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EFFECT OF COMMON BUNT INFECTION ON AGRONOMIC TRAITS AND RESISTANCE IN WINTER WHEAT LINES

Abstract. Common bunt (*Tilletia caries*) is a seed transmitted fungal disease in wheat. The resistance cultivars and lines of wheat should use to control this type of diseases in organic farming. A set of 75 wheat cultivars and lines from IWWIP of Turkey used. During the period 2016-2017, an experiment was carried out at the Kazakh Research Institute of Agriculture and Growing in an artificially inoculated nursery. The susceptible check, 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%. The sixteen genotypes were resistant to disease under artificial inoculation. The forty-two wheat genotypes (56% of all genotypes) expressed moderate resistance, which infected around 2.0-27.3% of ears. The wheat lines had different levels of agronomic traits under artificial inoculation of common bunt. The productivity of wheat genotypes under artificial infection ranged from 1.13 to 7.29 t/ha. The expected strong positive correlation was detected between the grain number and grain weight (r = 0.7), between the grain weight and TKW (r = 0.75) and the grain weight and total grain weight (r = 0.79). The negative correlation was found between the bunted ears and all agronomic traits. Identified resistance genotypes will be useful for breeding programs to forming resistance cultivars to common bunt in Kazakhstan.
Keywords: wheat, wheat cultivars, wheat lines, common bunt, resistance, productivity.

The Kazakhstan is one of the major wheat producers in the world. The climatic conditions on the north are very favorable to cultivate cereals crops. The total area planted to wheat in the country represents over 85% of total cereal production. Currently Kazakhstan produces 18-20 million tons of wheat grain, but output is highly dependent on weather and in recent years has fluctuated between 10 and 17 million tons. Kazakhstan is a major exporter of wheat and plays an important role in the food security of Central Asia [1]. However, diseases and pests also play an important role in yield reduction in Kazakhstan. Common bunt, caused by *Tilletiatritici* (Bjerk.) G. Wint. *In* Rabenh. [syn. *T. caries* (DC.) Tul. & C. Tul.) and *T. laevis* Kuhn *in* Rabenh. (syn. *T. foetida* (Wallr.) Liro.], has occurred in all wheat-growing countries of the world [2, 3]. The diseaseis largely spread in all wheat-growing regions [4]. The spores which are left on the surface of the contaminated seeds are systematically developing and multiplying, year by year, inside the growing wheat plants, when the plant reaches maturity, they transform the core of the wheat kernels into toxic fungus spores. In case of heavy incidence it is not possible to use the seed as food or feed. It causes yield loss in common wheat [5, 6] and reduces grain quality [7]. Already low doses of the spores represent a problem for seed sales and multiplication. The spores contain trimethylamine causing an unpleasant odour. Although chemical seed treatments can effectively control these diseases, especially common bunt, resistant cultivars remain desirable for bunt management in developing countries [8], for organic production of wheat, and as a lower-cost alternative to chemical treatment [9]. Although the chemical treatment of wheat seed for the control of common bunt is widely used, genetic resistance of wheat is an important part of the bunt control in many countries, especially on organic farms. Resistant varieties may reduce the losses due to bunt infection [10]. The most economic and effective way of controlling common bunt of wheat is using bunt resistance cultivars [11-13]. It is important to identify sources of wheat resistance to common bunt in order to use resistant varieties and to develop resistant cultivars through breeding effort. Testing for resistance to *Tilletia spp*. and identification of new sources of resistance are necessary especially under organic farming conditions [14]. Estimating the level of common bunt resistance is time consuming due to the need to wait until the symptoms are expressed. Symptoms happen when the grain filling period is nearly complete. The symptoms sometimes are only expressed on the last spikes formed, and the symptoms often are only expressed in a few of the florets [11]. So, understanding the effect of the common bunt on earlier agronomic traits would help in identifying the trait associated with the resistance and hence the ability to select resistant genotypes earlier rather than waiting until plant maturity. For example, it was reported that common bunt has an effect on plant height, number of heads and root length of heads [15].

Our aim of this study was to evaluate agronomic traits and resistance of wheat cultivars and lines to common bunt under artificial infection. The approach of this study was to study the effect of common bunt infection on some easily measured agronomic traits in a set of seventy-five International common bunt nursery's winter wheat genotypes. Also identification resistant and susceptiblegenotypes to know if there are differences in the response of theagronomic traits to the disease in order to determine if we can use anagronomic trait as an indicator for the level of resistance to common bunt.

Materials and methods. A set of 75 winter wheat lines from Common Bunt Resistant Nursery (CBUNT- RN 2015-2016) were used to study effect of common bunt on some important agronomic traits. This nursery was performed and distributed by the International Winter Wheat Improvement Program of Turkey and combined different type of germplasm 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 organized in the field, in the agricultural research blocks of Kazakh Research Institute of Agriculture and Growing, Almalybak, Almaty region, Kazakhstan, in the period 2016-2017. The experiments were carried out in randomized complete blocks with three repetitions. After inoculation, approximately 150 seeds have sown from each germplasm. Artificial inoculation of the seeds with spores has done by methods A.I. Borrgardt-Anpilogova [16], using a mixture of isolates of southeast part of Kazakhstan. The spores were obtained sampling natural infected plants from the field, from Scientific Research Institute for Biological Safety Problems, Otar, Kazakhstan. The doses of spores used for inoculation vary a lot [17]. In order to provide a total infection, the wheat cultivars and lines were treated separately with a higher inoculation dose of 0.08 g spores/150 seeds [18]. A winter wheat resistant (MUFITBEY and NACIBEY) and susceptible checks (GEREK79) were included to confirm the effectiveness of the common bunt inoculation protocol. The seeds were sown in the autumn and in the next year, at the heading stage, the disease could be detected in the field. The specific symptoms were evaluated at the heading stage by the visual inspection of the spikes in the month of June, when we could observe, at the infected plants, the dark coloured spikes, the spreading of the glumes and, at the maturity, the grains content transformed into a mass of dark coloured spores. The evaluation tests provided by scale Krivchenko, level of percent (%) of infected ears [19]. The resistance evaluation have done by reporting the number of susceptible plants to the total number of plants. The plant height was measured during ripening stage as the height of the plant from the ground to the tip of the plant. The length of the head was measured from the base of the head to the tip after the plants completely emerged. Number of spike was measured by counting of all spikes in one plant. The number of grain per spike was measured by counting all the grains in one general spike. The grain weight per spike, 1000 kernel weight and total grain weight were measured on mature plants that had not been watered for seven days as the average grain weight, weight of 1000 grains and weight of all grains, respectively. Statistical and correlation analysis were provided using Excel 2010.

Results and discussion. Resistance to common bunt. A mixture of common bunt teliospores from races for field in southeast part of Kazakhstan induced a different reaction on wheat lines of International CBUNT Nursery. The winter susceptible check, GEREK 79, had a high level of susceptibility to common bunt with 59.7% infected heads (table). 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 resistance winter genotypes, MUFITBEY and NACIBEY, had similar degrees of resistance with 10.1 and 2.0% infected heads, respectively. The high mean disease incidencein 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. Ten wheat lines were susceptible (31.4-48.2% infected ears) and seven lines were very susceptible(up to 50% infected ears) to common bunt infection.

Common bunt resistance and agronomic traits of wheat genotypes

#	Name of wheat lines	Plant height, Cm	Head length, Cm	Spike num-ber	Grain number/ Spike	Grain weight/ spike, g	1000 kernel weight, g	Total grain weight, g	% bunte-dears	Grain yield, t/ha
1	2	3	4	5	6	7	8	9	10	11
1	MUFITBEY (resistant check)	120,0	12,0	25,0	83,0	3,8	45,7	30,5	10.1	6.08
2	NACIBEY (resistant check)	105,0	10,0	19,0	61,0	1,8	29,5	16,6	2,0	2,17
3	GEREK79 (susceptible check)	116,0	9,0	19,0	47,0	0,7	14,8	12,7	39,7	2,63
4	PBW343*2/KUKUNA//ATAY/CALVEZ /3/ATAY/GALVEZ87	85,0	11,0	21,0	56,0	1,0	17,8	14,3	0,0	3,68
5	87-461 a 63-555//SAULESKU#26/ PARUS/3/AGRI/NAC//ATTILA	85,0	11,0	25,0	80,0	2,7	33,7	18,5	57,2	4,44
6	ORKINOS-1/SUNR23//SONMEZ	115,0	13,0	23,0	79,0	3,5	44,3	22,2	0,0	4,50
7	ATAY/GALVEZ87/6/TAST/SPRW/4/R OM-TAST/BON/3/DIDO//SU92/ CI13645/5/F130L.12	125,0	14,0	23,0	79,0	3,7	46,8	28,7	0,0	3,35
8	MADSEN/MALCOLM//ZARGANA-9/3/BURBOT-6	130,0	12,0	21,0	52,0	2,0	38,4	12,5	0,0	4,17
9	RINA-6/ORKINOS-7	115,0	12,0	25,0	64,0	2,4	37,5	15,0	0,0	2,58
10	SAULESKU#44/TR810200//GRISET-4	100,1	12,0	21,0	73,0	2,2	30,1	20,0	57,2	7,29
11	ATTILA/BABAX//PASTOR/4/TAST/SP RW//ZAR/3/ATAY/GALVEZ87	90,1	12,0	23,0	78,0	2,9	37,1	22,0	47,8	2,77
12	BURBOT-4/3/OMBUL/ALAMO//MV11	100,1	12,0	23,0	71,0	2,4	33,8	19,0	6,1	2,12
13	FRTL//AGRI//NAC/3/BONITO-36/4/ERIT58-87//KS82W409/SPN/3/ KRC66/SERI	105,1	10,0	19,0	50,0	1,7	34,0	10,2	11,9	1,92
14	GUN91/MNCH*2//T-2003	105,1	11,0	21,0	67,0	2,6	39,0	21,0	15,4	3,63
15	KRASNODAR/FRTL/6/NGDA146/4/Y MN/TOB//MCD/3/LIRA/5/F130L.12	120,1	11,0	25,0	84,0	3,5	41,6	25,6	11,1	6,24
16	TJB368-251/BUC//SMUT1590-165/3/KS7866-15/ORS8425/4/ NE87U119/CHAM//1D13.1/MKT	125,1	13,0	23,0	71,0	3,2	45,0	24,5	4,6	1,80
17	SHARK/F44105W2.1//AUS4930.7/2*PA STOR/3/ORKINOS-1	100,1	10,0	21,0	78,0	2,3	29,4	19,1	26,5	6,08
18	GANSU-1/3/AUS GS50AT34/SUNCO// CUNNINGHAM/4/ORKINOS-1	95,1	12,0	21,0	63,0	2,8	44,4	27,2	4,2	4,83
19	BURBOT-4/3/OMBUL/ALAMO//MV11	95,1	11,0	21,0	60,0	1,5	25,0	17,0	9,3	4,81
20	KUPAVA/BURBOT-4//PYN/2*BAU	90,2	12,0	21,0	57,0	2,2	38,5	16,0	54,8	3,05
21	DE9//MERGAN-2	125,2	14,0	21,0	59,0	2,5	42,3	21,0	0,0	2,12

Continuation of table

1	2	3	4	5	6	7	8	9	10	11
22	KRASNODAR/FRTL/6/NGDA146/4/YMN/TOB//MCD/3/LIRA/5/F130L.12	125,2	12,0	23,0	70,0	2,8	40,0	21,8	8,6	6,17
23	362K2.111//TX71A1039.VI*3/AMI/3/ES14/130L1.12//MNCH	120,2	11,0	21,0	74,0	2,0	27,0	18,6	10,0	5,20
24	SELYNKA/MERGAN-1	125,2	10,0	19,0	50,0	1,8	36,0	15,2	23,1	1,70
25	91-142 A 61/KATIA1//GRIZET-4	120,2	11,0	21,0	65,0	2,6	40,0	18,2	10,0	4,70
26	KUPAVA/BURBOT-4//PYN/2*BAU	100,2	11,0	19,0	50,0	1,3	26,0	16,5	31,4	5,67
27	KRASNODAR/FRTL/6/NGDA146/4/YMN/TOB//MCD/3/LIRA/5/F130L.12	115,2	11,0	23,0	65,0	2,7	41,5	16,0	34,5	4,25
28	ORKINOS-1*2/3/AUS GS50AT34/SUNCO//CUNNINGHAM	135,2	12,0	23,0	57,0	2,4	42,1	19,2	0,0	4,35
29	87-461 a 63-555/4/ERIT58-87//KS82W409//SPN/3/KRC66/SERI	110,2	13,0	23,0	57,0	2,5	43,8	19,3	32,5	1,55
30	SAULESKU#44/TR810200//ZGI	115,3	12,0	21,0	57,0	2,1	36,8	19,5	50,0	4,50
31	KRASNODAR/FRTL/6/NGDA146/4/YMN/TOB//MCD/3/LIRA/5/F130L.12	115,3	12,0	25,0	63,0	2,7	42,8	21,5	15,4	5,50
32	TAM200/KAUZ/4/CHAM6//1D13.1/MLT/3/SHI4414/CROW	80,3	13,0	23,0	80,0	3,3	41,2	18,8	21,2	2,80
33	SHARK/F44105W2.1//CHARA/3/MERGAN-1	100,3	10,0	21,0	65,0	2,4	37,0	17,6	15,6	3,98
34	ALPU/VR5053(WA#FM/201/23*2/GS50A)	105,3	12,0	23,0	62,0	2,0	32,2	16,4	25,0	3,73
35	KS902709-B-5-1/BURBOT-4	110,3	11,0	21,0	55,0	2,1	38,1	18,8	0,0	5,55
36	JCAM/EMU//DOVE/3/JGR/4/THK/5/BOEMA	95,3	11,0	21,0	80,0	2,2	27,5	18,0	12,9	3,20
37	BATERA//KEA/TOW/3/TAM200/4/494J6.11/TRAP#1/BOW/5/TX96V2427	105,3	10,0	21,0	55,0	1,6	29,0	12,8	6,1	2,70
38	BATERA//KEA/TOW/3/TAM200/4/494J6.11/TRAP#1/BOW/5/TX96V2427	95,3	12,0	21,0	63,0	2,0	31,7	15,1	5,9	5,27
39	ORKINOS-1/4/JING411// PLK70/LIRA/3/GUN91	125,3	14,0	25,0	76,0	3,1	40,7	25,8	15,4	2,12
40	GRIZET-4/3/ID#840335//PIN39/ PEW/4/LILIA BG/GT	120,4	13,0	23,0	90,0	2,8	31,1	17,8	17,9	4,55
41	KAMBARA1/ZANDER-17	95,4	14,0	25,0	72,0	2,1	29,1	18,7	27,3	2,20
42	ADMIS/5/SMB/HN4//SPN/3/WTS//YMH/HYS/4/SAB	100,4	11,0	21,0	66,0	2,3	34,8	20,8	17,7	6,45
43	RANA96/GANSU-3	125,4	12,0	23,0	74,0	3,1	41,8	21,2	0,0	5,05
44	RINA-6/BEZ/NAD// KZM(ES85.24)/3/F900K	110,4	11,0	22,0	49,0	2,1	42,8	14,3	0,0	5,35
45	VORONA/3/TOB*2/7C//BUC/4/CHAM6//1D13.1/MLT/3/SHI4414/CROW	110,4	9,0	21,0	58,0	2,0	34,4	15,0	5,3	4,83
46	Son64/4/Wr51/mida//Nt.h/K117/5/Anza/3/Pi//Nor/Hys/4/ Sefid	120,4	11,0	19,0	58,0	2,8	48,2	23,4	20,0	5,24
47	ALD/SNB//ZARRIN/3/YACO/2*PARUS	70,4	9,0	19,0	72,0	2,8	38,8	18,7	33,3	1,93
48	SPN/MCD//CAMA/3/NZR/4/ALD/SNB*2/5/GASCOGNE	75,4	11,0	21,0	61,0	1,3	21,3	7,8	6,5	2,78
49	SPN/MCD//CAMA/3/NZR/4/ALD/SNB*2/5/GASCOGNE	65,4	10,0	20,0	55,0	1,3	23,6	11,5	5,9	2,58
50	CMH79A.955/4/AGA/3/4*SN64/CNO67//INIA66/5/NAC/6/CMH83.25//RSH/8/ZRN	80,5	11,0	23,0	72,0	2,2	27,7	18,1	21,7	2,85
51	CMH79A.955/4/AGA/3/4*SN64/CNO67//INIA66/5/NAC/6/CMH83.25//RSH/8/ZRN	90,5	12,0	23,0	83,0	2,5	30,1	18,0	13,9	2,78
52	CMH79A.955/4/AGA/3/4*SN64/CNO67//INIA66/5/NAC/6/CMH83.25//RSH/8/ZRN	85,5	12,0	21,0	64,0	1,8	28,1	16,0	17,5	2,65

Continuation of table

1	2	3	4	5	6	7	8	9	10	11
53	QUDS*3/MV17	95,5	11,0	21,0	67,0	2,0	28,3	16,2	48,2	2,63
54	ALMT*3/7/VEE/CMH77A.917//VEE/6/ CMH79A.955/4/AGA/3/SN64*4/CNO67 //INIA66/5/NAC	80,6	10,0	21,0	53,0	1,8	34,0	14,0	0,0	4,83
55	CROC_1/AE.SQUARROSA(224)/OPAT A	80,5	12,0	19,0	52,0	1,8	35,7	14,7	20,6	3,50
56	SANZAR-8/KKTS	90,5	11,0	21,0	72,0	2,0	30,5	16,7	41,9	3,68
57	INTENSIVNAYA//PBW343*2// TUKURU	90,5	12,0	19,0	64,0	2,0	29,6	14,5	23,4	2,83
58	TSAPKI/FARMEC	90,5	11,0	21,0	71,0	2,0	26,7	20,1	57,2	6,47
59	AMCEL/KS970274/3/KS91048L-2-1/ CM112793(CHL)/2*STAR)/HWK1064-6	95,5	12,0	19,0	56,0	2,3	41,0	19,2	2,2	2,53
60	DORADE-5/KS980512	100,6	12,0	23,0	92,0	3,5	38,0	21,0	23,8	6,35
61	OR 943576/KS920709	95,6	13,0	23,0	85,0	1,8	21,1	17,0	5,9	3,47
62	MRS/CI14482//YMH/HYS/3/RONDEZV OUS/4/ABI 86*3414X84W063-9939- 2//KARL92	90,6	13,0	21,0	60,0	1,8	30,0	20,0	44,5	4,15
63	KS92WGRC-25	110,6	11,0	19,0	49,0	1,5	30,6	13,0	38,5	4,73
64	BEZOSTAYA/AE.CYLINDRICA	120,6	14,0	29,0	81,0	3,0	37,0	25,3	0,0	4,51
65	BEZOSTAYA/TR.MILITINAE//TR.MIL ITINAE-6	140,6	16,0	24,0	97,0	3,0	30,0	20,5	0,0	1,55
66	BEZOSTAYA/TR.MILITINAE//TR.MIL ITINAE-4	140,5	14,0	24,0	49,0	1,8	36,7	20,7	0,0	3,68
67	CV.RODINA/AE/SPELTOIDES(10 KR)/S.CEREALE(1.OKR)	140,4	14,0	24,0	62,0	1,8	29,0	16,8	20,0	3,60
68	CV.RODINA/AE/SPELTOIDES(10 KR)/S.CEREALE(1.OKR)	140,0	14,0	24,0	59,0	2,0	33,8	18,7	5,4	4,37
69	CV.RODINA/AE/SPELTOIDES(10 KR)	140,7	14,0	24,0	71,0	2,6	36,6	20,2	0,0	5,68
70	F06393GP10	70,7	10,0	22,0	63,0	1,8	28,5	16,7	25,8	0,87
71	F08034G1	75,7	10,0	22,0	62,0	2,2	35,4	17,3	34,5	4,43
72	F08347G8	75,8	11,0	22,0	74,0	3,0	39,1	19,0	8,9	1,13
73	OSTROV	75,7	11,0	20,0	79,0	2,7	34,1	17,0	0,0	2,32
74	F07270G2	100,9	10,0	18,0	44,0	1,8	41,0	16,3	74,4	4,17
75	F00628G34-1	80,7	10,0	18,0	80,0	3,1	38,7	24,1	4,9	3,53

Agronomic evaluation. In the present work 9 traits were assessed on 75 winter wheat lines through 2 years grown under artificial infection of common bunt. The wheat lines had different levels of agronomic traits under artificial inoculation of common bunt. The plant and spike height were 70.4-140.7 cm and 9.0-14.0 cm, respectively. The number of spike per plant ranged from 18 to 25 spikes. The grain weight per spike was 0.7-3.8 gram. The 1000 kernel weight and total grain weight were showed different level of productivity, 14.8-48.2 gram and 7.8-30.5 gram, respectively. The productivity of wheat genotypes under artificial infection ranged from 1.13 to 7.29 t/ha.

Correlation analysis. The correlations among the nine traits were mostly similar, but in some cases, the strength of the correlations was different. The correlation coefficients were found to be highly significant at the 0.05 probability level. The moderately positive correlation was detected between the plant height and head length (r = 0.51), between the head length and number of spike (r = 0.62). Also, moderately positive correlation was found between grain number and total grain weight (r = 0.53). The expected strong positive correlation was detected between the grain number and grain weight (r = 0.7), between the grain weight and TKW (r = 0.75) (figures 1, 2).

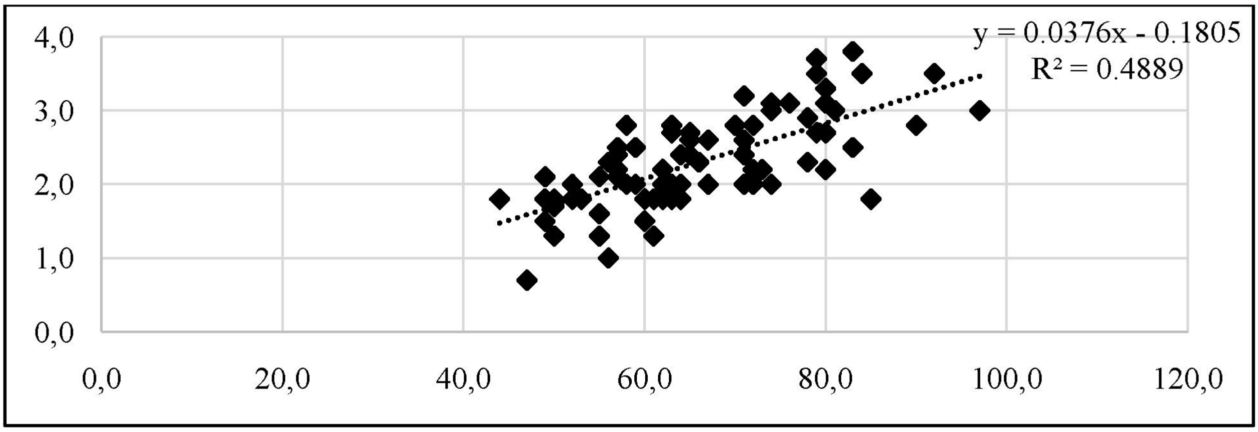

Figure 1 – The correlation coefficient of the between grain number and grain weight per spike

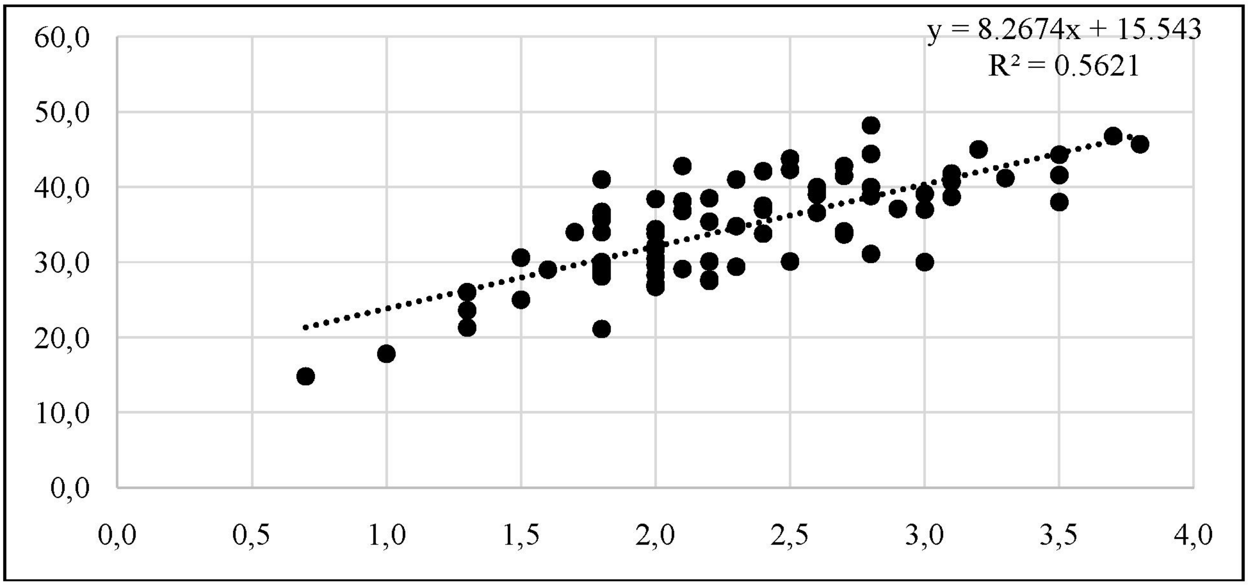

Figure 2 – The correlation coefficient of the between grain weight per spike and TKW

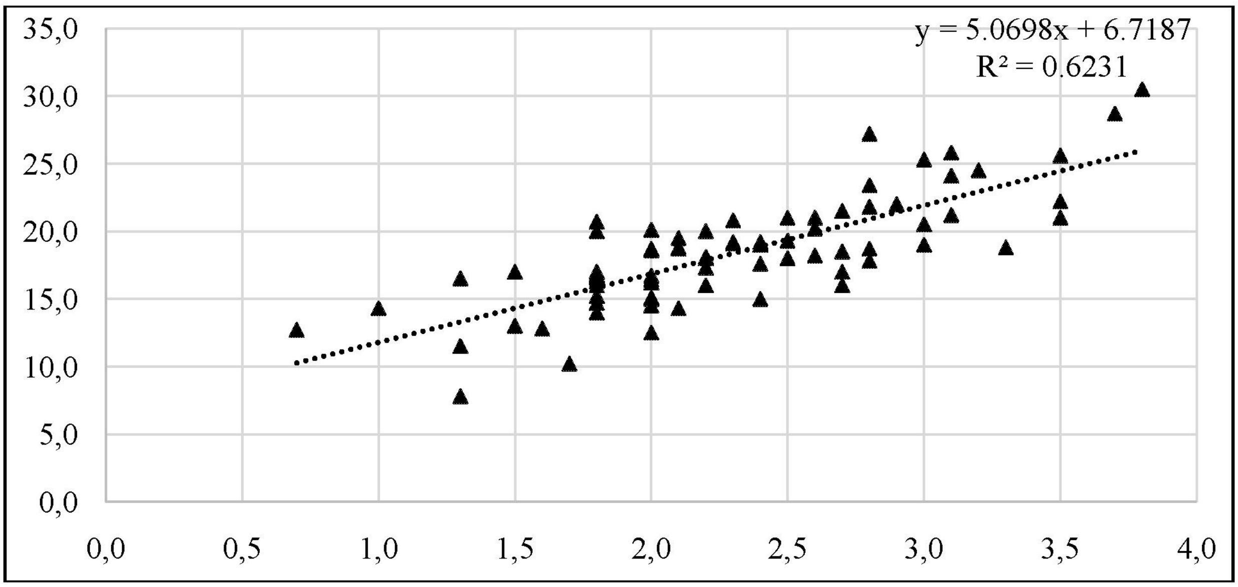

Figure 3 – The correlation coefficient of the between grain weight per spike and total grain weight per plant

Also, strong positive correlation was found between grain weight and total grain weight (r = 0.79) (figure 3). The negative correlation was found between the bunted ears and all agronomic traits, but these correlations were no so high, from r = 0.1 to r + 0.29.

Conclusion. In conclusion, the common bunt infection was found to decrease the productivity and biological yield in the tested genotypes. Artificial inoculation tests for common bunt resistance showed that a large number of resistance genotypes is available in disease condition of southeast part of Kazakhstan. On base this study sixteen genotypes from the CBUNT Nursery of IWWIP can be considered as valuable resistance sources to common bunt. Identified resistance genotypes will be useful for breeding programs to forming resistance cultivars to common bunt in Kazakhstan.

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ҚАТТЫ ҚАРАКҮЙЕ АУРУЫНЫҢ КҮЗДІК БИДАЙ ЛИНИЯЛАРЫНЫҢ АГРОНОМИЯЛЫҚ БЕЛГІЛЕРІМЕН ТӨЗІМДІЛІГІНЕ ӘСЕРІ

Аннотация. Қатты қаракүйе (*Tilletia caries*) тұқым арқылы берілетін бидайдың саңырауқұлақ ауруларының бірі. Органикалық ауылшаруашылығында аурудың алдын алу үшін ауруға төзімді бидай» сорттары мен линияларын өсіру қажет. Зерттеу жұмысында Түркияның «Күздік бидайды жақсарту бойынша халықаралық орталық»(IWWIP) құрған халықаралық қатты қаракүйе тәлімбағының 75 бидай линиялар жиынтығы қолданылды. Зерттеу жұмысы 2016-2017 жылдары Қазақ егіншілік және өсімдік шаруашылығы ҒЗИ-ның жасанды инфекциялық тәлімбағында жүргізілді. Сезімтал бақылау нұсқасы GEREK 79 генотипі 59,7% масақ қатты қаракүйемен ауырып, сезімталдылықтың жоғары деңгейіне ие болды. Он алты генотип жасанды инфекция аясында ауруға төзімділік танытты. Аурудың ең жоғары деңгейі 59,7%-ға дейін масақтары залалданған бидай линиясында тіркелді. 42 бидай генотипі 2.0-27.3% шамасында қатты қаракүйемен залалданып, орташа төзімді деп танылды. Жасанды жағдайда қатты қаракүйе ауруы бидайдың агрономиялық көрсеткіштеріне әртүрлі әсер етті. Бидай линияларының өнімділік деңгейі 1,13 т/га-дан 7,29 т/га-ға дейін ауытқыды. Болжам жасалынған жоғары оң корреляция коэффициенті дән саны мен дән салмағы (r = 0,7), дән салмағы мен 1000 дәннің салмағы (r = 0,75) және 1 масақтағы дән салмағы мен жалпы дән салмағы (r = 0,79) арасында байқалды. Ал теріс корреляция аурумен залалданған масақтар саны мен басқа агрономиялық көрсеткіштердің арасында байқалды. Идентификацияланған төзімді генотиптер Қазақстандағы қатты қаракүйеге төзімді БИДВАЙ сорттарын құруға арналған селекциялық бағдарламаларда қолдану үшін құнды болып табылады.

Түйін сөздер: бидай, бидай линиялары, қатты қаракүйе, төзімділік, өнімділік, агрономиялық көрсеткіштер.

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ВЛИЯНИЕ ТВЕРДОЙ ГОЛОВНИ НА АГРОНОМИЧЕСКИЕ ПОКАЗАТЕЛИ И УСТОЙЧИВОСТЬ ЛИНИИ ОЗИМОЙ ПШЕНИЦЫ

Аннотация. Твердая головня (*Tilletiacaries*) является наиболее опасным грибковым заболеванием пшеницы. Из системы мероприятий по борьбе с твердой головней наиболее радикальной является создание устойчивых сортов и линий пшеницы. В данной работе использованы 75 сортов и линий пшеницы, созданные в «Международном центре по улучшению озимой пшеницы» (IWWIP), Турция. Эксперимент проведен в 2016–2017 гг. в инфекционном стационаре Казахского научно-исследовательского института земледелия и растениеводства. Восприимчивый контроль, GEREK 79, показала восприимчивость (59,7% поврежденных колосьев). Самая высокая уровень болезни составляла 74,4% пораженных колосьев. Шестнадцать генотипов были устойчивыми в условиях искусственного инфицирования. Сорок два генотипов пшеницы были умеренно-устойчивыми, их колосья поражались головней от 2,0% до 27,3%. Агрономические показатели в условиях искусственного инфицирования колебались по-разному по сравнению с контролем. Урожайность генотипов пшеницы колебалось от 1,13 до 7,29 т/га. Ожидаемая высокая положительная корреляция обнаружена между число зерен и массой зерна (r = 0,7), между массой зерна и массой 1000 зерен (r = 0,75), а также между массой зерна с главного колоса и общей массой зерна с растения (r = 0,79). Отрицательная корреляция обнаружена между колосьев пораженный твердой головней и другими агрономическими признаками. Идентифицированные устойчивые генотипы будут ценными в селекционных программах Казахстана для формирования устойчивых сортов пшеницы к твердой головне.

Ключевые слова: пшеница, линии пшеницы, твердая головня, устойчивость, продуктивность, агрономические признаки.

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