



(RESEARCH ARTICLE)



NATURAL INFECTION BY BLACK POINT IN ADVANCED TRITICALE LINES ACROSS THREE CROP SEASONS

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World Journal of Advanced Research and Reviews, 2026, 32(01), 1013–1022

Publication history: Received on 06 September 2026; revised on 14 October 2026; accepted on 16 October 2026

Article DOI: <https://doi.org/10.30574/wjarr.2026.32.1.2640>

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ABSTRACT

Three groups of twenty triticale advanced lines were evaluated separately – each group in a different crop season- for their reaction to black point under natural conditions at the Norman E. Borlaug Experimental Station in the Yaqui Valley, Mexico, during crop seasons 2014-2015, 2015-2016, and 2018-2019. Sowing dates for each group were November 19 and 28, 2014, 12 and 19, 2015, and 12 and 22, 2018, respectively. Healthy and infected grains in ten spikes per line were counted. In 2014-2015, infection in the first date ranged from 0 to 13.59 %, with an average of 2.33, and for the second date 0 to 19.9 %, with an average of 3.52. In 2015-2016, infection in the first date ranged from 0.31 to 45.59 %, with an average of 13.08, and for the second date 0.44 to 42.27 %, with an average of 11.69. In 2018-2019, infection in the first date ranged from 0 to 44.73 %, with an average of 4.35, and for the second date 0 to 8.35 %, with an average of 1.15. Lines with the highest average percentage of infection in each crop season were WIR46058/GNU_1//ERIZO_11/3/SVHT02/STIER_3/4/WIR46058/GNU_1//ERIZO_11/5/NESSER/6/CAGUAN_4-1/FAHAD_5/7/NIMIR_3/ERIZO_12/5/GC.3/733.EB//MPE/3/LAMB_3/4/BUF_2/6/POLLMER_2/8/BAT*2/BCN//CAAL/3/ERIZO_7/BAGAL_2//FARAS_1 with 10.31 %, TURACO/CENT.SARDEV/7/LIRON_2/5/DISB5/3/SPHD/PVN//YOGUI_6/4/KER_3/6/BULL_10/MANATI_1/8/LIRON_2/5/DISB5/3/SPHD/PVN//YOGUI_6/4/KER_3/6/BULL_10/MANATI_1/9/BICEN with

38.36 %, and 804/BAT/3/MUSX/LYNX//STIER_12-3/4/VARS_3-1/5/FAHAD_8-1*2//HARE_263/CIVET/9/BICEN/8/SUSI_2/5/TAPIR/YOGUI_1//2*MUSX/3/ERIZO_7/4/FARAS_1/6/VARS_2/7/754.3/IBEX//BUF_2/10/T1505_WG//ERIZO_10/BULL_1-1/3/ERIZO_10/BULL_1-1/4/COPI_1/5/ARDI_1/TOPO1419//ERIZO with 26.54 %, respectively.

Keywords: Triticale, Triticosecale, Black Point, Natural Infection

1 INTRODUCTION

Triticale (*x Triticosecale* Wittmack) is a cereal crop developed by crossing wheat (*Triticum* spp.) with rye (*Secale cereale* L.), which combines useful characteristics of both species and is important for grain production, animal feeding, forage production, and agricultural adaptation to challenging environmental conditions [1,2]. Triticale world production in 2024 was 12.40 million tons; Poland had the highest production with 4.96 million tons followed by Germany with 1.51 and France with 1.09 million tons, while Mexico produced 12,816.86 tons [3]. Black point (BP) is a worldwide disease of small grain cereals, especially in Australia, Canada, China, India, Guatemala, Mexico, Peru, Russia, the United Kingdom, and the United States [4]. Many of the fungi that cause BP are saprophytic [5], *Alternaria alternata* (Fr.:Fr.) Keissl. and *Bipolaris sorokiniana* (Sacc.) Shoemaker are generally considered the primary causal agents of the disease [6]. Many fungal species can be isolated from harvested grain, for example, Kai-Ge *et al.* [7] isolated 21 strains from 11 genera of these fungi. These fungal species are important in humid field environments, where they infect seed when relative humidity exceeds 90% and seed moisture content exceeds 20 %. Rainfall during seed maturation, along with several days of humid weather leading up to harvest, promotes the development of BP; the condition primarily affects expanding green kernels, which are the most vulnerable [8,9]. Infected ears which could look normal, may be elliptical, brown to dark brown lesions on the inner side of the glumes. The disease is more pronounced as brown to dark brown or blackish, localized discolored areas, usually around the embryo (Figure 1). Discoloration may also occur near the brush, in the crease or any part of the seed. It may be light or dark or with a distinct margin. Severe infection causes discoloration and shrivelling of the whole seed [6], and significantly reduces grain quality, and leads to toxic secondary metabolites that may cause esophageal cancer [4]. Vertical sections may show brown to black spots in the endosperm of infected seed [10]. The disease known as red spot caused by *Pyrenophora tritici-repentis* (Died.) Drechs., can also occur in seed affected by BP [11]. Black point not only causes economic losses due to the degradation in the quality of flour and semolina, but also affects seed germination and inhibits seedling growth [7]. It is an endemic disease of durum wheat (*Triticum durum* Desf.) and bread wheat (*Triticum aestivum* L.) in the southern region of the state of Sonora in Mexico [12]. BP also affect triticale (*x Triticosecale* Wittmack) [5]. In wheat, artificial inoculation of germplasm may help breeding programs in identifying resistant genotypes to BP. It has been demonstrated that inoculation by injection and vacuum infiltration of *Alternaria alternata* [13] and by spraying with *Bipolaris sorokiniana* [14] and with several species that cause BP [7], is useful to identify resistant and susceptible germplasm. In order to contribute to the monitoring of this disease in southern Sonora, the objective of this work was to evaluate the reaction of triticale advanced lines during the 2014-2015, 2015-2016, and 2018-2019 fall-winter crop seasons under natural infection.



Figure 1: Symptoms of black point on triticale grain.

2 MATERIALS AND METHODS

Three groups of twenty triticale advanced lines were evaluated separately – each group in a different crop season - for their reaction to black point, under natural conditions at the Norman E. Borlaug Experimental Station which belongs to the National Institute for Forestry, Agriculture, and Livestock Research, located in block 910 in the Yaqui Valley, Sonora,

Mexico (27°22'3.01" N and 109°55'40.22" W, 37 masl) in a clay soil with pH of 7.8, during crop seasons 2014-2015, 2015-2016, and 2018-2019. Sowing dates for each group of lines were November 19 and 28, 2014, 12 and 19, 2015, and 12 and 22, 2018, respectively, using 8 g of seed for a 0.7 m bed with two rows without replications. Fertilization consisted of 150 kg ha⁻¹ of urea before sowing. One irrigation for seed germination and three complementary irrigations were applied during the season. Before the first complementary irrigation, 100 kg ha⁻¹ of urea were applied. Thirty days after sowing, the herbicide Situi® XL (metsulfuron methyl) [15] was applied at a dose of 25 g/ha of commercial product. Harvest was done manually and the evaluation by visual inspection counting the number of healthy and infected grains in ten spikes per line, in order to determine the percentage of infection. Since BP affects primarily expanding green wheat kernels and also during seed maturation [8,9] which generally occurs in March in southern Sonora, the daily relative humidity was recorded from March 1 to 31 during 2016 and 2019, by the weather station CIANO-910, located in block 910 in the Yaqui Valley which belongs to the automated weather station network of Sonora [16]. Data for March 2015 were not available.

3 RESULTS AND DISCUSSION

During crop season 2014-2015, the range of infection for the first sowing date was 0 to 13.59 % with an average of 2.33 (Figure 2); 9 lines did not have infected grains, 5 lines fell within the 0.1-2.5 % infection category, 3 lines within 2.6-5.0 %, 2 lines within 5.1-10 %, and 1 line within 10.1-30 %. The range of infection for the second date was 0 to 19.9 % with an average of 3.52 %; 7 lines did not have infected grains, 4 lines fell within the 0.1-2.5 % infection category, 3 lines within 2.6-5.0 %, 4 lines within 5.1-10 %, and 2 lines within 10.1-30 %.

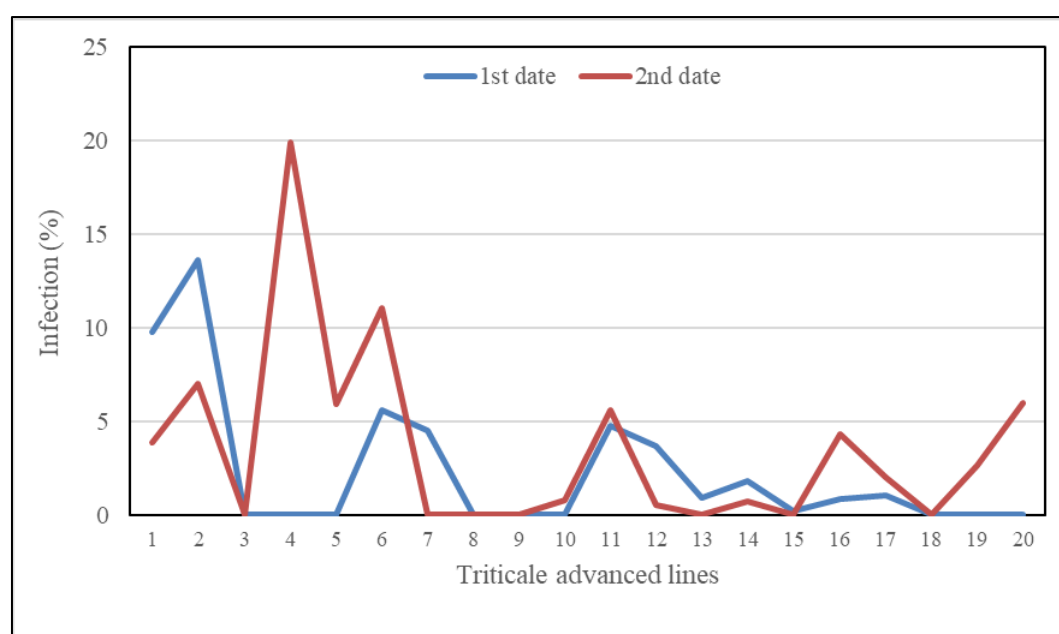


Figure 2: Percentage of infection with black point in two sowing dates, of 20 triticale advanced lines, evaluated under natural infection in the field, during the fall-winter crop season 2014-2015, at the Norman E. Borlaug Experimental Station in the Yaqui Valley, Sonora, Mexico

The only line that showed a contrasting difference in percentage of infection greater than 10 % between the first and second date was T1505_WG//ERIZO_10/BULL_1-1/3/ERIZO_10/BULL_1-1/4/COPI_1/5/ARDI_1/TOPO1419//ERIZO_9/3/SUSI_2/6/DAHBI/COATI_1//ONA_1/ERIZO_12/4/ERIZO_10/BULL_1-1//MANATI_1/3/SUSI_2 with 19.9 %. On the other hand, lines that showed the highest percentage of infection were: WIR 46058/GNU_1//ERIZO_11/3/SVHT02/STIER_3/4/WIR46058/GNU_1//ERIZO_11/5/NESSER/6/CAGUAN_4-1/FAHAD_5/7/NIMIR_3/ERIZO_12/5/GC.3/733.EB//MPE/3/LAMB_3/4/BUF_2/6/POLLMER_2/8/BAT*2/BCN//CAAL/3/ERIZO_7/BAGAL_2//FARAS_1 in the first date with 13.59 % and the line already mentioned with 19.9 % in the second date.

During crop season 2015-2016, the range of infection for the first sowing date was 0.31 to 45.59 % with an average of 13.08 (Figure 3); 4 lines fell within the 0.1-2.5 % infection category, 1 line within 2.6-5.0 %, 7 lines within 5.1-10 %, 5 lines within 10.1-30 %, and 3 in the > 30 % infection category. The range of infection for the second date was 0.44 to 42.27 % with an average of 11.69 %; 4 lines fell within the 0.1-2.5 % infection category, 2 lines within 2.6-5.0 %, 4 lines within 5.1-10 %, 9 lines within 10.1-30 %, and 1 in the > 30 % infection category.

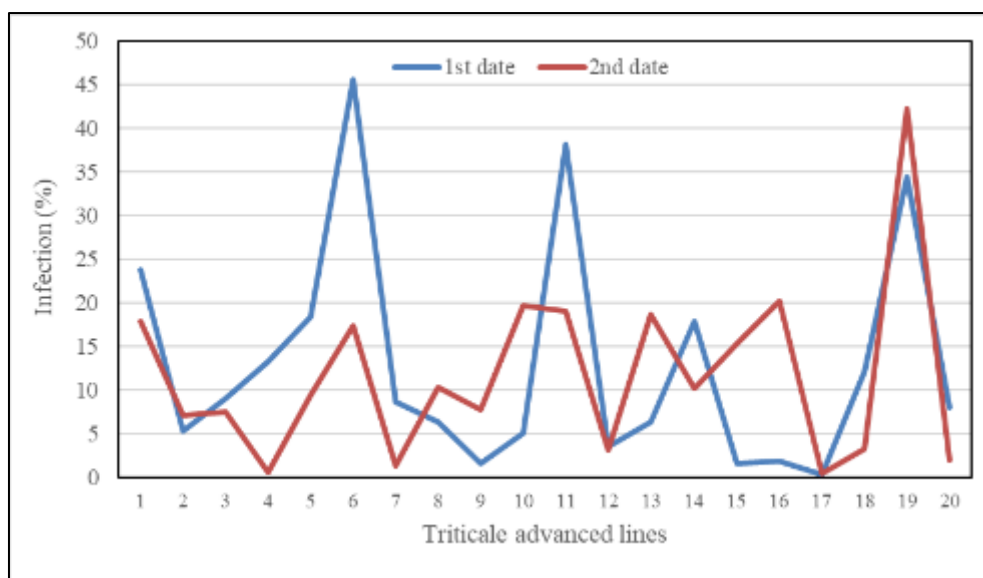


Figure 3: Percentage of infection with black point in two sowing dates, of 20 triticale advanced lines, evaluated under natural infection in the field, during the fall-winter crop season 2015-2016, at the Norman E. Borlaug Experimental Station in the Yaqui Valley, Sonora, Mexico

There were seven lines that showed a contrasting difference in percentage of infection greater than 10 % between the first and second date, these were: BAT*2/BCN//CAAL/3/ERIZO_7/BAGAL_2//FARAS_1/5/POLLMER_2.2.1*2//FARAS/CMH84.4414/4/CAAL/3/ERIZO_8/RHINO_3//NIMIR_3 with 12.27 %, POLLMER_2.2.1*2//FARAS/CMH84.4414/5/BANT_4//HARE_7265/YOGUI_1/3/SUSI_2/4/MASSA/NIMIR_3/3/YOGUI_1/TARASCA87_3//HARE_212 with 12.77 %, T1505_WG//ERIZO_10/BULL_1-1/3/ERIZO_10/BULL_1-1/4/COPI_1/5/ARDI_1/TOPO1419//ERIZO_9/3/SUSI_2/9/TURACO/CENT.SARDEV/7/LIRON_2/5/DISB5/3/SPHD/PVN//YOGUI_6/4/KER_3/6/BULL_10/MANATI_1/8/LIRON_2/5/DISB5/3/SPHD/PVN//YOGUI_6/4/KER_3/6/ BULL_10/MANATI_1 with 13.73 %, SONNI_3*2//FARAS/CMH84.4414/6/RONDO/BANT_5//ANOAS_2/3/RHINO_3/BULL_1-1/5/DAHBI_6/3/ARDI_1/TOPO1419//ERIZO_9/4/2*ZEBRA79/LYNX*2//FAHAD_1 with 14.67 %, BAT*2/BCN//CAAL/3/ERIZO_7/BAGAL_2//FARAS_1/6/ARLIN_3/ALTAR84//SNP/2*BLANCO, RYE/4/DAHBI_6/3/ARDI_1/TOPO1419//ERIZO_9/5/YOGUI_3/ERIZO_11//ONA_2/POSS_1-2 with 18.37 %, BAT*2/BCN//CAAL/3/ERIZO_7/BAGAL_2//FARAS_1/5/PRESTO//2*TESMO_1/MUSX603/4/ARDI_1/TOPO1419//ERIZO_9/3/SUSI_2 with 19.03 %, and PRESTO//2*TESMO_1/MUSX603/4/ARDI_1/TOPO1419//ERIZO_9/3/SUSI_2/5/AR/SNP6//TARASCA87_2/C,S10/3/PORSAS4-1/4/CHACAL_3-2/6/BAT*2/BCN// CAAL/3/ERIZO_7/BAGAL_2//FARAS_1 with 28.28 %. Lines that showed the highest percentage of infection were: PRESTO//2*TESMO_1/MUSX603/4/ARDI_1/TOPO1419//ERIZO_9/3/SUSI_2/5/AR/SNP6//TARASCA87_2/C,S10/3/PORSAS_4-1/4/CHACAL_3-2/6/BAT*2/BCN//CAAL/3/ERIZO_7/BAGAL_2//FARAS_1 with 45.59 % in the first date, and TURACO/CENT.SARDEV/7/LIRON_2/5/DISB5/3/SPHD/PVN//YOGUI_6/4/KER_3/6/BULL_10/MANATI_1/8/LIRON_2/5/DISB5/3/SPHD/PVN//YOGUI_6/4/KER_3/6/BULL_10/MANATI_1/9/BICEN with 42.27 % in the second date.

During crop season 2018-2019, the range of infection for the first sowing date was 0 to 44.73 % with an average of 4.35 % (Figure 4); 8 lines did not have infected grains, 4 lines fell within the 0.1-2.5 % infection category, 3 lines within 2.6-5.0 %, 3 lines within 5.1-10 %, 1 line within 10.1-30 %, and 1 line within > 30 % infection category. The range of infection for the second date was 0 to 8.35 % with an average of 1.15 %; 7 lines did not have infected grains, 10 lines fell within the 0.1-2.5 % infection category, 1 line within 2.6-5.0 %, and 2 lines within 5.1-10 %. The only line that showed a contrasting difference in percentage of infection greater than 10 % between the first and second date was 804/BAT/3/MUSX/LYNX//STIER_12-3/4/VARSAS_3-1/5/FAHAD_8-1*2//HARE_263/CIVET/9/BICEN/8/SUSI_2/5/TAPIR/YOGUI_1//2*MUSX/3/ERIZO_7/4/FARAS_1/6/VARSAS_2/7/754.3/IBEX//BUF_2/10/T1505_WG//ERIZO_10/BULL_1-1/3/ERIZO_10/BULL_1-1/4/COPI_1/5/ARDI_1/TOPO1419//ERIZO with 36.38 %. This line showed the highest percentage of infection in both dates with 44.73 and 8.35 %, respectively.

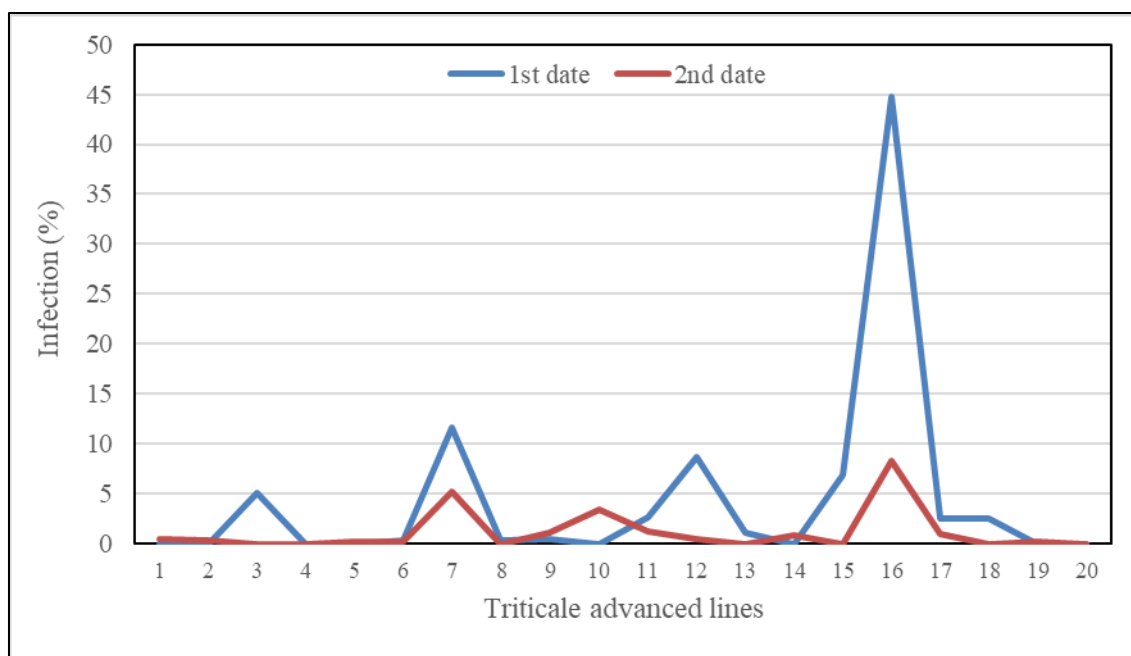


Figure 4: Percentage of infection with black point in two sowing dates, of 20 triticale advanced lines, evaluated under natural infection in the field, during the fall-winter crop season 2018-2019, at the Norman E. Borlaug Experimental Station in the Yaqui Valley, Sonora, Mexico

The average percentage of infection was rather different in the three seasons (Figure 5), particularly in 2015-2016 which showed noticeable greater infection than the other two crop seasons, 76.4 % greater than 2014-2015 and 79.6 % greater than 2018-2019. Although relative humidity (RH) data for crop season 2014-2015 crop season were unavailable, the average RH during March 2016 ranged from 65.14 to 84.85 % with a mean of 75.33 %. In constrast, RH in March 2019 ranged from 61.16 to 83.81 % averaging 68.89 % (Figure 6). Except for three days, RH was higher in March of 2016 than March 2019 with daily differences ranging from 0.64 to 23.52 % and averaging 7.57 %. It has been also reported that in March 2016, the natural incidence of BP was higher than in March 2017 [17].

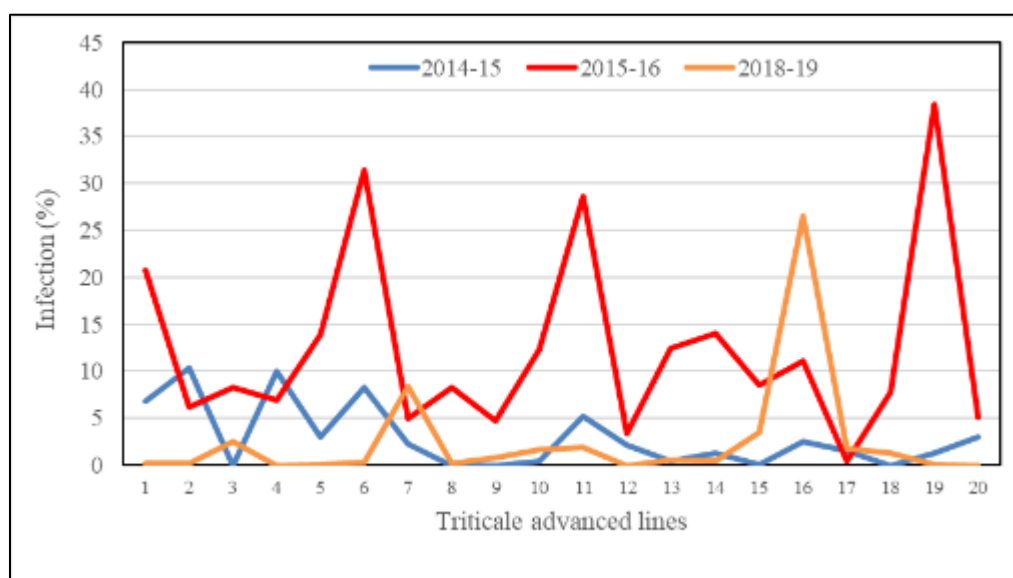


Figure 5: Average percentage of infection with black point in two sowing dates and in three crop seasons (2014-2015, 2015-2016, and 2018-2019), of three groups of 20 different triticale advanced lines, valuated under natural infection in the field, at the Norman E. Borlaug Experimental Station in the Yaqui Valley, Sonora, Mexico

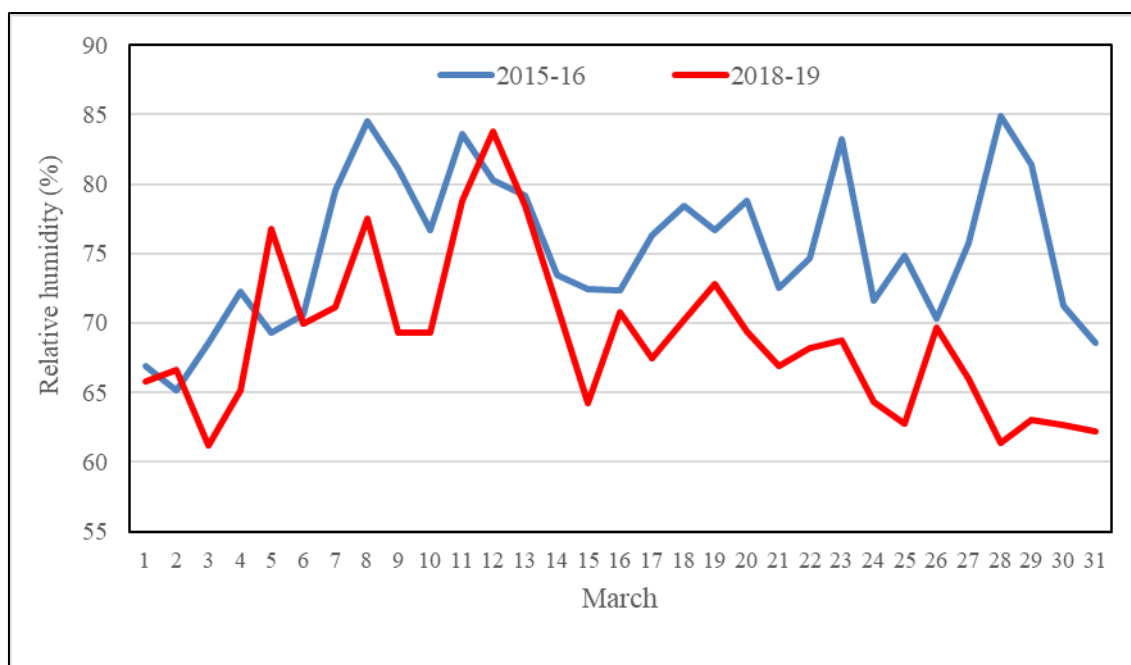


Figure 6: Average relative humidity during March 2016 and 2019, recorded by the weather station CIANO-910, located in block 910 at the Norman E. Borlaug Experimental Station in the Yaqui Valley, Sonora, Mexico

This difference was associated with higher daily RH in March 16, which exceeded that recorded in March 2017 on 23 days. The average daily RH in March 2017 ranged from 58.57 to 84.85 %. Nevertheless, BP occurrence is not exclusively associated with high humidity, as the disease may also be prevalent under hot, dry conditions, particularly when wheat maturity is delayed [18], or when plants are exposed to stress factors such as premature seed senescence and other environmental stresses [19]. Previous studies [8,9] have also indicated that rainfall during seed maturation and humid weather in the days immediately preceding harvest favors BP development. Within the infection categories of the groups based on the average of the two dates in each crop season, in 2014-2015, 4 lines did not show any infected grains (Table 1), 8 lines fell within the 0.1-2.5 % infection category, 3 lines within 2.6-5.0 %, 4 lines within 5.1-10.0 %, and 1 line within 10.1-30.0 % (Figure 7). The overall average of the group was 2.92 % with a range of 0 to 10.31 %. In 2015-2016, 1 line fell within the 0.1-2.5 % category, 4 lines within 2.6-5.0 %, 6 lines within 5.1-10.0 %, 7 lines within 10.1-30.0 %, and 2 lines in > 30 %. The overall average of the group was 12.38 % with a range of 0.37 to 38.36 %. In 2018-2019, 3 lines did not show any infected grains (Table 1), 13 lines fell within the 0.1-2.5 % infection category, 2 lines within 2.6-5.0 %, 1 line within 5.1-10.0 %, and 1 line within 10.1-30.0 %. The overall average of the group was 2.52 % with a range of 0 to 26.54 %.

Table 1: Triticale advanced lines that did not show any infected grains with black point during crop seasons 2014-2015 and 2018-2019, evaluated under natural conditions at the Norman E. Borlaug Experimental Stations in the Yaqui Valley, Sonora, Mexico

No.	Pedigree	Selection history
2014-2015		
1	BAT*2/BCN//CAAL/3/ERIZO_7/BAGAL_2//FARAS_1/8/G AUR_2/HARE_3//JLO97/CIVET/5/DISB5/3/SPHD/PVN //YOGUI_6/4/KER_3/6/150.83//2*TESMO_1/MUSX603 /7/ GAUR_2/HARE_3//JLO 97/CIVET	CTSS04B00008S-020Y-24M-2Y-0M-2Y-0M
2	NILEX/3/BULL_10/MANATI_1//FARAS/CMH84.4414/6/ HX87-244/HX87-255/5/PRESTO//2*TESMO_1/MUSX603 /4/ ARDI_1/TOPO 1419//ERIZO_9/3/SUSI_2	CTSS08Y00155T-099Y-016M-18Y-099M-6Y-1BMX-4Y
3	95T159/4/T1502_WG/MOLOC_4//RHINO_3/BULL_1-1/3/POLLMER_3/FOCA_2-1/5/CAAL/3/T1494_WG// ERIZO_10/2*BULL_1-1	CTSS08Y00168T-099Y-024M-5Y-099M-1Y-4BMX-1Y
4	POPP1_2/TAHARA/4/DAHBI_6/3/ARDI_1/TOPO 1419// ERIZO_9/7/CAAL/MANATI_1/5/6TA876/6TB164//PND-	CTSS08Y00122S-099Y-021M-6Y-099M-3Y-4BMX-3Y

	T/RHM/3/TESMO_2/4/2*ERIZO_12/6/POLLMER_3/ FOCA_2-1	
2018-2019		
1	10P154-INT14	'14.400020
2	FAHAD_8-2*2//PTR/PND-T/3/GAUR_3/ANOAS_2// BANT_1/4/HARE_7265/YOGUI_1//BULL_2/5/POPP1_1/6 /BULL_10/MANATI_1*2//FARAS/CMH84.4414/7/BICEN	CTSS13Y00039S-10Y-3M-1Y-2M-1Y- 0B
3	09P018-INT11/9/T1505_WG//ERIZO_10/BULL_1-1/3/ ERIZO_10/BULL_1-1/4/COPI_1/5/ARDI_1/TOPO1419// ERIZO_9/3/SUSI_2/8/LIRON_2/5/DISB5/3/SPHD/PVN// YOGUI_6/4/KER_3/6/BULL_10/MANATI_1/7/83TR1- 11/3/150.83//2*TESMO_1/MUSX603/4/150.83// 2*TESMO_1/MUSX 603	CTSS13Y00135S-65Y-3M-3Y-2M-1Y- 0B

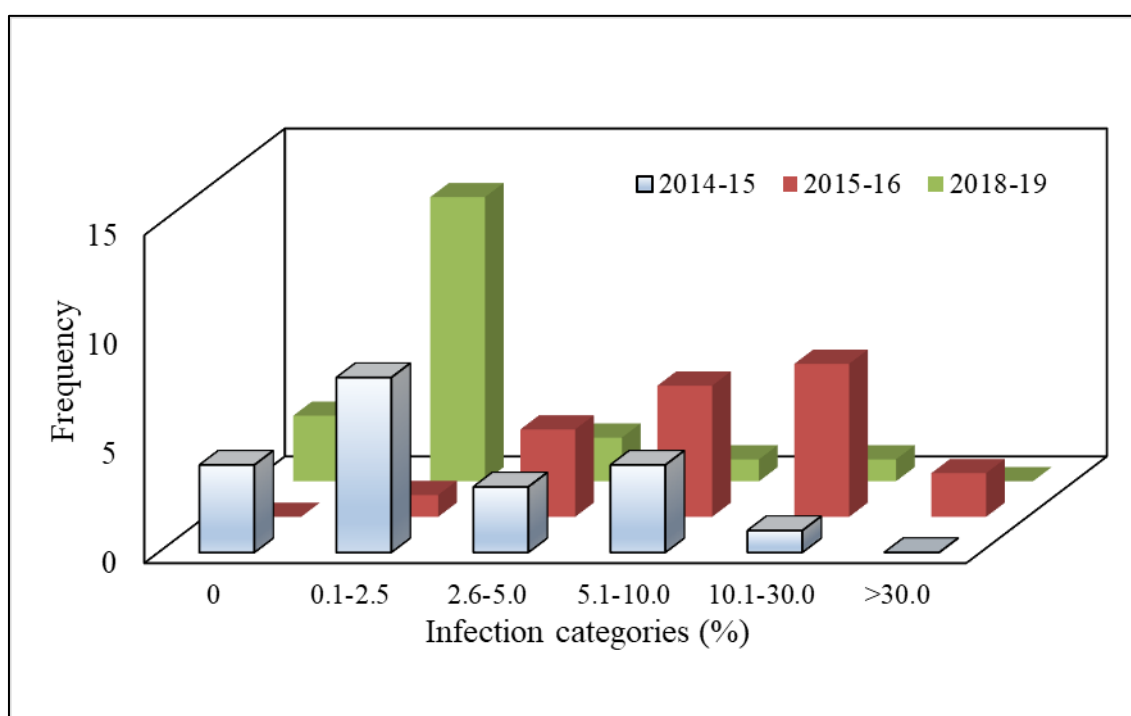


Figure 7: Infection categories (%) with black point in two sowing dates and in three crop seasons (2014-2015, 2015-2016, and 2018-2019), of three groups of 20 different triticale advanced lines, evaluated under natural infection in the field, at the Norman E. Borlaug Experimental Station in the Yaqui Valley, Sonora, Mexico

The incidence of BP in wheat-growing areas of southern Sonora during the fall-winter season varies among bread wheat [20], durum wheat, and triticale [12]. This variation may be attributed not only to seasonal weather conditions, but also to distinct climatic zones within the region [21,22]. Another contributing factor is the availability of primary inoculum, which is influenced by environmental conditions and the capacity of certain fungal species, including *Alternaria tritici* Pras. & Prab., *Helminthosporium sativum* Pamm., King & Bakke, and *Fusarium* spp. to survive as saprophytes on plant debris [5]. The percentage of BP infection can be high in certain crop seasons, for instance, during the 2009-2010 season, the durum wheat line SOMAT_4/INTER_8/4/GODRIN/GUTROS//DUKEM/3/ THKNEE_11/5/CNDO/PRIMADUR//HAI-OU_17/3/SNITAN exhibited an infection rate of 50.6 % under natural field conditions [20]. During the same season, bread wheat lines BABAX/LR42//BABAX/3/ER2000, BABAX/ LR42//BABAX*2/4/SNI/TRAP#1/3/KAUZ*2/TRAP//KAUZ, and TC870344/GUI//TEMPORALERAM87/AGR /3/2*WBLL1 showed infection rates of 30.8 %, 27.3 %, and 20.5 %, respectively. Likewise, during the 2013-2014 season, the bread wheat lines SOKOLL*2/3/BABAX/LR42//BABAX and KISKADEE#1/CHYAK each exhibited a BP incidence of 31.4 % [23]. During the same crop season the triticale lines T1505_WG//ERIZO_10/BULL_1-1/3/ERIZO_10/BULL_1-1/4/COPI_1/5/ARDI_1/TOPO1419//ERIZO_9/3/SUSI_2/6/DAHBI/COATI_1//ONA_1/ERIZO_12/4/ERIZO_10/BULL_1-1//MANATI_1/3/SUSI_2 and WIR46058/GNU_1//ERIZO_11/3/SVHT02/STIER_3/4/WIR46058/GNU_1//ERIZO_11/5/NESSER/6/CAGUAN_4-1/FAHAD_5/7/NIMIR_3/ERIZO_12/5/GC.3/733.EB//MPE/3/LAMB_3/4/BUF_2/6/POLLMER_2/8/BAT*2/BCN//CAAL/3/ERIZO_7/

BAGAL_2//FARAS_1 exhibited 34.55 % in the first date and 48.03 % in the second date, respectively [24]. As in wheat, severe BP infection in triticale can adversely affect grain quality and reduce the market value of grain products. Furthermore, BP may impair seed germination and seedling vigor, thereby compromising seed quality and subsequent crop establishment. In addition to the use of resistant cultivars [25], BP can be partially managed by reducing irrigation frequency after heading and lowering nitrogen application rates, practices that do not compromise grain yield or quality. Continuous evaluation of experimental triticale germplasm for BP reaction is essential to identify tolerant or highly resistant genotypes that may be suitable for future commercial release.

4 CONCLUSION

Within the infection categories of the triticale groups based on the average of the two dates in each crop season, in 2014-2015, 4 lines did not show any infected grains, 8 lines fell within the 0.1-2.5 % infection category, 3 lines within 2.6-5.0 %, 4 lines within 5.1-10.0 %, and 1 line within 10.1-30.0 %. The overall average of the group was 2.92 % with a range of 0 to 10.31 %. In 2015-2016, 1 line fell within the 0.1-2.5 % category, 4 lines within 2.6-5.0 %, 6 lines within 5.1-10.0 %, 7 lines within 10.1-30.0 %, and 2 lines in > 30 %. The overall average of the group was 12.38 % with a range of 0.37 to 38.36 %. In 2018-2019, 3 lines did not show any infected grains, 13 lines fell within the 0.1-2.5 % infection category, 2 lines within 2.6-5.0 %, 1 line within 5.1-10.0 %, and 1 line within 10.1-30.0 %. The overall average of the group was 2.52 % with a range of 0 to 26.54 %.

Lines with the highest percentage of infection in crop season 2014-2015 were: WIR 46058/GNU_1//ERIZO_11/3/SVHT02/STIER_3/4/WIR46058/GNU_1//ERIZO_11/5/NESSER/6/CAGUAN_4-1/FAHAD_5/7/NIMIR_3/ERIZO_12/5/GC.3/733.EB//MPE/3/LAMB_3/4/BUF_2/6/POLLMER_2/8/BAT*2/BCN//CAAL/3/ERIZO_7/BAGAL_2//FARAS_1 with 13.59 % in the first date and T1505_WG//ERIZO_10/BULL_1-1/3/ERIZO_10/BULL_1-1/4/COPI_1/5/ARDI_1/TOPO1419//ERIZO_9/3/SUSI_2/6/DAHBI/COATI_1//ONA_1/ERIZO_12/4/ERIZO_10/BULL_1-1//MANATI_1/3/SUSI_2 with 19.9 % in the second date; in 2015-2016 PRESTO//2*TESMO_1/MUSX603/4/ARDI_1/TOPO1419//ERIZO_9/3/SUSI_2/5/AR/SNP6//TARASCA87_2/C,S10/3/PORSAS_4-1/4/CHACAL_3-2/6/BAT*2/BCN//CAAL/3/ERIZO_7/BAGAL_2//FARAS_1 with 45.59 % in the first date, and TURACO/CENT.SARDEV/7/LIRON_2/5/DISB5/3/SPHD/PVN//YOGUI_6/4/KER_3/6/BULL_10/MANATI_1/8/LIRON_2/5/DISB5/3/SPHD/PVN//YOGUI_6/4/KER_3/6/BULL_10/MANATI_1/9/BICEN with 42.27 % in the second date; and in 2018-2019 804/BAT/3/MUSX/LYNX//STIER_12-3/4/VARSA_3-1/5/FAHAD_8-1*2//HARE_263/CIVET/9/BICEN/8/SUSI_2/5/TAPIR/YOGUI_1//2*MUSX/3/ERIZO_7/4/FARAS_1/6/VARSA_2/7/754.3/IBEX//BUF_2/10/T1505_WG//ERIZO_10/BULL_1-1/3/ERIZO_10/BULL_1-1/4/COPI_1/5/ARDI_1/ TOPO 1419//ERIZO with 44.73 % in the first date and 8.35 % in the second date.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

Acknowledgments

Authors express their gratitude to the Mexican National Institute for Forestry, Agriculture, and Livestock Research (INIFAP), and to "Patronato" – Farmers' Union for Agricultural Research and Experimentation of the state of Sonora, Inc., - for providing the facilities to carry out the research.

Funding Source

This research was financially supported by the Mexican National Institute for Forestry, Agriculture, and Livestock Research (INIFAP).

Disclosure of conflict of interest

The authors declare that No conflict of interest.

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