Iraqi J. Agric. Vol.15 No.2 pp.169–175 Oct./2010

HOST REACTION OF IRAQI WHEAT CULTIVARS AND HYBRID LINES TO BUNT CAUSAL AGENTS

M.A. Al-Hamdany J. A. Sabar H.A. Abas
H.Y. Jaber M. S. Khatar N. R. Shuraida

ABSTRACT

Host reaction of 24 Iraqi registered and released wheat cultivars along with 34 hybrid lines [F6 of (Mexipak X R-24) X Saber beg with the causal agents of wheat bunt (*Tilletia tritici* and *T. laevis*) were investigated. The seeds were inoculated with teliospores (0.5 g/100gm wheat seeds) and planted in wet soil at Tuwaitha and Zuffrania Experimental Stations in 2005-2007 seasons. Data of disease responses of Iraqi cultivars revealed that almost all the Iraqi bread wheat cultivars including the landrace cultivars such as Abo-Ghraib, Tamoz 2, IPA 99, Latifiya and Iraq are highly susceptible. Disease incidence of these cultivars ranged from 71.83 to 33.25%. However, Mexipak, Salii and Waha- Al-Iraq showed moderate susceptible to susceptible reactions. Similar results were observed on the hybrid lines, where 29 are highly susceptible, 4 are susceptible and one line showed moderate susceptible reaction. Thus, the percentages of disease response of the tested wheat genotypes were, 87.04, 7.41, 3.70, and 1.85 for highly susceptible, susceptible, moderate susceptible and resistant reactions respectively, based on slightly modified scale suitable for Iraq.

INTRODUCTIN

Wheat bunt or common bunt or stinking smut or hill bunt or covered smut is a seed-born disease incited by two species of Tilletia, *T. tritici* (Bjerk.) Wint. (Syn. *T. caries*) and *T. laevis* Kűhn (Syn. *T. foetida*. Its one of the most potentially very important plant disease in almost wheat growing regions in the world. This disease however, was recognized as an infectious disease in the 18th century, and by 1807, a microorganism was associated with its cause for the first time (25). Despite the huge using of seed dressing fungicide for disease control in particular in the developing countries, the disease continuously produce important quantity and quality yield losses, when fungicides were not used or were not correctly applied (2, 6, 19). The secondary loss caused by this disease is due to grain contamination with toxic bunt spores (16). Therefore, control of common bunt is crucial for the production of quality wheat because at field severity, less than 0.1% infected wheat spikes might be enough to make the seeds unsuitable for food without expensive and very time-consuming cleaning (8). In contrary to loose and flag smut of wheat, bunt infected spikes are not easily identified in the field until the time of crop maturity. Wheat bunt differs from those diseases in that only the seed tissues within the seed coat are completely replaced by teliospores of the causal agent. During harvesting or spike threshing, bunt balls always break and millions of teliospores contaminated the healthy seeds in particular the seed hairs. Thus, if such seeds are sown, teliospores will germinate and infect the coleoptiles (18, 25).

In Iraq, wheat bunt has been investigated in many studies since 1953 (1). Most the reported studies were concentrated on disease control (3, 5, 9, 11, 12).

Ministry of Sci. and Tech.- Baghdad, Iraq.
Received:June/2009.
Accepted:Feb./2010.

However, field survey on landraces wheat cultivars was thoroughly investigated during 1990s (2, 4, 13). Recently, heavy incidences are always observed in farmers fields in particular the fields sown by farmers seeds which had been Stored from the previous season without any treatment. In contrary to 1980s and 1990s, bunt infections were observed in wheat fields of Middle and Southern regions (4). Therefore, wheat bunt should be considered in Iraq and wheat seeds must be treated before sowing. This unusual observation might due to a critical change in the pathogen virulence or to the host reaction of the landrace cultivars. Therefore, this present paper represents the first step of a comprehensive investigation on the host: pathogen interaction by studying the disease response of the Iraqi cultivars and available wheat accessions to the bunt causal agents.

MATERIALS AND METHODS

Foundation seeds of 24 Iraqi registered or released wheat cultivars from our collection along with 34 hybrid lines of (Mexipak X R-24) X Saber beg were artificially inoculated with teliospores of a mix population of bunt causal agents (*T. tritici* and *T. laevis*) obtained from Mousil wheat fields and have been used as inocula for many seasons in Baghdad Region. The inoculum's level used was 0.5 gm teliospores/100gm of wheat seeds (16). Three experiments were conducted in Tuwaitha and Zuffrania Experimental Stations during 2005-2007. Inoculated seeds of a genotype/station were sown in three replicates of 1 m row/each using Randomized Block Design. Field plots carrying the experiments were irrigated 48 hrs prior to sowing date. Therefore, all the inoculated seeds were sown in wet soil during the third week of December. To avoid inoculum leaching from the seeds, the field plots were irrigated when more than 75% of the seedlings were emerged. Bunt incidence was calculated as a percent of diseased spikes in each replicate.Szunics scale (24) for disease response with slight modification might be very suitable in Iraq. The scale depends on the number of infected spikes from the total spikes counted as follows: infected spikes 0.0= very resistant, o.1-5. 0= resistant, 5.1-10.0= moderately resistant, 10.1-20.0= moderate susceptible instead of (10.1-30.0 in Szunics scale), 20.1-30 susceptible, and 30.1-100= very susceptible. The data of disease incidence for each station /season were statistically analyzed (23).

RESULTS AND DISCUSSION

Since bunt causal agents either *T.tritici* or *T. laevis* enters the seedling coleoptiles before emergence (14, 21, 25), long lasting emergence period due to late sowing dates i.e. time from seed sowing to seedling emergence, is highly favored infection process (14, 21). The most favorable condition for bunt infection found in this investigation was 10 to 12 days from seed sowing. This is very common when the sowing date is in the third week of December. Data of host reaction of the cultivated wheat cultivars (Table 1) obviously reflected the susceptible reaction of all cultivated Iraqi wheat cultivars. Disease incidences were ranged from 71.83 to 19.4%, while the lowest incidence (2.62%) was found on the durum cultivar (Om-Rabee). Our results are highly different from that reported by Shams Allah (22), in particular the disease responses of wheat cultivars Tamoz 2, Iratom, Iraq, and Noor. Shams Allah in his MSc.Thesis reported that the disease incidences for these four cultivars were 5.35, 8.85, 10.39 and 16.57% respectively, therefore he characterized both Tamaze 2 and Iratom as bunt resistant cultivars. These low incidences of these cultivars could be due to early sowing (During November) where the soil temperature was higher than that occurred during the sowing date used in this investigation. However, the

high infection types observed on all tested wheat cultivars regardless their origins (Some of them like Abo-Ghraib 3, IPA 99, Hashimiya and Noor were introduced from ICARDA and CIMYIT); raise a very big question on the pathogen population in Iraq.

Table 1: Disease Incidence of Bunt causal agents on Iraqi wheat cultivars following artificial inoculation of the seeds.[1]

	Percentages of Infected Spikes at			Means of Incidences % and Disease Response[2]	
	Tuwaitha 2005-2006	Tuwaitha 2007-2008	Zuffrania 2007-2008		
Tamoze 2	57.14	48.16	55.0	53.43	HS
Tamoze 3	71.72	49.60	50.0	57.10	HS
Abo-Ghraib 3	64.50	78.00	73.0	71.83	HS
Tel-Afar 3	42.10	46.16	40.5	42.92	HS
IPA 99	34.65	51.16	48.0	44.60	HS
Latifiyah	40.0	62.83	53.0	51.94	HS
Iraq (Qaied)	43.92	26.33	29.5	33.25	HS
Oor (Melad)	34.88	39.66	42.0	38.84	HS
Ashor (Tahadi)	57.66	49.76	55.30	54.24	HS
Hashimiya	60.22	75.66	71.50	69.12	HS
Noor	46.0	38.00	38.00	40.66	HS
Sawa	63.00	59.00	72.5	64.83	HS
Madaien (Nida)	66.00	46.33	50.0	54.11	HS
Babil 113	16.28	31.93	42.00	30.07	HS
Adnanyia	49.33	54.00	46.00	49.77	HS
Salii	30.50	29.30	15.60	25.13	S
Furat[3]	35.83	40.0	31.50	35.77	HS
Dijla[3]	34.33	29.67	42.0	35.33	HS
Iratom	32.25	26.33	48.5	35.69	HS
Saber Beg	51.83	-	-	51.83	HS
Mexipack	29.16	19.5	23.1	23.92	S
Faris	-	15.10	12.7	13.9	MS
Om- Rabee	4.6	1.0	2.27	2.62	R
Waha AL-Iraq	14.0	23.33	20.89	19.40	MS
LSD 0.05	10.14	13.70	15.45	-	

1. Inoculated seeds (0.5 gm spores/100g seeds) were sown in wet soil.
2. A modified scale was used to evaluate disease response were, 0.0= highly resistance, 0.1-5.0 = resistance, 5.1-10.0 = Moderate resistance, 10.1-20.0 = Moderate susceptible, 20.1-39.0 = Susceptible and more than 30% reflect highly susceptible reaction.

In Germany, out of 52 spring wheat cultivars tested in 2001 and 2002, more than 50% of them showed bunt incidence less than 1% while the highest incidence was 36% (15). Therefore, searching and or identification effective *Bt* resistant genes against endemic pathogen virulences in Iraq is very urgent need in Iraq in order to start a breeding program for bunt resistance in wheat. Such program will be very useful in Iraq since all the landraces cultivars are highly susceptible. Moreover, such program will prevent any outbreak in bunt disease in the following seasons. The Ministry of Agricultural through the Faculty of Plant Protection, for the time being, should supply the Agricultural Directorates in Iraqi Provinces and Cities a very effective fungicide to treat the seeds of the small farmers before sowing them again.

Unfortunately, the host reactions of nearly most selected hybrid lines showed similar results as tabulated in Table (2) of 34 drought tolerant promising lines, 85.3% (29 lines) showed highly susceptible reaction and 11.7% (4 lines) were susceptible, while one hybrid line (718) could be considered as a moderately susceptible line (Table 2). Meantime a new promising resistant source of bunt disease (no infected spikes) is now under investigation (Al-Hamdany unpublished data).

The differences in bunt prevalence or incidence from season to another season observed in this investigation as showed in table 1 and 2 is a common phenomenon due to many changeable factors (7), i.e. soil moisture and temperature conditions at the time of seed germination. Cool soil temperatures between 5 to 10°C favor infection process while, 15°C might led to disease escape (18) Disease incidence of wheat bunt in the field trials varied between 0% and 38.7% and in the greenhouse between 52.9 and 100% (10). Polisenska *et al.* (20) reported severe infection on spring wheat cultivars in one season, but the infection was negligible in the next.

Table 2: Disease response of 34 wheat hybrid lines to bunt causal agents following artificial inoculation during 2005-2008 seasons in Tuwaitha and al- Zuffrania Stations.[1]

Wheat Genotypes[2]	Percentages of Infected Spikes at			Means of Disease Incidence % and Disease Response	
	Tuwaitha 2007-2008	Tuwaitha 2007-2008	Zuffrania 2007-2008		
603	44.44	47.97	51.51	47.97	HS
605	70.9	61.00	64.00	65.56	HS
606	62.0	62.81	59.80	61.53	HS
609	-	38.93	42.80	40.86	HS
610	66.94	40.33	42.2	49.82	HS
612	76.63	24.43	26.50	42.52	HS
613	39.80	35.30	36.40	37.16	HS
615A	80.8	67.98	75.10	74.52	HS
615B	63.96	41.90	42.40	49.42	HS
619	91.40	67.16	64.50	74.35	HS
621	59.30	47.73	49.30	52.11	HS
624A	74.50	58.30	64.30	65.7	HS
628	38.00	28.76	29.00	31.92	HS
630	12.5	27.13	25.0	21.54	S
633A	79.0	44.45	46.50	56.65	HS
633B	26.90	26.10	27.10	26.7	S
643	69.4	27.30	29.60	42.1	HS
649	50.60	52.80	61.20	54.86	HS
702	82.67	38.50	46.4	55.85	HS
704	86.67	78.56	83.2	82.81	HS
705	22.22	48.23	45.10	38.51	HS
707	21.20	50.70	42.60	38.16	HS
708	34.24	25.76	28.3	29.43	S
709	38.15	54.06	46.20	46.13	HS
710	35.18	51.26	47.0	44.48	HS
711	74.00	41.30	46.20	53.83	HS
712	50.40	54.36	48.4	51.05	HS
713	66.30	22.50	45.7	44.83	HS
714	58.53	33.33	35.0	42.28	HS
715	34.70	46.4	----	40.55	HS
718	21.73	18.16	19.72	19.87	MS
719	94.00	87.76	91.20	90.98	HS
720	93.25	63.44	39.4	65.36	HS
721	29.73	23.37	29.52	27.54	S
LSD 0.05	6.80	7.11	12.40	-	

1. Contaminated seeds (0.5 g teliospores/100g wheat seeds) were sown in 48hrs pre-irrigated field plots in the third week of December every season.
2. Hybrid lines (F7) were selected from the cross Mexipak X R-24 X Saber beg.

Regarding the classification of disease response in wheat bunt interaction, some scale designate resistant reaction if disease incidence is less than 10%, while the susceptible reaction is characterized by showing more than 40% (26). This study suggested or recommended a new scale for evaluation the host reaction of bread wheat. This suggestion is based on the fact that factor of primary loss is 0.925 of disease incidence (17), and the fact that if there is less

than 0.1% infected spikes in any wheat field, the seeds of that field is unsuitable for food (18) nor sowing next season (Bashir and Al-Hamdany unpublished data), therefore the modified Szunics scale used in this investigation is highly suitable for resistance designation in Iraqi wheat cultivars to meet the requirements of registration a genetic resources or released new wheat cultivars to the farmers by the Iraqi Committee of Registration and Release of Agricultural Cultivars. Finally, to understand how bunt disease is very important in wheat, the production of certified wheat fields must have no more than 7 bunted spikes per 150 m^2.

REFERENCES

1- Al-Adami, A. R. (1953). A Preliminary List of Plant Diseases in Iraq. Ministry of Agriculture, bull., (17):14.

2- Al-Baldawi, A. A. (1993). Occurrence and importance of wheat and barley diseases in Iraq. Pages 105-113 In: Proc. Workshop on the Technology Transfer in the Production of Cereals and Legumes, September 20-22, 1993, Mosul, Iraq,

3- Al-Baldawi, A.A.; R. A., Shally; and N.N., Abdul-Rahman (1981). Effect of some fungicides in controlling covered smut of wheat. Yearbook of the Faculty of Agricultural Applied Researches, 2: 63-68.

4- Al- Maroof, E.M.; A.K. Hussein and D.A. Mushel (2005) Status and distribution of wheat bunt disease in Iraq. Arab journal of plant Prot., 23: 127-131.

5- Al- Maroof, E.M.; F.A. Faidh and A.I. Queli (2004). Efficiency of some fungicides in common bunt disease control in wheat. Page 329-336 In: Proc. 2nd Int. Conf. of Development and the Environment in the Arab World, March, 23-25.

6- Al-Maroof, E.M.; I.F. Ibrahim; A.A. Al- Janabi, M.O. Al-Ubaidi (1995). induced resistant mutants to wheat common bunt disease in Saber beg hybrids. Iraqi Journal of Agricultural Science, 24: 213-219

7- Anonymous (1987). Stinking Smut or Common Bunt of Wheat. Report No.12, June, 1987, University of Illinois Extension Reports of Plant Diseases.

8- Borgen, A., C. Markussen Kristensen. (1992). Common bunt. MSc Thesis, Department of plant biology and agricultural sciences, KVL. Copenhagen, p:137.

9- Daoud, A.A. and K.K. Al-Hassan. (1981). Effect of Iraqi sulfur dust and its by-product (foam) in controlling stinking smut of wheat. Yearbook of Faculty of Agricultural applied Researches, 2: 51-62.

10- Domalasova, V. and P. Bartos (2007). Reaction of spring wheat cultivars to common bunt caused by *Tilletia tritici* (Bjerk.) Wint. And *Tilletia laevis* Kűhn. Czech. J. Genet. Plant Breed., 43(3): 82-86.

11- Hassan, M.S.; N.N. Hama; A.K. Al-Tae; S. Shamsuldin and J.M. Saleh (2001). Production of new fungicides for common bunt disease control on wheat from raw local materials. Tekrit J. for Agricultural Science, 7: 79-85.

12- Hassan, M.S. and F.H. Mustafa (1981). Screening some fungicides against stinking smut of wheat. Yearbook of Faculty of Agricultural Applied Researches, 2: 45-50.

13- Ibrahim, I.F.; E. M. Al-Maroof; A.H. Mahmood; K.K. Al-Janabi and M.O. Al-Ubaidi (1988). Response of three wheat mutants to common bunt in Iraq. Indian phytopathology, 42: 153-160.

14- Kendrick, E.L. (1965). The reaction of varieties and hybrid selections of winter wheat to pathogenic races of *Tilletia caries* and *T. foetida*. Plant Dis. Rep., 49:843-846.

15- Koch, E.; R. Wachter and H. Spiess (2006). Characterization of resistance of wheat varieties and breeding lines against common bunt (*Tilletia tritici*) and dwarf bunt (*T. controversa*). Czech. Journal of Genetics and Plant breeding (Special issue), 42: 32.

16- Liatukas, P. and V. Ruzgas (2005). Genetic resources for organic wheat breeding: Impact on resistance to common bunt. Biologija, (3): 62-64.

17- Mamluk, O. F. (1998). Distribution of common bunt in wheat production belt. Euphytica, 100: 45-50.

18- Martens, J.W.; W.L. Seaman and T. G. Atkinson (1984). Diseases of Field Crops in Canada. Canadian Phytopathological Society. p:160.

19- Oncica, F. (2007). Associations of bunt resistance gene Bt8 with agronomic traits in a winter wheat (*Triticum aestivum* L.) cross. Romanian Agricultural Research, (24): 25-29.

20- Polisenska, J.; A. Pospisil, and J. Benada (1998). Effect of sowing date on common bunt (*Tilletia caries*) infection in winter wheat at lower inoculums rates. Zeitschrift für Pflanzenkrankheiten und Pflanzenschutz, 105: 295-305.

21- Purdy, L.H., and E.L. Kendrick (1963). Influence of environmental factors on the development of wheat bunt in the Pacific Northwest. IV. Effect of soil temperature and soil moisture on infection by soil borne spores. Phytopathology, 53:416-418.

22- Shams Allaha, S.A. (2005). Biological and protectional studies on covered smut disease of wheat in Iraq. MSc Thesis, Agriculture College, Baghdad. Univ.

23- Snedecor, G. W. and W. G. Cochran. (1976). "Statistical Methods". Iowa State Univ. Press, Ames, Iowa, USA, p: 575.

24- Szunics, L. (1990). A scale to measure bunt resistance in wheat. Növenytermeles, 39(4): 297-304. In Biologija, (2005), 3: 62-64.

25- Wiese, M. V. (1977). Compendium of Wheat Diseases. Prepared by The American Phytopathological Society, p:106.

26- Wilcoxson, R.D. and E.E. Saari, eds. (1996). Bunt and Smut Diseases of Wheat: Concepts and Methods of Disease Management. Mexico, D. F.: CIMMYT.

مجلة الزراعة العراقية مجلد15 عدد2 ص169-175 تشرين الأول/2010

تفاعل عائل بعض أصناف وهجن الحنطة مع مسببات مرض التفحم المغطى

محمد عبد الخالق الحمداني جمال عبد الرحمن صبار حسن عبد الواحد عباس
حسن يوسف جابر مثنى شبل خطار نهى رجب شريدة

الملخص

درس تفاعل العائل 24 صنف حنطة و34 خطوط هجينة تمثل الجيل السادس من (مكسيباك X (R-24 X صابر بيك تجاه مسببات مرض التفحم المغطى في الحنطة (البنط) *Tilletia tritici* و *T. laevis*. لوثت البذور بالأبواغ التيلية وبواقع 0.5 غم أبواغ لكل 100 بذور حنطة وزرعت في تربة رطبة في التويشة والزعفرانية خلال 2005-2007. أشارت نتائج السلوك المرضي لأصناف الحنطة العراقية إلى إن معظم الأصناف وبظمنها الأصناف المزروعة بمساحات واسعة مثل أبو غريب 3، تموز 2، إباء 99، اللطيفية والعراق ذات حساسية عالية. تراوحت نسب الإصابة المسجلة على نباتات تلك الأصناف من 73.83 إلى 33.25%، بينما اتصفت الأصناف مكسيباك وسالي وواحة العراق بالحساسية والحساسية المعتدلة. لوحظت النتائج نفسها على الهجن المستخدمة في هذه الدراسة، حيث سجل تفاعل الحساسية العالية في 29 هجيناً والحساسية في 4 هجن بينما ظهر على هجين واحد (718) تفاعل الحساسية، وبشكل عام فقد بلغت النسب المئوية لمراتب السلوك المرضي لجميع التراكيب الوراثية المدروسة 87.04، 7.41، 3.70، 1.85 للحساسية العالية والحساسية المعتدلة والمقاومة على التوالي اعتماداً على مدرج مطور قليلا يناسب العراق.

وزارة العلوم والتكنولوجيا- بغداد، العراق.