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EFFECT OF SUSCEPTIBILITY OF SOME EGYPTIAN WHEAT CULTIVARS TO STRIPE RUST INFECTION ON PHYSICAL, CHEMICAL AND TECHNOLOGICAL PROSPERITIES.

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ABSTRACT

This research was carried out to study the effect of stripe rust disease infection on the quality of physical, chemical and technological characteristics of wheat grain, flours and bread produced from seven Egyptian wheat cultivars (Sakha-8, Sakha-69, Sakha-93, Gemmiza-5, Gemmiza-7, Gemmiza-9 and Giza-168) compared with uninfected (protected by fungicide) ones. Wheat cultivars were planted during three successive seasons at Sakha (Kafr El-Sheikh Governorate) experimental farm, wheat disease research section, Sakha, Agric. Res. Sta., Agricultural Research Center. (ARC), Egypt. Results of this research can be summarized as follows. Physical qualities of wheat grain of all wheat cultivars infected with stripe rust disease greatly decreased, where 1000 grain weight, hectoliter weight and flour extraction greatly decreased compared with the same protected wheat cultivars. The infected cultivar, Sakha-8 showed the highest decreased in 1000 grain weight, hectoliter weight and flour extraction rate, which were 24.3%, 13.4% and 22.6% respectively. Meanwhile Gemmiza-9 showed the lowest decrease, which amounted in 0.7%, 0.5% and 0.7% for the above mentioned characteristics respectively, compared with the same uninfected and protected (protected) cultivars. Chemical quality of flour of all wheat cultivars infected with stripe rust improved greatly, where protein, wet gluten, dry gluten ratios greatly increased compared with the same protected cultivars. Farinograph and extensograph parameters of dough of all wheat cultivars infected with rust were improved, where values of water absorption development time, stability time, extensibility, resistance to extension and dough energy increased compared with the same protected wheat cultivars dough. Baking quality and sensory of balady bread produced from infected wheat cultivars improved greatly compared with balady bread produced from the same protected cultivars, where loaf volume and total score of sensory evaluation exhibited the superior values of baking quality and sensory evaluation.

INTRODUCTION

Wheat (*Triticum spp* L.) is one of the most important food crops in all over the world. . Its status as a staple is second only to rice. One reason for its popularity is that, unlike other cereals, wheat contains a high amount of gluten, the protein that provides the elasticity necessary for excellent bread making. Although over 30,000 varieties of wheat exist, the two major types are bread wheat and durum wheat. Bread wheat (*Triticum aestivum* L.) plays a major role among the few crop species being extensively grown as staple food sources. As the human population grows, new methods and approaches must be found to attain wheat cultivars with improved characteristics. The challenge now is to produce higher-yielding varieties with good technological quality that are resistant or tolerant to a wide range of biotic and abiotic stresses. Most of the world countries are suffering from problem of wheat deficiency especially after recent financially disturbances.

Stripe rust, caused by *Puccinia striiformis* Westend f.sp. *tritici*, is one of the most important diseases of wheat in the world, considerable loss in grain yield ranging from about 40 percent to complete destruction of wheat in all over the world Saari and Prescott (1985).

In Egypt, stripe rust attacked most of the wheat cultivars during 1967 to 1995, causing severe infection in North Delta area El- Daoudi *et al*.(1996). Also, stripe rust caused high loss in the production of most Egyptian wheat cultivars in the Delta area during 1996/1997 growing season El- Daoudi (1998). It was reported in many countries and in all cold winter countries, since the disease can be disseminated thousands of kilometers across countries and oceans by wind Roelfs (1985).

Ash and Brown (1990) showed that in most cases, early stripe rust epidemics had greater effect on yield than late epidemics. Total grain yield and 1000-grain weight were most often affected. El-Daoudi *et al*. (1996) reported that wheat stripe rust caused an average loss in grain yield ranged from 14% to 20.5% in Delta region but national loss was estimated by about 10% in grain yield.

Volkova (2006) mentioned that direct yield losses on unprotected yield fields reached 30-50%. Bolat and Altay (2007) showed that calculated yield loss due to stripe rust varied among genotypes and locations with an overall range from 12.7-87.0%.

The stripe rust disease can be controlled using fungicide application. However, breeding for resistance is considered to be the most economical and environmentally suitable to reduce the degrees of pollutions.

The main objectives of this research are:

1- Studying the effects of wheat stripe rust infection on physico-chemical properties of seven Egyptian bread wheat cultivars in comparing with uninfected and protected ones.
2- Studying the effects of wheat stripe rust infection on the rheological and technological quality of flour dough of the obvious Egyptian wheat cultivars in comparing with uninfected and protected ones.
3- Helping staff of wheat breeding cultivar to select wheat cultivars characterized with high resistance for stripe rust and good technolological properties.

MATERIALS AND METHODS

Field studies:

Seven Egyptian wheat cultivars i.e. Sakha-8, Sakha-69, Sakha-93, Gemmiza-5, Gemmiza-7, Gemmiza-9 and Giza-168 (exhibited midrange of variability in their susceptibility to stripe rust). These cultivars were sown at Sakha Agric. Research Station (Kafr El-Sheikh Gov.), Wheat Disease Section, Plant Pathology Institute, Agricultural Research Center (*ARC*), during 2004/ 2007 seasons, also normal practices of growing wheat cultivars as recommended for the region were followed.

A split plot design was followed to carry out this experiment. The main plots were infected with stripe rust and protected ones, while the sub-plots were the cultivars. The experimental unit was a plot (3m long×2.5m wide).

Each plot contain six rows, each was planted by 5 gm seeds for each cultivar. The experimental received an artificial inoculation by mixture of stripe rust physiological races (0E0, 4E16, 58E6, 70E18, 74E2, 198E166 and 166E182) and talcum powder at the rate of 1:20(w: w) following the procedure adopted by Tervet and Cassel (1951). Protected plots were received application three sprayers of systemic fungicide; Sumi-8 EC 5% (a.i. *Diniconazole*) at the rate of 35 ml/100L water, starting from disease onset.

Data of stripe rust severity % were recorded on adult plants according to Peterson *et al*. (1948). At harvest, the grain yields of each cultivar (4 replicates) were mixed together and representative sample were taken for physical, chemical and technological qualities evaluation. Data represents the mean values of three seasons.

Laboratory studies:

All laboratory studies were done in Wheat Technology Section, Food Technology Research Institute (*FTRI*), *ARC*.

Physical analysis of wheat grains :

1000 grain weight, hectoliter weight, flour extraction rate, wet and dry gluten was determined according to methods of AACC (1983).

Chemical analysis :

Ash and crude protein content of grain and extracted flour were determined as the methods described in AOAC (1990).

Technological characteristics :

Rheological properties of dough :

Farinograph and extensograph were used for the determination rheological properties of dough using the methods described in AACC (1983).

Balady bread making :

Balady bread of each wheat flours using was applied methods of Attia (1986).

Baking test :

Loaf weight was carried out after one hour of baking, loaf volume was determined by rape seed displacement and specific loaf volume was obtained by dividing leaf volume by its weight AACC (1983). Sensory evaluation was carried out after one hour of baking for appearance (20), crust color (10), Layers separation (15), crumb distribution (20), odor (15) and teste (20) with total scores (100) using method of Attia (1986).

Statistical analysis:

The results were analyzed by an analysis of variance ($P<0.005$) and the means separated by Duncan's multiple range test. The results were processed Snedecor and Cochroan (1980).

RESULTS AND DISCUSSION

Table (1) show the physico-chemical properties of wheat grains of some Egyptian wheat cultivars protected and infected with stripe rust . It is clear that, the values of moisture and ash contents of protected cultivars ranged from 10.93 to11.28% and 1.26-1.97% respectively. Meanwhile, these values ranged between 8.29-8.90% and 1.5-2.73% due to the infection with stripe rust disease. This may be due to the lower extraction rates which reflect the rust consumption of carbohydrates which showed also a slight increase of protein. Concerning 1000 grain weight and hectoliter (kg/100L) it is clear that, the infection of stripe rust decreased greatly the weight of 1000 grains and hectoliter compared with the same protected wheat cultivars. This may be due to wheat grain shrinking as a result of low moisture and low carbohydrates (flour extraction). The decreasing percentage due to infection for 1000 grains showed a range of 0.7 and 24 % while it was 0.5 – 23.4 % for hectoliter compared with protected ones. This means that some of wheat cultivars under study were susceptible for stripe rust, i.e. Sakha-8 and Sakha-69 while Gemmiza-9, Sakha-93 and Giza-168 were resistance somewhat. Similar trend as that of 1000 grain and hectoliter weight were found regarding wheat flour extraction rat a Similar trend as that of 1000 grain and hectoliter weight were found. Similar results were recorded by Chen *et al*. (2002) and Wang *et al*. (2004).

Table (1): Effect of susceptibility of seven Egyptian wheat cultivars to stripe rust infection on its grain Physico-chemical properties.

Cultivars	Treatments	D.S.%	Physico-chemical properties of grain				
			Moisture %	Ash %	1000gw gm	Hectoliter Kg/100L	Flour Extraction %
Sakha-8	Protected	0	10.93^{a}±0.43	1.95^{a}±0.16	44.8^{a}±1.06	72.5^{a}±0.81	68.7^{a}±0.59
	Infected	50 S	8.29^{b}±0.21	2.73^{a}±0.28	33.9^{b}±0.80	55.5^{b}±0.29	53.2^{b}±0.61
Sakha-69	Protected	0	11.00^{a}±0.36	1.60^{b}±0.10	37.1^{a}±0.67	75.0^{a}±0.58	70.0^{a}±0.58
	Infected	40 S	8.53^{b}±0.27	2.20^{a}±0.18	30.5^{b}±0.75	65.5^{b}±0.66	60.5^{b}±0.50
Sakha-93	Protected	0	10.10^{a}±0.51	1.26^{a}±0.20	39.5^{a}±1.04	71.0^{a}±0.95	67.8^{a}±0.40
	Infected	Tr MS	8.75^{a}±0.40	1.50^{a}±0.09	39.0^{a}±0.58	70.0^{a}±0.86	66.5^{a}±0.76
Gemmiza-5	Protected	0	10.56^{a}±0.32	1.73^{b}±0.12	42.8^{a}±0.42	73.0^{a}±0.56	67.5^{a}±.39
	Infected	30 S	8.20^{b}±0.42	2.30^{a}±0.17	38.3^{b}±0.38	68.0^{b}±0.96	64.3^{b}±0.75
Gemmiza-7	Protected	0	10.60^{a}±0.41	1.90^{a}±0.10	43.3^{a}±0.62	72.5^{a}±.76	69.1^{a}±0.49
	Infected	20 S	8.70^{b}±0.47	2.10^{a}±0.19	29.5^{b}±0.50	69.0^{b}±0.58	66.5^{b}±0.29
Gemmiza-9	Protected	0	11.28^{a}±0.52	1.97^{b}±0.07	45.8^{a}±0.91	75.6^{a}±0.67	70.8^{a}±0.90
	Infected	Tr MR	8.80^{b}±0.44	2.05^{a}±0.013	45.5^{a}±0.83	75.2^{a}±1.0	70.3^{a}±0.65
Giza-168	Protected	0	11.00^{a}±0.76	1.95^{a}±0.10	37.9^{a}±0.76	71.0^{b}±.76	67.9^{a}±0.55
	Infected	Tr MS	8.90^{a}±0.55	2.15^{a}±.0.15	37.1^{a}±0.70	75.2^{a}±0.53	66.3^{a}±0.80

Values are means of three replicates ± SE. Numbers in the same column followed by the same letter are not significant difference at P>O.05.

D.S.=Disease severity, 0= Resistance, MR=Moderately resistance, MS=Moderately susceptible, S=Susceptible.

It could be concluded that, infection with stripe rust decreased 1000 grain weight, hectoliter weight and flour extraction rate greatly in Sakha-8, Sakha-69, moderately in Gemmiza-5, Gemmiza-7 and slightly in Gemmiza-9, Sakha-93 and Giza-168. Moreover wheat grain quality decreased by increasing the susceptibility to stripe rust infection.

Table (2) show the chemical properties of wheat flour extracted from protected and stripe rust infected of same Egyptian wheat cultivars. It is clear that, moisture and ash content ranged from 11.3 to 13.0% and 0.68 - 0.87% respectively of protected wheat, while it showed a values ranged from 9.55 to 12.6% and 0.7-0.96% respectively for the infected wheat. Concerning protein content, it is very clear that, the flour extracted from infected wheat grain contained higher amount of protein than that of protected wheat. Also, infected wheat flour resulted in higher contents of wet and dry gluten compared with that extracted from protected ones. This may be due to the consumption of some starch or carbohydrates by the stripe rust for growth. These data are in agreement with Hiba (2008) who reported that, protein contents of wheat increased with decreased starchy kernel content.

Table(2): Effect of susceptibility of seven Egyptian wheat cultivars to stripe rust infection on chemical composition of extracted flour.

Cultivars	Treatments	D.S. %	Chemical properties of flour				
			Moisture %	Ash %	Protein %	Wet gluten %	Dry gluten %
Sakha-8	Protected	0	$11.3^{a}\pm0.15$	$0.87^{b}\pm0.02$	$13.20^{b}\pm0.12$	$25.70^{b}\pm0.38$	$9.10^{b}\pm0.05$
	Infected	50 S	$9.55^{b}\pm0.29$	$0.96^{a}\pm0.02$	$15.30^{a}\pm0.21$	$28.90^{a}\pm0.52$	$10.30^{a}\pm0.09$
Sakha-69	Protected	0	$12.73^{a}\pm0.23$	$0.72^{b}\pm0.01$	$12.70^{a}\pm0.35$	$24.50^{b}\pm0.13$	$8.90^{b}\pm0.11$
	Infected	40 S	$11.16^{b}\pm0.33$	$0.88^{a}\pm0.02$	$13.80^{a}\pm0.31$	$27.30^{a}\pm0.47$	$9.80^{a}\pm0.08$
Sakha-93	Protected	0	$12.80^{a}\pm0.31$	$0.68^{a}\pm0.02$	$11.60^{a}\pm0.06$	$23.60^{a}\pm0.30$	$8.40^{a}\pm0.06$
	Infected	Tr MS	$12.60^{a}\pm0.41$	$0.70^{a}\pm0.01$	$11.70^{a}\pm0.12$	$23.80^{a}\pm0.17$	$8.50^{a}\pm0.15$
Gemmiza-5	Protected	0	$12.40^{a}\pm0.20$	$0.75^{b}\pm0.02$	$13.60^{b}\pm0.15$	$27.40^{b}\pm0.20$	$9.20^{b}\pm0.25$
	Infected	30 S	$11.33^{b}\pm0.17$	$0.92^{a}\pm0.01$	$14.70^{a}\pm0.37$	$28.80^{a}\pm0.35$	$10.10^{a}\pm0.06$
Gemmiza-7	Protected	0	$12.35^{a}\pm0.13$	$0.77^{a}\pm0.02$	$13.60^{a}\pm0.20$	$27.60^{a}\pm1.05$	$9.30^{b}\pm0.17$
	Infected	20 S	$11.15^{b}\pm0.08$	$0.85^{a}\pm0.03$	$14.60^{a}\pm0.33$	$28.50^{a}\pm0.25$	$10.00^{a}\pm0.06$
Gemmiza-9	Protected	0	$12.00^{a}\pm0.12$	$0.83^{a}\pm0.02$	$13.80^{a}\pm0.17$	$28.00^{a}\pm0.12$	$9.50^{b}\pm0.12$
	Infected	Tr MR	$11.80^{a}\pm0.18$	$0.85^{a}\pm0.01$	$14.00^{a}\pm0.19$	$28.20^{a}\pm0.13$	$10.40^{a}\pm0.06$
Giza-168	Protected	0	$13.00^{a}\pm0.15$	$0.80^{a}\pm0.06$	$12.00^{a}\pm0.29$	$24.40^{a}\pm0.23$	$8.90^{b}\pm0.11$
	Infected	Tr MS	12.30b±0.12	0.96a±0.02	12.70a±0.33	24.70a±0.40	9.30a±0.10

Values are means of three replicates ± SE, Numbers in the same column followed by the same letter are not significant difference at P>O.05.

D.S.=Disease severity, 0= Resistance, MR=Moderately resistance, MS=Moderately susceptible, S=Susceptible.

From the above mentioned data it could be concluded that, infected wheat with stripe rust caused an increase in ash, protein, wet gluten and dry gluten contents, with increasing its susceptibility to the stripe rust infection. Ames *et al*. (2003) and Edward *et al*. (2003) reported that protein and gluten contents generally used to assess the quality of wheat flour. They mentioned that, increased protein is accompanied by increased gluten strength. Higher protein or very strong gluten results better quality wheat flour, and plays a significant role in the end product.

The rheological properties of wheat dough of protected and infected wheat are shown in Table (3 and 4). Farinograph tests recorded that, values of water absorption, arrival time, development time and stability time were higher for infected wheat dough than protected ones. Meanwhile dough weakening value decrease as a result of infection with stripe rust compared with that protected ones. This may be due to the higher contents of protein, wet gluten and dry gluten in infected wheat flour. Cuniberti *et al*. (2003) reported that, water absorption correlates well with protein composition. Water absorption is a key parameter for evaluation of wheat quality.

Table (3) : Effect of susceptibility of seven Egyptian wheat cultivars to stripe rust infection on Farinograph prosperities of its flour dough.

Cultivars	Treatments	D.S.%	Farinograph parameter				
			Water absorption %	Arrival time (min.)	Development time (min.)	Stability time (min.)	Dough weakening B.U.
Sakha-8	Protected	0	63.3^{a}±0.17	1.0^{a}±0.0	1.5^{b}±0.12	4.0^{b}±0.13	140^{a}±2.52
	Infected	50 S	63.7^{a}±0.36	1.0^{a}±0.1	2.0^{a}±0.10	6.3^{a}±0.16	100^{b}±1.53
Sakha-69	Protected	0	61.1^{a}±0.12	0.5^{b}±0.0	1.0^{b}±0.10	3.0^{b}±0.11	140^{a}±2.89
	Infected	40 S	61.5^{a}±0.35	1.0^{a}±0.1	1.5^{a}±0.06	4.0^{a}±0.07	130^{a}±2.52
Sakha-93	Protected	0	55.6^{b}±0.71	0.5^{b}±0.0	1.0^{b}±0.12	2.5^{b}±0.06	160^{a}±2.80
	Infected	Tr MS	65.0^{a}±0.39	1.0^{a}±0.0	1.5^{a}±0.06	3.5^{a}±0.10	140^{b}±3.20
Gemmiza-5	Protected	0	64.4^{b}±0.23	0.5^{b}±0.0	1.0^{a}±0.10	3.5^{b}±0.10	140^{a}±2.42
	Infected	30 S	67.0^{a}±0.25	1.0^{a}±0.0	1.5^{a}±0.15	4.0^{a}±0.06	120^{b}±1.10
Gemmiza-7	Protected	0	62.7^{b}±0.31	0.5^{b}±0.0	1.5^{a}±0.10	3.5^{a}±0.25	140^{a}±1.05
	Infected	20 S	64.5^{a}±0.29	1.0^{a}±0.10	1.5^{a}±0.0	4.0^{a}±0.15	130^{b}±0.68
Gemmiza-9	Protected	0	60.0^{a}±0.23	1.5^{a}±0.06	1.5^{a}±0.06	4.0^{a}±0.09	130^{a}±1.53
	Infected	Tr MR	60.7^{a}±0.26	1.5^{a}±0.10	1.5^{a}±0.06	4.0^{a}±0.12	130^{a}±2.08
Giza-168	Protected	0	62.0^{b}±0.58	1.0^{a}±0.10	1.5^{a}±0.10	2.5^{a}±0.21	150^{a}±0.58
	Infected	Tr MS	66.0^{a}±0.56	1.0^{a}±0.15	1.5^{a}±0.20	3.0^{a}±0.15	140^{b}±1.0

Values are means of three replicates ± SE, Numbers in the same column followed by the same letter are not significant difference at P>O.05.

D.S.=Disease severity, 0= Resistance, MR=Moderately resistance, MS=Moderately susceptible, S=Susceptible.

Developing and stability time of the Farinograph mainly due to differences in protein quality. These parameters positively correlated with bread baking quality. These data are in agreement with those obtained by Uhlen *et al*. (2004) and Cunibert *et al*.(2003).Who reported that, development time and stability time of farinogram depend on polymeric protein and not on total protein amount in wheat flour. These parameters are therefore principally depended on genotype. Also Faridi and Faubion (1990) stated that, the dough development time (peak time) is an indicator of protein quality; stronger flour normally require a longer development time than that of weaker flour.

Tables (4) show the extensograph properties of wheat dough, extensograph parameters recorded that, resistance to extension (B.U.), Extensibility (mm) and proportional number (resistance to extension/Extensibility) values were higher in infected wheat dough than protected ones. Also Energy (cm2) showed the highest values for infected wheat dough compared with the protected ones. This may be due to the higher contents and quality of protein, wet gluten and dry gluten.

These data are in agreement with those obtained by Cuniberti *et al*. (2003) who reported that, dough extensibility and bake-test loaf volume in long fermentation process depend on total amount of polymeric protein in the grain or flour. Extensibility, loaf volume are in addition to genotype dependence, influence markedly by environmental effects such as N availability. Also, Uhlen *et al*. (2004) reported that, the composition of gluten subunits are indirectly related to baking quality via the quantity or the size distribution of the glutenin polymer, which are essential for the mixing requirements and the resistance of the dough. Also, they mentioned that, increased protein content, however, generally increased dough extensibility. In addition, Cuniberti *et al*. (2003), stated that, the incremental increase of gliadin with increasing grain protein content is highest followed by polymeric protein while albumin-globulin content much lower. This and earlier studies suggested that, no single rheological parameter has potential in predicting the baking quality of different bread wheat. All rheological parameters of dough correlated with bread quality Autio *et al*. (2001).

It could be concluded that, the dependence of various quality parameters on protein composition can useful as a guide for manipulating specific character trait in wheat breeding programs. The rheological data showed to be relevant for many cereal laboratories where these instruments are relied on for prediction of end-use quality.

Table (4): Effect of susceptibility of seven Egyptian wheat cultivars to stripe rust infection on Extenograph barometries to its dough.

Cultivars	Treatments	D.S.%	Extensograph parameter			
			Resistance to extension R (B.U.)	Extensibility E(mm)	Proportional number R/E	Energy (cm^2)
Sakha-8	Protected	0	$270^{b}\pm4.70$	$100^{a}\pm5.29$	$2.7^{b}\pm0.17$	$30^{b}\pm5.0$
	Infected	50 S	$540^{a}\pm7.64$	$115^{a}\pm3.06$	$4.7^{a}\pm0.3$	$73^{a}\pm4.04$
Sakha-69	Protected	0	$240^{b}\pm3.51$	$135^{a}\pm3.10$	$108^{a}\pm0.12$	$56^{a}\pm3.0$
	Infected	40 S	$260^{a}\pm3.79$	$150^{a}\pm4.80$	$1.7^{a}\pm0.06$	$57^{a}\pm2.52$
Sakha-93	Protected	0	$150^{b}\pm6.02$	$165^{a}\pm1.15$	$0.9^{a}\pm0.1$	$32^{b}\pm0.58$
	Infected	Tr MS	$220^{a}\pm3.06$	$120^{b}\pm2.08$	$1.3^{a}\pm0.15$	$48^{a}\pm3.79$
Gemmiza-5	Protected	0	$180^{b}\pm5.25$	$120^{a}\pm0.88$	$105^{a}\pm0.25$	$32^{b}\pm1.20$
	Infected	30 S	$300^{a}\pm5.78$	$125^{a}\pm3.6$	$2.4^{a}\pm0.23$	$60^{a}\pm2.31$
Gemmiza-7	Protected	0	$120^{b}\pm1.15$	$120^{a}\pm5.0$	$1.0^{a}\pm0.06$	$25^{b}\pm0.78$
	Infected	20 S	$160^{a}\pm5.51$	$120^{a}\pm5.10$	$1.3^{a}\pm0.21$	$35^{a}\pm1.05$
Gemmiza-9	Protected	0	$110^{b}\pm2.31$	$115^{a}\pm7.5$	$1.0^{a}\pm0.12$	$18^{b}\pm4.0$
	Infected	Tr MR	$170^{a}\pm7.64$	$115^{a}\pm1.15$	$1.5^{a}\pm0.19$	$31^{a}\pm1.0$
Giza-168	Protected	0	$130^{b}\pm1.73$	$150^{a}\pm1.2$	$0.9^{a}\pm0.06$	$28^{a}\pm1.15$
	Infected	Tr MS	$210^{a}\pm2.52$	$150^{a}\pm4.0$	$1.4^{a}\pm0.20$	$30^{a}\pm0.51$

Values are means of three replicates ± SE, Numbers in the same column followed by the same letter are not significant difference at P>O.05.
0= Resistance, MR=Moderately resistance, MS=Moderately susceptible, S=Susceptible.

Table (5) show the organoleptic and baking properties of Balady bread produced from protected and stripe rust infected wheat flour. It is clear that, organoleptic properties values of bread wheat produced from infected wheat showed good quality in all caltivars compared with bread produced from protected wheat flour. The total scores ranged from 85 to 95% for infected wheat bread; meanwhile it ranged from 80 to 93% in protected wheat bread. This may be due to the increase of protein, wet and dry gluten in infected wheat flour which reflected on increasing of proportion number (resistance to extension / extesibility), and energy (cm^2) parameters of extensograph.

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Also baking properties show that, the loaf volume and specific loaf volume (loaf volume / loaf weight) increased due to infection compared with protected bread which were ranged from 285 to 595 cm^3 and 3.2 to 6.4 cm^3 / gm versus 365 to 546 cm^3 and 2.9 to 5.4 cm^3 / gm for infected and protected wheat bread respectively. This may be due to the higher content and quality of protein of infected wheat flour. These data are in line with the data reported by Cuniberti *et al*. (2003), who found that, extensibility and loaf volume are in addition to genotype dependence, influenced markedly by environmental effects such as N availability. Also Uheln *et al*. (2004) reported that, differences in baking quality related to differences in gluten protein composition and in particular to high molecular weight glutenin subunits, which are essential for mixing requirement and resistance of the dough. Also, they reported that increased protein content however, generally increase dough extensibility. Therefore it can be concluded that protein content and protein quality have major influence of the baking potential of wheat flour.

Conclusion

From data revealed through this research, it could be concluded that, 1000 grain weight (gm), hectoliter weight (kg/100L) and flour extraction of wheat grain for infected wheat cultivars decreased by increasing the susceptibility to infection by stripe rust. The high cultivars negatively affected were Sakha-8> Sakha-69> Gemmiza-5> Gemmiza-7> Giza-168> Sakha-93, while Gemmiza-9 unaffected. On the other hand, protein, wet gluten, dry gluten and ash content increased in the flour of infected wheat cultivars compared with the flour of the same protected ones. Rheolegical tests showed increment of water absorption, development time dough stability, extensibility, resistance to extension and dough energy in infected wheat dough compared with protected wheat dough of the same wheat cultivars. Sensory evaluation and baking tests, showed increasing of total scores of organleptic properities, loaf volume and specific loaf volume in infected wheat bread, compared with protected wheat bread. Finally Gemmiza -9 has highly resistance, meanwhile Gemmiza-5 and Gemmiza-7 moderately affected by stripe rust but Sakha-93 and Giza-168 slightly affected.

Although the infected wheat produced good Balady bread its very important to select wheat resistant cultivar to stripe rust disease to decrease the loss of wheat yield and decrease the gape between production and imported wheat.

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دراسة تأثير الإصابة بالصدأ الأصفر على الصفات الطبيعية والكيماوية والتكنولوجية لبعض أصناف القمح المصري

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أجري هذا البحث بهدف دراسة تأثير الإصابة بمرض الصدأ الأصفر على جودة الصفات الطبيعية والكيماوية والتكنولوجية لحبوب القمح ودقيقه والخبز الناتج من سبع أصناف من القمح المصري (سخا-٨، سخا-٦٩، سخا-٩٣، جميزة-٧، جميزة-٧، جميزة-٩، جيزة-١٦٨) والتي تم زراعتها في ثلاث مواسم متتالية (٢٠٠٤ إلى ٢٠٠٧) في محطة بحوث سخا الزراعية ضمن تجارب قسم بحوث أمراض القمح، ومقارنتها بنفس الأصناف السابقة غير معداه بل وحميت من الإصابة برش مبيد سومى-٨ ثلاث مرات بمجرد ظهور الإصابة.

وكانت النتائج كما يلي:

١- انخفضت صفات الجودة الطبيعية في محصول جميع أصناف القمح المصابة بالصدأ الأصفر مقارنة بغير المصابة، حيث انخفض بدرجة كبيرة في وزن ال١٠٠٠ حبه، وزن الهيكتوليتر ونسبة استخلاص الدقيق. وكان الصنف سخا-٨ أكثرها انخفاضاً ونسبتها ٢٤.٣%، ٢٣.٤%، ٢٢.٦% على التوالي، بينما كان الصنف جميزة-٩ أقلها انخفاضاً ونسبتها ٠.٧%، ٠.٥%، ٠.٧% في وزن الألف حبة، وزن الهيكتوليتر، نسبة استخلاص الدقيق على التوالي.

٢- بينما ارتفعت صفات الجودة الكيماوية لدقيق محصول أصناف القمح المصابة بالصدأ الأصفر مقارنة بغير المصابة. حيث زادت نسبة البروتين والجلوتين الرطب والجاف في دقيق الأصناف المصابة مقارنة بغير المصابة.

٣- سببت الإصابة بمرض الصدأ الأصفر تحسن صفات العجين في جميع الأصناف المختبرة بمقارنتها بغير المصابة. أظهرت نتائج اختبارات الفارينوجراف والاكستنسوجراف زيادة كل من: نسبة امتصاص المياه، زمن نضج العجين، زمن ثبات العجين، مطاطية العجين وذلك مقارنة بصفات العجين من نفس أصناف القمح غير المصابة بنفس المرض.

٤- تحسنت صفات جودة الخبز والصفات الحسية في الخبز الناتج من دقيق محصول أصناف القمح المختبرة والمصابة بالصدأ الأصفر، حيث زادت قيم حجم الخبز وقيم الجودة الحسية بدرجة أفضل وأكثر من مثيلاتها في الخبز الناتج من دقيق محصول نفس الأصناف غير المصابة بنفس المرض.

قام بتحكيم البحث

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Table(5): Organoleptic and baking properties of bread from infected and protected seven Egyptian wheat cultivars against stripe rust.

Cultivars	Treatments	D.S.%	Appearance	Crust color	Layer	Crumb distribution	Odor	Taste	Total scores	Laof weight	Loaf volume	Volume/ weight
			20	**10**	**15**	**20**	**15**	**20**	**100**	**gm**	**Cm^3**	**Cm^3/gm**
Sakha-8	Protected	0	15^a ±0.68	8^a ±0.50	15^a ±1.30	10^b ±1.53	13^a ±0.59	15^a ±1.53	80^a ±4.0	120^a ±2.52	425^b ±2.51	3.5^b ±.29
	Infected	50 S	17^a ±0.9	10^a ±0.51	15^a ±0.98	16^a ±1.53	14^a ±1.01	18^a ±.60	90^a ±2.89	100^b ±1.15	435^a ±1.25	6.4^a ±0.2
Sakha-69	Proteced	0	16^a ±0.29	9^a ±1.15	13^a ±1.53	15^a ±2.41	12^a ±1.0	15^a ±0.95	80^a ±2.3	100^a ±1.59	535^b ±1.31	5.4^a ±0.15
	Infected	40 S	17^a ±0.65	10^a ±1.15	14^a ±0.95	16^a ±2.63	12^a ±.60	16^a ±0.9	85^a ±2.53	100^a ±1.15	560^a ±2.0	5.6^a ±0.25
Sakha-93	Protected	0	20^a ±0.67	10^a ±0.48	15^a ±2.0	15^a ±4.51	13^a ±.69	17^a ±1.02	90^a ±1.53	115^a ±3.61	425^b ±3.1	3.6^b ±.20
	Infected	Tr MS	20^a ±0.70	10^a ±0.4	15^a ±1.0	18^a ±4.0	13^a ±1.42	17^a ±0.70	93^a ±2.20	100^a ±5.0	465^a ±2.5	4.6^a ±0.2
Gemmiza-5	Protected	0	15^a ±0.38	10^a ±1.15	13^a ±1.53	13^a ±1.0	14^a ±1.53	15^a ±1.0	80^b ±3.21	125^a ±3.0	525^b ±4.73	4.2^b ±0.1
	Infected	30 S	16^a ±1.10	10^a ±.87	15^a ±1.0	16^a ±1.0	14^a ±1.15	19^a ±1.53	90^a ±1.15	110^b ±3.21	595^a ±3.51	5.4^a ±0.12
Gemmiza-7	Protected	0	18^a ±0.60	10^a ±1.53	12^a ±1.0	15^a ±0.81	14^a ±0.88	16^a ±0.99	85^a ±0.58	117^a ±1.0	480^b ±5.0	4.1^b ±0.06
	Infected	20 S	19^a ±1.10	9.0^a ±0.54	13^a ±0.50	16^a ±1.15	13^a ±1.0	15^a ±1.0	85^a ±2.31	100^b ±1.0	550^a ±3.0	5.5^a ±0.25
Gemmiza-9	Protected	0	19^a ±0.60	10^a ±0.41	14^a ±2.0	16^a ±0.71	15^a ±2.52	19^a ±1.47	93^a ±1.73	122^a ±3.0	546^a ±3.0	4.5^a ±0.12
	Infected	Tr MR	19^a ±0.62	10^a ±0.98	14^a ±0.58	17^a ±1.15	15^a ±2.52	20^a ±1.22	95^a ±2.89	110^b ±1.0	530^b ±2.52	4.8^a ±0.11
Giza-168	Protected	0	17^a ±0.90	10^a ±1.21	13^a ±1.0	14^a ±2.0	12^a ±1.73	18^a ±0.65	84^a ±2.21	125^a ±1.53	365^a ±2.32	2.9^a ±0.06
	Infected	Tr MS	19^a ±1.0	10^a ±0.79	12^a ±2.0	15^a ±0.63	12^a ±1.1	18^a ±1.05	56^b ±1.10	119^b ±1.01	285^b ±1.08	3.2^a ±0.13

Values are means of three replicates ± SE. Numbers in the same column followed by the same letter are not significant difference at $P>0.05$.
D.S.=Disease severity, 0 = Resistance, MR=Moderately resistance, MS=Moderately susceptible, S=Susceptible.