International Journal of Engineering & Technology, 7 (4.38) (2018) 737-740

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper

Common Bunt Resistance of Winter Wheat Genotypes Under Artificial Infection

Kuttymurat Tagayev[1], Aleksey Morgounov[2], Minura Yessimbekova[3], Aigul Abugalieya[3]

[1]*Kazakh National Agrarian University, Abay Avenue, 8, Almaty, A26M8G3, Kazakhstan*
[2]*CIMMYT, P.K. 39 Emek, Ankara, 06511, Turkey*
[3]*Kazakh Research Institute of Agriculture and Plant Growing, Erlepesova street 1, Almalybak village, Almaty region, B42Y1G2, Kazakhstan*
**Corresponding author E-mail: tagayev.k@mail.ru*

Abstract

Common bunt (*Tilletia caries*) is a seed-transmitted fungal disease in wheat. The resistant cultivars and germplasm lines of wheat will be useful for control this type of disease in organic farming. A set of 75 wheat cultivars and lines from International Winter Wheat Improvement Program (IWWIP) of Turkey were used to determine resistance to common bunt. The experiment was carried out at the Kazakh Research Institute of Agriculture and experimental material was grown in an artificially inoculated nursery during the 2016-2017 season. The productivity of wheat genotypes under artificial infection ranged from 1.13 t/ha to 7.29 t/ha. The susceptible check to common bunt, GEREK 79 had a high level of susceptibility to common bunt with 59.7% infected heads. The high mean disease incidence in the nursery was 74.4%. Sixteen genotypes were resistant to disease under artificial inoculation. Out of 75 wheat cutivars, 42 wheat genotypes (56% of all genotypes) were classified as moderate resistance to disease. Identified resistance genotypes will be useful for breeding programs for forming resistance cultivars to common bunt in Kazakhstan.

Keywords: *Common bunt; Productivity; Resistance; Wheat; Wheat cultivars; Wheat lines.*

1. Introduction

Kazakhstan is one of the major wheat producers in the world. The climatic conditions on the Northern Side are very favorable to cultivate cereal crops. The most important sector in agriculture of Kazakhstan is wheat production. Among the CIS countries, Kazakhstan enters the top of three leaders, ranking third after Russia and Ukraine. However, diseases and pests also play an important role in yield reduction in Kazakhstan. Common bunt, known as smut disease is caused by two fungi *Tilletia tritici* and *T. laevis*. This disease occur all wheat-planting regions of the world [1, 2]. It is a dangerous wheat disease, known since ancient times, and produce spore-contaminated seeds [3]. The disease spread in all wheat-growing regions [4]. The common bunt spores, which are from previous crop contaminated seeds, are developed and multiplied, inside the developing in wheat seedlings stage, when the plant attains full maturity stage, they convert the kernel of the wheat into toxic mass of bunt spores. It causes yield loss in common wheat [5, 6] and decrease yield quality via the developing of black mass of fungus, which gives smell like fish odor [7]. Suppression of bunt diseases using chemical fungicides is possible by treatment of the seeds, but this way is not effective constantly, and it neither is best choice to control this disease, because cost of fungicides is high, also dangerous for human health, animal health and environment. In addition, chemical treatment is not allowed under organic farming conditions. Although the seed treatment of wheat using fungicides for the control of wheat fungi diseases is widespread. However use of genetic resistance cultivars of wheat is effective and not dangerous way of the disease control in the most of countries, particularly on organic agriculture.

Use of resistant varieties may reduce the losses due to bunt drastically globally. Infection levels in highly susceptible cultivars exceed 80% of diseased spikes, while in highly resistant cultivars only 0% diseased spikes were observed [8]. The most effective and economic beneficial method of the control of wheat fungi diseases is using bunt resistant cultivars of wheat [3, 9, 10]. The study of identification of sources of resistance to disease is important for forming resistant wheat cultivars and advanced lines via conventional breeding. Investigation for resistance to common bunt and identification of new sources of resistance are required particularly under organic agriculture conditions [11].

The goal of this study was to identifiy the resistance of wheat cultivars and lines to common bunt under artificial infection. Genetic analysis has also been carried out to evaluate the inheritance of the common bunt resistance.

2. Materials and Methods

Common Bunt Resistant Nursery (CBUNT- RN 2015-2016) was prepared and distributed by the International Winter Wheat Improvement Program of Turkey. This nursery was combination of different types of germplasm lines resistant to common bunt (75 wheat genotypes from 7 countries –Turkey, Iran, Kazakhstan, Mexico, Romania, Russia, and USA). The experiments of artificial inoculation with spores of common bunt were conducted in the field condition, in the farming research blocks of Kazakh Research Institute of Agriculture and Growing, Almalybak, Almaty region, Kazakhstan, during the period 2016-2017. The experiments were conducted in a randomized design using three replications. Firstly,seed treatment of wheat seeds with fungicides, and then

150 seeds have sown from each wheat germplasm. Artificial inoculation of the seeds with spores has done by methods of Borrgardt-Anpilogova [12], using a mixture of isolates from southeast part of Kazakhstan. The spores were obtained from naturally infected plants from the fields of Scientific Research Institute for Biological Safety Problems, Otar, Kazakhstan. For inoculation usage of doses of spores were optimal according to Dumalasova V. and Bartos P. [13]. To provide a total infection, the seeds of wheat cultivars and lines were treated using dose of 0.08 g spores per 150 seeds according to Nielsen B,J, [14]. The seeds of wheat cultivars and advanced lines were planted in October and in the spring, at the heading stage of wheat, phytopathological evaluation of common bunt in the field condition was carried out. The phytopathological scoring was studied at the heading stage of wheat by the visual evaluation of the infected spikes during the period of June and July, by detecting the black colored spikes at the infected plants, distributed to the husks and, at maturity, the kernels contain dark mass of pathogen colored spores. The total identification of resistance wheat cultivars and advanced lines has done by counting the number of susceptible wheat plants to the total number of sowed plants of each cultivar and line. The evaluation tests has been carried out by scale of Krivchenko which provide level of percent (%) of infected ears [15].

3. Results and Discussion

The 2016-2017 years were very favorable for evaluation of common bunt resistance. The productivity of wheat genotypes under artificial infection ranged from 1.13 t/ha to 7.29 t/ha. The susceptible check, GEREK 79, had a high level of susceptibility to common bunt with 59.7% infected heads (table 1). This high level of infection in the susceptible check on cultivar GEREK 79 confirmed that the common bunt infection was successful. Goates (1996) [3] suggested that common bunt resistance evaluation should be considered valid when a susceptible check had more than 50% infected heads. The two resistant winter genotypes, MUFITBEY and NACIBEY, had similar degrees of resistance with 10.1 and 2.0% infected heads, respectively. The high mean disease incidence in the nursery was 74.4%. Among 75 lines tested genotypes from CBUNT International nursery, 16 genotypes were resistant to disease under artificial inoculation: PBW343*2/KUKUNA//ATAY/CALVEZ/3/ATAY/GALVEZ87, ORKINOS-1/SUNR23//SONMEZ, ATAY/GALVEZ87/6/TAST/SPRW/4/ROM-TAST/BON/3/DIDO//SU92/CI13645/5/F130L.12, MADSEN/MALCOLM//ZARGANA-9/3/BURBOT-6, RINA-6/ORKINOS-7, DE9//MERGAN-2,ORKINOS-1*2/3/AUS GS50AT34/SUNCO//CUNNINGHAM, KS902709-B-5-1/BURBOT-4, RANA96/GANSU-3, RINA-6/BEZ/NAD//KZM(ES85.24)/3/F900K, ALMT*3/7/VEE/CMH77A.917//VEE/6/ CMH79A.955/4/AGA/3/SN64*4/CNO67//INIA66/5/NAC, BEZOSTAYA/AE.CYLINDRICA, BEZOSTAYA/TR.MILITINAE//TR.MILITINAE-6, BEZOSTAYA/TR.MILITINAE// TR.MILITINAE-4,CV.RODINA/AE/SPELTOIDES(10 KR) and OSTROV. It is 21.3% of all studied wheat genotypes. The other 42 wheat genotypes (56% of all genotypes) expressed moderate resistance, which infected around 2.0-27.3% of ears. The ten wheat lines were susceptible, which showed 31.4-48.2% of incidence to common bunt infection: TILA/BABAX//PASTOR/4/TAST/SPRW//ZAR/3/ATAY/ GALVEZ87,KUPAVA/BURBOT-4// PYN/2*BAU, KRASNODAR/FRTL/6/ NGDA146/4/YMN/TOB//MCD/3/ LIRA/5/F130L.12,87-461 a 63-555/4/ERIT58-87//KS82W409//SPN/3/KRC66/SERI, ALD/SNB// ZARRIN/3/YACO/2*PARUS, QUDS*3/MV17,SANZAR-8/KKTS, MRS/CI14482// YMH/HYS/3/ RONDEZVOUS/4/ABI 86*3414X84W063-9939-2//KARL92,KS92WGRC-25 and F08034G1. These genotypes were as susceptible to common bunt. For the tested genotypes, the winter wheat genotypes had a high very susceptibility (seven genotypes; 87-461 a 63-555//SAULESKU#26/PARUS/3/AGRI/NAC//ATTILA, SAULESKU#44/ TR810200//GRISET-4, KUPAVA/BURBOT-4//PYN/2*BAU, SAULESKU# 44/TR810200//ZGI, TSAPKI/FARMEC, F07270G2 and susceptible check GEREK 79) to common bunt. On base of received results, which confirmed our assumption that these genotypes are susceptible to the race of south Kazakhstan common bunt.

Table 1: Common bunt resistance of wheat genotypes

#	Genotype	Origin*	% bunted ears	Yield, t/ha
1	MUFITBEY (resistant check)	TCI	10.1	6.08
2	NACIBEY (resistant check)	TCI	2.0	2.17
3	GEREK79 (susceptible check)	TR-ESK	59.7	2.63
4	PBW343*2/KUKUNA//ATAY/CALVEZ/3/ATAY/GALVEZ87	TCI	0.0	3.68
5	87-461 a 63-555//SAULESKU#26/PARUS/3/AGRI/NAC//ATTILA	TCI	57.2	4.44
6	ORKINOS-1/SUNR23//SONMEZ	TCI	0.0	4.50
7	ATAY/GALVEZ87/6/TAST/SPRW/4/ROM-TAST/BON/3/DIDO//SU92/CI13645/5/F130L.12	TCI	0.0	3.35
8	MADSEN/MALCOLM//ZARGANA-9/3/BURBOT-6	TCI	0.0	4.17
9	RINA-6/ORKINOS-7	TCI	0.0	2.58
10	SAULESKU#44/TR810200//GRISET-4	TCI	57.2	7.29
11	ATTILA/BABAX//PASTOR/4/TAST/SPRW//ZAR/3/ATAY/GALVEZ87	TCI	47.8	2.77
12	BURBOT-4/3/OMBUL/ALAMO//MV11	TCI	6.1	2.12
13	FRTL//AGRI//NAC/3/BONITO-36/4/ERIT58-87//KS82W409/SPN/3/KRC66/SERI	TCI	11.9	1.92
14	GUN91/MNCH*2//T-2003	TCI	15.4	3.63
15	KRASNODAR/FRTL/6/NGDA146/4/YMN/TOB//MCD/3/LIRA/5/F130L.12	TCI	11.1	6.24
16	TJB368-251/BUC//SMUT1590-165/3/KS7866-15/ORS8425/4/NE87U119/CHAM//1D13.1/MKT	TCI	4.6	1.80
17	SHARK/F44105W2.1//AUS4930.7/2*PASTOR/3/ORKINOS-1	TCI	26.5	6.08
18	GANSU-1/3/AUS GS50AT34/SUNCO//CUNNINGHAM/4/ORKINOS-1	TCI	4.2	4.83
19	BURBOT-4/3/OMBUL/ALAMO//MV11	TCI	9.3	4.81
20	KUPAVA/BURBOT-4//PYN/2*BAU	TCI	54.8	3.05
21	DE9//MERGAN-2	TCI	0.0	2.12
22	KRASNODAR/FRTL/6/NGDA146/4/YMN/TOB//MCD/3/LIRA/5/F130L.12	TCI	8.6	6.17
23	362K2.111//TX71A1039.VI*3/AMI/3/ES14/130L1.12//MNCH	TCI	10.0	5.20
24	SELYNKA/MERGAN-1	TCI	23.1	1.70
25	91-142 A 61/KATIA1//GRIZET-4	TCI	10.0	4.70
26	KUPAVA/BURBOT-4//PYN/2*BAU	TCI	31.4	5.67
27	KRASNODAR/FRTL/6/NGDA146/4/YMN/TOB//MCD/3/LIRA/5/F130L.12	TCI	34.5	4.25

28	ORKINOS-1*2/3/AUS GS50AT34/SUNCO//CUNNINGHAM	TCI	0.0	4.35
29	87-461 a 63-555/4/ERIT58-87//KS82W409//SPN/3/KRC66/SERI	TCI	32.5	1.55
30	SAULESKU#44/TR810200//ZGI	TCI	50.0	4.50
31	KRASNODAR/FRTL/6/NGDA146/4/YMN/TOB//MCD/3/LIRA/5/F130L.12	TCI	15.4	5.50
32	TAM200/KAUZ/4/CHAM6//1D13.1/MLT/3/SHI4414/CROW	TCI	21.2	2.80
33	SHARK/F44105W2.1//CHARA/3/MERGAN-1	TCI	15.6	3.98
34	ALPU/VR5053(WA#FM/201/23*2/GS50A)	TCI	25.0	3.73
35	KS902709-B-5-1/BURBOT-4	TCI	0.0	5.55
36	JCAM/EMU//DOVE/3/JGR/4/THK/5/BOEMA	TCI	12.9	3.20
37	BATERA//KEA/TOW/3/TAM200/4/494J6.11/TRAP#1/BOW/5/TX96V2427	TCI	6.1	2.70
38	BATERA//KEA/TOW/3/TAM200/4/494J6.11/TRAP#1/BOW/5/TX96V2427	TCI	5.9	5.27
39	ORKINOS-1/4/JING411//PLK70/LIRA/3/GUN91	TCI	15.4	2.12
40	GRIZET-4/3/ID#840335//PIN39/PEW/4/LILIA BG/GT	TCI	17.9	4.55
41	KAMBARA1/ZANDER-17	TCI	27.3	2.20
42	ADMIS/5/SMB/HN4//SPN/3/WTS//YMH/HYS/4/SAB	TCI	17.7	6.45
43	RANA96/GANSU-3	TCI	0.0	5.05
44	RINA-6/BEZ/NAD//KZM(ES85.24)/3/F900K	TCI	0.0	5.35
45	VORONA/3/TOB*2/7C//BUC/4/CHAM6//1D13.1/MLT/3/SHI4414/CROW	TCI	5.3	4.83
46	Son64/4/Wr51/mida//Nt.h/K117/5/Anza/3/Pi//Nor/Hys/4/ Sefid	IR	20.0	5.24
47	ALD/SNB//ZARRIN/3/YACO/2*PARUS	IR	33.3	1.93
48	SPN/MCD//CAMA/3/NZR/4/ALD/SNB*2/5/GASCOGNE	IR	6.5	2.78
49	SPN/MCD//CAMA/3/NZR/4/ALD/SNB*2/5/GASCOGNE	IR	5.9	2.58
50	CMH79A.955/4/AGA/3/4*SN64/CNO67//INIA66/5/NAC/6/CMH83.25//RSH/8/ZRN	IR	21.7	2.85
51	CMH79A.955/4/AGA/3/4*SN64/CNO67//INIA66/5/NAC/6/CMH83.25//RSH/8/ZRN	IR	13.9	2.78
52	CMH79A.955/4/AGA/3/4*SN64/CNO67//INIA66/5/NAC/6/CMH83.25//RSH/8/ZRN	IR	17.5	2.65
53	QUDS*3/MV17	IR	48.2	2.63
54	ALMT*3/7/VEE/CMH77A.917//VEE/6/CMH79A.955/4/AGA/3/SN64*4/CNO67//INIA66/5/NAC	IR	0.0	4.83
55	CROC 1/AE.SQUARROSA(224)/OPATA	MX	20.6	3.50
56	SANZAR-8/KKTS	MX	41.9	3.68
57	INTENSIVNAYA//PBW343*2//TUKURU	MX-TCI	23.4	2.83
58	TSAPKI/FARMEC	USA	57.2	6.47
59	AMCEL/KS970274/3/KS91048L-2-1/CM112793(CHL)/2*STAR)/HWK1064-6	USA	2.2	2.53
60	DORADE-5/KS980512	USA	23.8	6.35
61	OR 943576/KS920709	US--TCI	5.9	3.47
62	MRS/CI14482//YMH/HYS/3/RONDEZVOUS/4/ABI 86*3414X84W063-9939-2//KARL92	US-TCI	44.5	4.15
63	KS92WGRC-25	US	38.5	4.73
64	BEZOSTAYA/AE.CYLINDRICA	KAZ	0.0	4.51
65	BEZOSTAYA/TR.MILITINAE//TR.MILITINAE-6	KAZ	0.0	1.55
66	BEZOSTAYA/TR.MILITINAE//TR.MILITINAE-4	KAZ	0.0	3.68
67	CV.RODINA/AE/SPELTOIDES(10 KR)/S.CEREALE(1.OKR)	RUS	20.0	3.60
68	CV.RODINA/AE/SPELTOIDES(10 KR)/S.CEREALE(1.OKR)	RUS	5.4	4.37
69	CV.RODINA/AE/SPELTOIDES(10 KR)	RUS	0.0	5.68
70	F06393GP10	ROM	25.8	0.87
71	F08034G1	ROM	34.5	4.43
72	F08347G8	ROM	8.9	1.13
73	OSTROV	ROM	0.0	2.32
74	F07270G2	ROM	74.4	4.17
75	F00628G34-1	ROM	4.9	3.53

*TCI – Turkey-CIMMYT-ICARDA, TR-ESK – Turkey-Eskisher, IR – Iran, MX – Mexico, US – United States of America, KAZ – Kazakhstan, RUS – Russia, ROM – Romania

4. Conclusion

In conclusion, the common bunt infection was found to decrease the biological yield in the tested genotypes. Artificial inoculation tests for common bunt resistance showed that a large number of resistant genotypes are available in disease condition of southeast part of Kazakhstan. Sixteen genotypes can be considered as valuable resistance sources to common bunt on basis of study using wheat genotypes from CBUNT Nursery of IWWIP. Identified resistance genotypes will be useful for breeding programs to forming resistance cultivars to common bunt in Kazakhstan.

References

[1] Munjal RL (1966), Bunt disease of wheat. *Scientific Reports* 3, 33-36.

[2] Bahadur P & Singh BM (1987), Hill bunt of wheat and its importance. *International journal of tropical plant diseases* 5, 25-33.

[3] Goates BJ, Common bunt and dwarf bunt. In: Wilcoxson RD & Saari EE (1996), *Bunt and smut diseases of wheat: concepts and methods of disease management*. Mexico: CYMMIT, 12-25.

[4] Wilcoxson RD & Saari EE (1996), *Bunt and smut diseases of wheat: concepts and methods of disease management*. Mexico: CIMMYT.

[5] Holton CS (1947), Host selectivity as a factor in the establishment of physiologic races of *Tilletia caries* and *T. foetida* produced by hybridization. *Phytopathology* 37, 817-821.

[6] Goel LB & Singh DV (1975), Smuts and bunts of wheat and their control. In Raychaudhuri SP, Varma A, Bhargava KS & Mehrotra BS (Eds), *Advances in mycology and plant pathology*. New Delhi: Harsh Kumar at Sagar Printers, 131–147.

[7] Flor HH, Gaines EF & Smith WK (1932), The effect of bunt on yield of wheat. *J. Am. Soc. Agron* 24, 778-784.

[8] Dumalasova V & Bartos P (2006), Resistance of winter wheat cultivars to common bunt, *Tilletia tritici* (Bjerk.). Wint. and *T. Laevis* Kühn. *Journal of Plant Diseases and Protection* 113, 159-163.

[9] Smeltzer DG (1952), Inheritance of resistance to race T-1 of *Tilletia caries* in Minturki and Cooperatorka wheats. *Agronomy Journal* 44, 529-533.

[10] Gaudet DA & Puchalski BL (1989), Status of bunt resistance in western Canadian spring wheat and triticale. C*anadian Journal of Plant Science* 69, 797–804.

[11] Borgen A (2000), Biological control of common bunt in organic agriculture. *Journal of Crop Production* 3, 159-174.

[12] Anpilogova MZ (1958), Methods of resistance characteristics of parent materials to fungi diseases and select pair for crossing processes. In *Proc. Botanic, genetics and breeding*, 33(1), 200-320.

[13] Dumalasova V & Bartos P (2008), Effect of inoculum doses on common bunt infection on wheat caused by *Tilletia tritici* and *T. Laevis*. *Czech Journal of Genetics and Plant Breeding* 44(2), 73-77.
[14] Nielsen BJ (2003), Strategies for avoiding seed-borne diseases. In *Proceedings 11th Australian Barley Technical Symposium and 53rd Australian Cereal Chemistry Conference*. 75-79.
[15] Krivchenko VI (1971), *Methods of evaluation resistance of cereal crops to bunt diseases*. Moscow: Kolos.