheritance of the disease resistance, but Nikam *et al.* (2007) mentioned that most of the resistant varieties have been found to be susceptible after some years because of breakdown in their resistance and evolution of variability in the pathogen.

The present study is directed for screening of some chickpea genotypes for earliness, yield and resistance against fusarium wilt for escaping from drought stress and fusarium wilt which cause yield losses.

Materials and methods

Chickpea genotypes for the screening of earliness and resistance against fusarium wilt were acquired from Food Legume Research Section, Field Crop Res. Inst. ARC, Giza, Egypt named Giza 88, Giza 1, Giza 2 and L 138 and from ICARDA, Aleppo, Syria named F 95 – 14 C, F 98 – 79 C, F 98 – 233 C, F 97 – 195 C, F 97 – 167 C, F 97 – 14 C, F 98 – 173 C and F 98 – 58 C.

Field Experiments:

The experiments were conducted through two successive seasons; 2009 / 2010 and 2010 / 2011 at Etay El – Baroud Agric. Res. Station, Behera Governorate. Twelve genotypes mentioned before were sown in 22/11/2009 and 25/11/2010 for the first and second seasons, respectively. The experimental layout was randomized complete block design (RCBD) with three replications. The area of each experimental unit was 5.4 m², consisting of three ridges of 3 m in length and 0.60 m in between. Seeds were sown in hills of 20 cm apart in two sides/ ridge with 2 seeds / hill.

Fusarium wilt disease which naturally happened by *Fusarium oxysporum* was assessed at the seedling and podding stages after 30 and 120 days from sowing, respectively. The percentage of wilt incidence of each genotype was calculated and the disease reaction (DR) was determined using (1 – 9) disease rating scale given by Iqbal *et al.* (2005), where 1: highly resistance (0 – 10 % plant wilted), 3: resistant (11 – 20 % plants mortality), 5: moderately resistance (21 – 30 % mortality), 7: susceptible (31 – 50 % mortality) and 9: highly susceptible (more than 50 % mortality). Disease incidence was calculated using the following formula:

$$\text{Wilt incidence} = \left(\frac{\text{Number of wilted plants}}{\text{Total number of plants}} \right) \times 100$$

The number of days to 50 % flowering and 90 % maturity were recorded. At harvesting the following agronomic parameters were determined: plant height (cm.), number of branches / plant, number of capsules / plant, seed weight (g.) / plant, 100 seed weight (g.) and seed yield / feddan (ardab).

Laboratory Experiments:

1-Isolation, purification and identification of *Fusarium oxysporum* f.sp.*ciceris*:

The infected portions of stem and root were cut into one cm. small pieces. These were surface sterilized with 2.5 % sodium hypochlorite for a minute then rinsed in sterilized distilled water,

blottered and plated on PDA medium on 9 cm. Petri dishes and incubated at 23°C for 7 days (Elfatih *et al.*, 2002). Identification was carried out with the help of (Haware *et al.*, 1992; Barhate *et al.*, 2006 and Ahmad, 2010).

2 – Effect of chickpea leaf and root extract on fungal growth:

In order to study the role of plant extract of different chickpea genotypes on the growth of *F. oxysporum* f. sp. *ciceris*, 5 g. shoot tips and roots of each genotype were dipped in 100 ml distilled water and sieved after two hours through whatman No. 1 filter paper (Ahmad, 2010). The filtrates were vacuum filtered through sterile 0.2 µm filters (Syborn / Nalgen Co., Rochesterr NY). Sterilized dextrose water agar medium (DWA 2 %) was mixed with 10 ml water extract and poured in Petri dishes (9 cm.). After cooling, media were inoculated with 5 mm margins mycelia plug of a 7 – day – old culture of *F.oxysporum* f.sp.*ciceris* and incubated at 26±2°C (Iqbal *et al.*, 2005). The experiment conducted with four replicates and the fungal linear growth was taken 7 days after incubation.

Statistical Analysis:

Data were statistical analyzed according to Snedecor and Cochran (1981). Treatment means were compared by L.S.D. at 5 % level of probability.

Results and discussion

During chickpea growth duration, days for 50 % flowering and 90 % physiological maturity were calculated and at the end of the experiment some agronomic parameters were estimated. From results in Table (1) it is clear that, L 138 had the less number of days to 50 % flowering followed by F 97 – 195 C and G 88 with averages of 56.0, 63.0 and 67.7 days, respectively. Also, L 138 had lesser number of days for 90 % maturity with average of 132.0 day than the other genotypes which ranged from 141.3 to 144.0 days. Also, it can be noticed that the Egyptian genotypes had better averages (71.13 and 139.65 days) than ICARDA genotypes (74.03 and 142.18 days) in case of days for flowering and maturity. The differences between genotypes in the timing of flowering are in agreement with the findings of Worland (1996) who reported that the timing of flowering is dependent upon the genotype, the seasonal temperature profile, photoperiod and vernalization responses of plant. Also, Kumar and Abbo (2001) mentioned that the flowering time of chickpea genotype varies with latitude and temperature variation, thus the genes controlling flowering time are sensitive to temperature and day length. At the end of the experiment, plant height (cm.), number of branches/plant, number of capsules/plant, seed weight/plant (g), 100 seed weight (g) and seed yield/feddan (ardab) were

determined (Table 1). Data show that genotypes; F 98 – 173 C, L 138, F 98 – 233 C and F 97 – 14 C had the highest values of plant height (cm.) with averages

of 61.9, 59.5, 57.2 and 57.2 cm., respectively. In case of number of branches / plant

Table 1. Agronomic traits of twelve chickpea (*Cicer arietinum* L.) genotypes under field conditions (first season, 2009 / 2010).

Parameter Genotype	Days for flowering	Days for maturity	Plant height (cm.)	No.of branches / plant	No.of capsules/ plant	100- seed Weight/ Plant (g)	Seed weight/ Plant (g)	Seed yield/ feddan (ardab)
G 88	67.7	142.0	44.5	0.55	9.80	22.90	4.46	4.84
G 1	81.8	142.3	49.8	1.10	38.17	16.79	7.92	4.30
G 2	79.0	142.3	45.3	0.75	15.05	21.06	4.42	4.13
L 138	56.0	132.0	59.5	1.15	16.70	24.90	11.15	5.32
F 95 – 14 C	71.8	141.8	49.4	1.55	22.77	24.53	6.46	3.55
F 98 – 79 C	71.8	141.8	55.2	1.65	33.30	21.59	8.95	3.86
F 98 – 233 C	77.0	141.3	57.2	2.00	35.60	19.44	6.76	4.02
F 97 – 195 C	63.0	143.0	55.7	2.65	22.60	17.22	9.55	4.54
F 97 – 167 C	79.0	144.0	51.5	2.10	48.55	16.30	7.84	3.81
F 97 – 14 C	78.3	141.7	57.2	1.50	36.05	17.79	6.83	3.60
F 98 – 173 C	77.3	141.3	61.9	1.00	39.60	19.43	8.84	4.48
F 98 – 58 C	74.0	142.5	55.4	2.00	16.20	20.61	5.70	5.31
L.S.D. 0.05	3.05	7.96	2.24	0.31	3.30	1.47	0.75	0.59

it is clear that F 97 – 195 C, F 97 – 167 C, F98 – 233 C and F 98 – 58 C had the highest values with averages of 2.65, 2.10, 2.00 and 2.00, respectively. On the other hand genotypes, F 97 – 167 C, F 98 – 173 and G 1 had more number of capsules / plant than the other genotypes with averages of 48.55, 39.60 and 38.17, respectively. In this respect G 88 had the lowest values for the previous three traits mentioned before. As it clear from this table, L 138 had the first grade for the seed weight / plant(g) followed by F 97 – 195 C and F98 – 79 C with averages of 11.15, 9.55 and 8.95 (g), respectively. Also L 138 maintained the first grade in case of 100 - seed weight (g) followed by F 95 – 14 C and G 88 with averages of 24.90, 24.53 and 22.90 (g), respectively. Finally the same trend was noticed with seed yield / feddan (ardab) where L 138 had the highest value followed by G 88 and F 97 – 167 C with averages of 5.32, 4.84 and 4.54 ardab, respectively. The differences among the tested genotypes for their agronomic traits are in agreement with the findings of Bastawisy *et al.* (2008) who reported that this differences may be due to the presence of genetic variability in the genotypes. Or *et al.* (1999) focused on the importance of the earliness where they reported that in Mediterranean environment, early flowering might allow a longer reproduction period. Also, Johansen *et al.* (1997) mentioned that there was linear positive relationship between early crop growth and seed yield. Pathologically fusarium wilt play an important role in chickpea production where Navas - Corte's *et al.* (2000) reported that fusarium wilt reduced chickpea yield by decreasing both seed yield and seed weight. Also, Sandhu *et al.* (2007) mentioned that two super

– early chickpea breeding lines; ICCV96029 and ICCV96030 were found early in flowering and podding and produced > 2.0 t ha⁻¹ fresh green seed yield, but the acceptability of these lines was restricted due to their susceptibility to disease. On the other hand, Elfatih *et al.* (2002) reported that because of ICCV2 resistance to fusarium wilt, its earlier maturity and its higher grain yield, it is a potential variety for release in the traditional chickpea producing area of Sudan. From the above table it can be noticed that Egyptian genotypes had seed weight/plant (g), 100 - seed weight (g) and seed yield/feddan (ardab) with range between 4.42 – 11.15, 16.79 – 24.90 and 4.13 – 5.32, respectively and ICARDA genotypes between 5.70 – 9.55, 16.30 – 24.53 and 3.55 – 5.31 for the same parameters, respectively.

Under field conditions, fusarium wilt incidence of seedling stage (30 days after sowing) was determined. Results in Table (2) clear that the chickpea genotypes appeared different wilt percentages and it ranged from 5.30 to 10.99 %. L 138 had the low wilt percentage followed by G 88, F 97 – 167 C, F 95 – 14 C and G 2 with averages of 5.30, 5.48, 5.74, 6.13 and 7.17 %, respectively. In contrast, F 98 – 233 had the highest value with an average of 10.99 %. When the wilt incidence was determined at the podding stage (120 days), L 138 had the lowest value followed by F 97 – 195 C, G 88, F 98 – 173 C and F 98 – 58 C with averages of 6.22, 7.77, 8.30, 8.99 and 9.50 %. The disease reaction (DR) in the chickpea genotypes seedling stage was 1 except F 98 – 233 C which was 3, and in case of the podding stage ranged between 1 - 5 according to Iqbal *et al.* (2005). Generally, L 138 had the lower

total wilt incidence followed by G 88 and F 98 – 195 C with averages of 11.52, 12.78 and 15.65 %, respectively. The differences of the susceptibility between the two growth stages to fusarium wilt are in agreement with the findings of Ahmad *et al.* (2010) who evaluated 321 chickpea genotypes against fusarium wilt and they found that at seedling stage disease incidence varied from 0 to 29.3 % whereas at reproductive stage ranged from 0 to 57 %. In this respect, they mentioned that at seedling stage the chickpea crop stand generally remain good due to

sufficient moisture which favour the crop growth, thus there are loss chances of wilt / root rot disease. However, at the mid podding stage there are more chances of disease because of drought conditions and rise of temperature. It can be noticed that the wilt incidence of the Egyptian genotypes at seedling and podding stages range between 5.30 – 7.75 % and 6.22 – 18.43 %, respectively, but in case of ICARDA genotypes it ranged from 5.74 to 10.99 % and 7.77 – 26.99 %, respectively.

Table 2. Disease incidences of fusarium wilt on various chickpea (*Cicer arietinum* L.) genotypes at two growth stages (field experiment 2009 / 2010).

Genotype	Disease incidence				Total wilt %
	Seedling stage		Podding stage		
	Wilt %	DR*	Wilt %	DR	
G 88	5.48	1	8.30	1	13.78
G 1	7.75	1	18.43	3	26.18
G 2	6.17	1	17.03	3	23.20
L 138	5.30	1	6.22	3	11.52
F 95 – 14 C	6.13	1	13.09	5	19.22
F 98 – 79 C	9.52	1	21.41	5	30.93
F 98 – 233 C	10.99	3	26.99	1	37.98
F 97 – 195 C	7.88	1	7.77	3	15.65
F 97 – 167 C	5.74	1	11.99	5	17.73
F 97 – 14 C	9.64	1	22.67	1	32.31
F 98 – 173 C	7.42	1	8.99	1	16.41
F 98 – 58 C	7.12	1	9.50	1	16.62
Mean	7.43		14.37		

*Disease Reaction

L.S.D. 0.05 growth stage (S): 0.63

L.S.D. 0.05 genotype (G) : 1.54

L.S.D. 0.05 S x G : 2.17

The statistical analysis showed that the differences between the two growth stages, genotypes and the interaction between them are significant.

Results in Table (3) appear the agronomic traits of chickpea genotypes of the second season. Results show that days to flowering, L 138 had the first arrangement followed by F 97 – 195 C and G 88 as the same in the first season and the averages were 55.5, 65.5 and 69.3, respectively. In this respect, Murfet and Reid (1985) reported that the flowering genes influence maturity type and crop yield through their effects on the onset of reproduction, duration of reproductive phase, number of branches and number of flowers/node. On the other hand L138 and F 98 – 233 C maintained the first and second grades for the days of maturity as the first season followed by G 2 , F 98 – 233 C and F 97- 195 C with averages of 131.7, 141.7, 141.7, 141.7 and 141.7 days, respectively. In this respect, Summerfield and Robert (1988) reported that days to maturity in chickpea are untenable and generally breeders have used days to flowering as an indicator of crop duration. In practice, early flowering genotypes do

not necessarily mature early and some late flowering genotypes have a short reproductive period and mature simultaneously with earlier flowering ones.

Sabaghpour *et al.* (2003) mentioned the importance of selection for early maturity chickpea to escape end of season drought due to lack of rainfall during flowering and seed filling. Also Monpara and Dhameliya (2013) stated that since early flowering leads to early onset of productive growth, combined selection for days to flowering and flowering period would enable more gain in improving earliness of crop maturity. Take into consideration of yield component, L 138 had the highest value of seed weight / plant followed by F 98 – 79 C and G 2 with averages of 10.28, 9.94 and 9.48 (g), respectively. Also in case of 100 seed weight, L138 had the first arrangement followed by F 95 – 14 C and G 88 with averages of 24.51, 23.93 and 23.19 (g), respectively. In this respect, the highest values of seed weight / plant and 100- seed weight reflected on the seed yield/ feddan where L – 138 had the highest value of seed yield / feddan followed by G 88 and F 97 – 195 C with averages of 5.11,

4.63 and 4.36 ardab, respectively. Genotypes F 98 – 173C, L 138 and F98 – 233 C had the highest values of plant height with averages of 63.0, 60.0 and 59.0 cm., respectively. In case of number of capsules / plant, F 97 – 167 C had the highest value followed by F 98 – 173 C and G 1 with averages of 46.05, 42.95 and 41.04, respectively. Also, as it clear in the first season genotype G88 had the lowest values for

plant height, number of branches/plant and number of capsules/plant (Table 3).

It can be noticed that Egyptian genotypes had the better values for number of capsules / plant, days for flowering, days for maturity, seed weight / plant (g), 100 seed weight (g) and seed yield / feddan with averages of 23.42, 72.27, 140.10, 8.56, 21.97 and 4.45, respectively.

Table 3. Agronomic traits of some chickpea (*Cicer arietinum* L.) genotypes under field conditions (second season, 2010 / 2011).

Parameter Genotype	Days for flowering	Days for maturity	Plant height (cm.)	No.of branches/ plant	No.of capsules/ plant	100- seed weight (g)	Seed weight/ Plant (g)	Seed yield/ feddan (ardab)
G 88	69.3	143.0	45.3	0.60	11.72	23.19	8.20	4.63
G 1	83.0	144.0	50.3	1.15	41.04	17.20	6.28	4.11
G 2	81.3	141.7	45.8	0.80	17.72	22.99	9.48	3.94
L 138	55.5	131.7	60.0	1.40	23.20	24.51	10.28	5.11
F 95 – 14 C	73.0	142.2	51.0	1.65	26.37	23.93	8.40	3.13
F 98 – 79 C	72.5	142.2	56.3	1.60	36.40	22.36	9.94	3.62
F 98 – 233 C	80.7	141.7	59.0	2.10	38.20	17.84	8.80	3.78
F 97 – 195 C	65.5	141.7	56.8	2.50	23.35	21.42	9.01	4.36
F 97 – 167 C	78.0	144.0	52.5	2.25	46.05	16.14	7.29	3.50
F 97 – 14 C	77.5	142.0	58.7	1.60	37.37	17.09	7.93	3.46
F 98 – 173 C	79.5	142.2	63.0	2.10	42.95	20.63	6.70	4.19
F 98 – 58 C	73.7	142.2	58.0	1.15	17.80	20.61	5.47	3.85
L.S.D. 0.05	3.96	3.19	1.01	0.27	2.90	1.25	0.83	0.49

Generally results are closed to that of the first season where L – 138 had the highest genotypes in case of number of days to flowering, number of days to maturity, seed weight/plant (g), 100 - seed weight (g) and seed yield/feddan (ardab). These results are in agreement with the findings of Bastawisy *et al.* (2008) who reported that genotype Etay 38 gave the highest desirable significant for flowering and maturity date, number of capsules / plant and seed yield / plant. The other genotypes showed some differences in its arrangement compared with the first season.

Results in Table (4) show the disease incidence in the second season and it closed to that of the first one but with light differences in the arrangement of some genotypes. L 138 had the lowest value of the wilt incidence at the seedling stage with an average of 2.69 % followed by F 97 – 195 C, F 98 – 58 C and G 88 with averages of 3.09, 4.13 and 4.40 %, respectively. The same trend was noticed at the podding stage where the disease incidence was the lowest in case of L 138 followed by F 97 – 195 C, G 88, F 98 – 58 C and F 98 – 173 C with averages of 5.67, 6.46, 7.48, 8.67 and 8.86 %, respectively. The lowest total wilt incidence was noticed with L 138, F 97 – 195 C and G 88 with averages of 8.36, 9.55 and 11.88 %, respectively. The Egyptian genotypes at seedling and podding stages ranged between 2.69 – 7.92 % and 5.67 – 17.87 %, respectively, but in case of ICARDA genotypes it range from 3.09 to 9.46 %

and 6.46 – 26.36 %, respectively. The statistical analysis showed that the differences between the growth stages, genotypes and the interaction between them are significant.

Variation of *Fusarium oxysporum* f.sp.*ciceris* linear growth on the media containing chickpea genotypes leaf and root extracts was determined under laboratory conditions (Table 5). Generally, the fungal growth was maximum on the media containing roots extract as compared to leaves extract and these results are in agreement with the findings of Ahmad (2010) who mentioned that this proves soil borne nature of *F.oxysporum* f.sp.*ciceris*. Mycelial growth range from 2.05 to 4.84 cm. on the media mixed with leaf extracts and from 2.86 to 8.52 cm. on the others mixed with root extracts. Also, it can be noticed that the leaf and root extracts of the Egyptian cultivars; G 88, G1, G2 and the genotype L 138 had low fungal linear growth and it range from 2.05 to 4.73 cm. and 2.86 to 5.97 cm., respectively. On the other hand the genotypes obtained from ICARDA, it had more fungal linear growth than the Egyptian genotypes where it range from 2.53 to 4.84 cm. and 3.62- 8.52 cm. for leaf and root extract, respectively. The minimum mycelia growth of *F.oxysporum* f.sp.*ciceris* may be refer to the probability of its resistance to the wilt disease caused by this fungus and the maximum fungal growth to its susceptibility. These results are in agreement with the findings of Rahber- Bhatti (1986), Mukhtar

(2007) and Ahmad (2010) who reported that in some susceptible genotypes, fungal growth enhanced while in some other genotypes it was reduced and this might be due to some antagonistic properties in plants against diseases. The low fungal linear growth on the media containing leaf extracts (CLE) was noticed with L 138, F 97 – 195 C, F97 – 167 C and G 88 with averages of 2.05, 2.53, 3.66 and 3.67 cm., respectively. In case of roots extract, L 138, F 97 – 195 C, F 98 – 173 C and G 1 had the lesser linear

growth than the other genotypes with averages of 2.86, 3.62, 4.19 and 5.38 cm., respectively. In this respect, Rahhal *et al.* (1999) reported that chickpea entries shoot and root extracts had different effect on the linear growth of *Sclerotinia sclerotiorum* and the number and diameter of sclerotia / plate. The statistical analysis showed that there are significant differences between the two extracts, genotypes and the interaction between them.

Table 4. Disease incidence of fusarium wilt on various chickpea (*Cicer arietinum* L.) genotypes at two growth stages (field experiment 2010 / 2011).

Genotype	Disease incidence				Total wilt %
	Seedling stage		Podding stage		
	Wilt %	DR*	Wilt %	DR	
G 88	4.40	1	7.48	1	11.88
G 1	7.92	1	16.68	3	24.60
G 2	6.55	1	17.87	3	24.42
L - 138	2.69	1	5.67	3	8.36
F 95 – 14 C	6.02	1	11.25	5	17.27
F 98 – 79 C	9.46	1	26.36	5	35.82
F 98 – 233 C	6.02	1	20.38	1	26.40
F 97 – 195 C	3.09	1	6.46	3	9.55
F 97 – 167 C	5.68	1	12.02	5	17.70
F 97 – 14 C	7.27	1	22.02	1	29.29
F 98 – 173 C	5.00	1	8.86	1	13.86
F 98 – 58 C	4.13	1	8.67	1	12.80
Mean	5.69		13.67		

*Disease Reaction

L.S.D. 0.05 growth stage (S): 0.51

L.S.D. 0.05 genotype (G) : 1.24

L.S.D. 0.05 S x G : 1.76

Table 5. Effect of chickpea genotypes leaf extracts (CLE) and root extracts (CRE) on *Fusarium oxysporum* f.sp.*ciceris* linear growth (*in vitro*).

Genotype	<i>Fusarium oxysporum</i> f. sp. <i>ciceris</i> Linear growth (cm.)		Mean
	CLE	CRE	
G 88	3.67	5.47	4.57
G 1	4.73	5.38	5.06
G 2	3.93	5.96	4.95
L - 138	2.05	2.86	2.46
F 95 – 14 C	3.89	6.97	5.42
F 98 – 79 C	3.98	7.81	5.90
F 98 – 233 C	4.24	8.52	6.38
F 97 – 195 C	2.53	3.62	3.08
F 97 – 167 C	3.66	6.53	5.10
F 97 – 14 C	4.16	6.80	5.48
F 98 – 173 C	3.82	4.19	4.01
F 98 – 58 C	4.84	7.18	6.01
Mean	3.79	5.88	

L.S.D. 0.05 Extracts : 0.20

L.S.D. 0.05 Genotypes : 0.48

L.S.D. 0.05 E x G : 0.68

From the previous tables it is clear that L 138 is a potential genotype for release in the chickpea

producing area because of its higher seed weight/plant (g), 100 seed weight (g) and seed

yield/feddan (ardab) in addition to its earlier flowering and maturity and its resistance to fusarium wilt than the other genotypes which had different arrangements for the tested agronomic traits.

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تقييم بعض التراكيب الوراثية للحمص لصفات التبكير والمحصول ومكوناته ومقاومة الذبول الفيوزاريومي

¹ عادل الجارحي محمد ، ² محمد مجدى حمزه رحال

- 1- قسم بحوث المحاصيل البقوليه – معهد بحوث المحاصيل الحقلية – مركز البحوث الزراعيه – الجيزه
2- قسم بحوث أمراض المحاصيل البقوليه والعلف – معهد بحوث أمراض النباتات – مركز البحوث الزراعيه – الجيزه

أجريت هذه الدراسة خلال موسمي الزراعه 2010/2009 ، 2011 /2010 بمحطة البحوث الزراعيه بإيتاي البارود لتقييم 12 تركيب وراثي للحمص منها 4 تراكيب مصريه (جيزه 88 ، جيزه 1 ، جيزه 2 ، ل 138) و 8 متحصل عليها من الإيكاردا (F 95 – 14 C ، F 98 – 58 C ، F 98 – 173 C ، F 97 – 14 C ، F 97 – 167 C ، F 97 – 195 C ، F 97 – 233 C ، F 98 – 79 C) لصفات التبكير والمحصول ومكوناته ومقاومة الذبول الفيوزاريومي تحت الظروف المعملية والحقلية.

بصورة عامه تبين من قيم النتائج المحصوليه للموسمين أن التركيب الوراثي ل 138 إحتل المرتبه الأولى في صفة التبكير (عدد الأيام اللازمه للتزهير) ، عدد الأيام اللازمه للنضج ، وزن البذور / نبات (جم) ، وزن 100 بذره (جم) ، محصول البذور / فدان (أردب) لوحظ أيضا أن التراكيب الوراثيه المصريه الأربعة تميزت بقيم أعلى للصفات المحصوليه المذكوره سابقا عن التراكيب الوراثيه الثمانيه المتحصل عليها من الإيكاردا⁰ تحت الظروف الحقلية وجد أنه في الموسم الأول كان أقل نسبة ذبول فيوزاريومي خلال مرحلتى البادره وتكوين الكبسولات في التركيب الوراثي ل 138 يليه جيزه 88 ثم F 97 – 195 C بمتوسطات 11,52 ، 12,78 ، 15,65 % على الترتيب. فى الموسم الثانى تقاربت النتائج مع نتائج الموسم الأول حيث كان ل 138 الأقل فى نسبة الإصابة بالذبول يليه F 97 – 195 C ، جيزه 88 ثم F 98 – 58 C بمتوسطات 8,36 ، 9,55 ، 11,88 ، 12,80 % على الترتيب.

أظهر التركيب الوراثي ل 138 تبكيرا ملحوظا للتزهير والنضج بالإضافة لزياده فى وزن البذور / نبات، وزن 100 بذره، محصول البذور / فدان وكذلك أظهر مقاومه لإبأس بها للذبول الفيوزاريومي . لذلك يعتبر من التراكيب الوراثيه المبشره ويجب الإهتمام به وإكثاره لإدخاله ضمن الأصناف التجاريه .