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Monitoring the phytosanitary state of winter bread wheat fields and grain yield depending on sowing date.

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Global climatic changes are increasing medium and maximum air and soil temperatures and the frequency of extreme atmospheric phenomenon. Climate change impacts the growth and development of agricultural crops, among them winter wheat. Thus, determining the sowing date of winter wheat will be condusive for improving the phytosanitary state of winter wheat fields and increasing the grain yield.

These investigations were conducted in a nine-corse rotation stationary field at the laboratory for Plant Production and Cultivar Investigations of the Plant Production Institute nd. a. V.Ya. Yuriev (Eastern Forest-Steppe of Ukraine) during 2006–13. The soil was a typical medium-humus black earth soil on loess with up to 5.4% humus in the plowing layer. Winter bread wheat was sown during three periods: early optimal (10–14 September), optimal (19–25 September), and admissible late (29 September–5 October). The sowing rate of winter wheat on black fallow was 4.5–5.0 x 10^6 viable seeds/ha and 5.0–5.5 x 10^6 viable seeds/ha after dried peas. Nutrition was humus, 6.7 t/ha of crop rotation area, and $N_{(30–60)}$ $P_{(30–60)}$ $K_{(30–60)}$ + N_{30} (additional fertilizing by root feeding at the spring tillering stage) + N_{30} (root feeding at ear stage). Agrotechniques were general use. The degree of damage in the plants by intrastalk pests and the intensity of root rot development was studied using conventional methods (Omelyuta 1986).

Results. For over 40 years (2006, 07, 08, and 12 for yield capacity in 2007, 08, 09, and 13, respectively), we assessed that the damage by root rots (*Helminthosporium*/*Fusarium*) was low on average. During autumn tillering (the second stage of organogenesis of winter wheat according to F.M. Koupermann), the spread of root rots ranged between 0.8–3.9% and the intensity of disease development was 0.2–1.4% (on black fallow); spread and development of root rots did not exceed 2.5–0.8 %, after peas as a forecrop (Table 1). The occurence of harmful flies in winter wheat fields on different forecrops was very similar. At the early optimal sowing date, shoot damage caused by fly larvae was 6.2% on black fallow and 5.2% after peas.

Table 1. The phytosanitary state of winter bread wheat at the autumn tillering stage depending on sowing date, averaged over the years 2006–13.

Index	Forecrop					
	Black fallow			Dried peas		
	Early	Optimal	Late	Early	Optimal	Late
Number of plants/m^2	510	480	570	450	490	550
Total tillering	4.6	3.4	1.1	3.9	3.1	1.5
Number of tillers/m^2	2,330	1,640	640	1,790	1,500	810
Root rots, % spread	3.10	3.90	0.80	2.30	2.50	0.07
Root rots, % development	0.9	1.4	0.2	0.7	0.6	0.8
Tiller damage by fly larvae (total)	6.20	2.50	0.00	5.20	3.40	0.02
Tiller damage by *Oscinella* spp. larvae	2.8	1.3	0.0	2.1	1.9	0.0
Tiller damage by *Mayetiola destructor* larvae	0.70	0.20	0.00	0.20	0.07	0.00
Tiller damage by *Phorbia securis* larvae	2.7	0.7	0.0	2.9	1.4	0.0
Number of tillers undamaged by Diptera larvae/m^2	2,190	1,600	640	1,690	1,450	810

At the optimal sowing date, we observed less shoot damage by fly larvae compared with that on black fallow (2.5 times less) and after peas (1.5 times less). During autumn in winter wheat fields, the specific composition included *Oscinella* spp. and *Phorbia securis* Tiensum. We recorded the greatest quantity from 10–14 September, i.e., at the begining of the optimal sowing date. Tiller damage by *Oscinella* larvae was 2.8% on black fallow and 2.1% after peas. Tiller damage by *P. securis* larvae was 2.7% pm black fallow and 2.9% after peas. Tiller damage by *Oscinella* larvae was 53.6% less on black fallow and damage by *P. securis* larvae was 71.1% less (on black fallow) and 51.7% less (after peas) for plants sown at the optimal time compared to those sown at the early optimal time. Solitary damage to plants by *Mayetiola destructor* Say was observed. Shoot damage by *M. destructor* larvae was not greater than 0.7% at the optimal sowing dates on both forecrops. At the late sowing date, larvae of the various Diptera were not observed.

During spring tillering, the spread and development of root rots in winter wheat fields following peas was much less than those fields with a black fallow forecrop (Table 2). The lowest indexes for spread and development of root rots were 3.5% and 1.5% after peas and 5.9% and 2.8% on black fallow, respectively. We observed a higher degree of spread of root rots (3.2x greater on black fallow and 2.8x greater after peas) and intensity of disease (3.0x greater on black fallow and 2.9x greater after peas) for winter wheat sown at the optimal dates compared with sowning at the late date. During the spring, *Opomyza florum* F. was the dominate fly in winter wheat fields. Tiller damage by *O. florum* larvae at the optimal sowing date was 17.4–19.3% on black fallow and 21.0–23.2% after peas. The effectiveness of the late sowing date was 48.7% on black fallow and 44.8% after peas compared with the early optimal sowing date (Table 3, p. 126).

Table 2. The phytosanitary state of winter bread wheat at the spring tillering stage depending on sowing date, averaged over the years 2006–13.

Index	Forecrop					
	Black fallow			Dried peas		
	Early	Optimal	Late	Early	Optimal	Late
Number of plants/m^2	490	480	530	430	440	500
Total tillering	3.6	3.3	3.0	3.4	3.0	2.7
Number of tillers/m^2	1,740	1,580	1,670	1,480	1,340	1,360
Root rots, % spread	12.0	18.8	5.9	9.6	9.7	3.5
Root rots, % development	5.6	8.3	2.8	4.3	3.7	1.5
Tiller damaged by fly larvae (total)	30.0	24.9	22.7	34.7	31.3	25.0
Tiller damaed by *Oscinella* spp. larvae	4.0	1.5	1.6	4.7	1.8	1.7
Tiller damage by *Mayetiola destructor* larvae	3.3	3.1	2.3	3.1	3.9	4.9
Tiller damage by *Opomyza florum* larvae	19.3	17.4	9.9	23.2	21.0	12.8
Tiller damage by *Chaetocnema aridula* larvae	0.6	0.1	1.5	0.3	0.5	1.0
Tiller damage by *Chaetocnema hortensis* larvae	2.7	2.8	7.4	3.3	4.2	4.7
Number of tillers undamaged by intrastalk larvae/m^2	1,250	1,180	1,360	980	940	1,070

At spring tillering, *M. destructor* larvae caused 3.3% tiller damage on black fallow and 3.9% tiller damage after peas at the optimal sowing dates (Table 2). However, tiller damage by *M. destructor* larvae in fields sown at the late date on black fallow was 30.3% less compared to that at the early optimal date, but was 36.7% greater after peas. Tiller damage by *Oscinella* larvae in the wheat fields after both forecrops at the early optimal sowing date ranged between 4.0–4.7%. A shift in sowing date led to a reduction in tiller damage by *Oscinella* larvae on black fallow and after peas was 2.7% and 2.8% less, respectively. Less tiller damage was caused by *Leptohylemyia coarctata* Fll. Larvae were observed between 0.1–1.5% on black fallow and between 0.3–1. % after peas (an increase in damage was observed at the late sowing date). Less tiller damage by *Chaetocnema aridula* Gyll. and *Ch. hortensis* Geoffr. was observed at the early sowing date; 2.7% on black fallow and 3.3% after peas. Winter wheat sown at the late date was damaged by stem flea larvae to a higher degree on black fallow (63.5%) than after peas (29.8%) compared to plants sown at the early optimal date. In general, shifting the sowing dates for winter wheat from optimal to late led to reduction in total tiller damage by fly larvae from 30.0% to 22.7% on black fallow and from 34.7% to 25.0% after peas. Thus, in autumn, regulating the sowing date of winter wheat may improve the phytosanitary state of winter wheat fields without chemical protection in autumn.

A sowing date for winter wheat and an index for tillering ability influence the density of stems. During autumn, the number tillers/m^2 was 2.6–3.6 times greater on black fallow and 1.8–2.2 times greater after peas for plants sown at the optimal dates compared to those sown at the late date. As a result, undamaged tillers on black fallow were 94.0–98.0% and 94.0–97.0% after peas (from the total number of tillers) during autumn tillering at the optimal sowing dates. At the spring tillering stage, tillers not damaged by intrastalk pests was 72.0–75.0% on black fallow and 66.0–70.0% after peas (from the total number of tillers). At the late sowing date, 100% of the tillers on winter wheat were undamaged by fly larvae for both forecrops during autum; 81.0% of the tillers were not damaged by intrastalk larvae on black fallow and 79.0% after peas at during spring. Despite these results, the grain yield of winter wheat sown at the optimal dates was 6.12–6.40 t/ha on black fallow and 6.16–6.28 t/ha after peas compared with that sown at the late date, 5.70 t/ha on black fallow and 5.86 t/ha after peas (Table 3). The increase in grain yield of winter wheat sown at the optimal dates was 0.42 t/ha on black fallow and 0.30–0.42 t/ha after peas compared to the late sowing date.

Table 3. The effecitveness of sowing date (%) on the grain yield of winter bread wheat (t/ha), averaged over the years 2006–13.

Index	Season	Forecrop					
		Black fallow			Dried peas		
		Early	Optimal	Late	Early	Optimal	Late
Root rots, % development	autumn	—	—	—	—	—	—
	spring	—	—	66.3	—	59.5	65.1
Tiller damaed by *Oscinella* spp. larvae	autumn	—	53.6	100	—	—	100
	spring	—	62.5	60.0	—	61.7	63.8
Tiller damage by *Mayetiola destructor* larvae	autumn	—	71.4	100.0	—	—	—
	spring	—	—	30.3	36.7	—	—
Tiller damage by *Phorbia securis* larvae	autumn	—	74.1	100.0	—	51.7	100.0
Tiller damage by *Opomyza florum* larvae	spring	—	—	48.7	—	—	44.8
Tiller damage by *Leptohylemyia coarctata* larvae	spring	60.0	93.3	—	70.0	50.0	—
Tiller damage by *Chaetocnema aridula* and Ch. *hortensis* larvae	spring	63.5	62.2	—	29.8	—	—
Total number of tillers	autumn	—	59.7	100.0	—	34.6	100.0
	spring	—	17.0	24.3	—	—	27.9
Grain yield (t/ha)	summer	6.12	6.40	5.70	6.28	6.16	5.86

Reference.

Omelyuty VP, Ed. 1986. Counting of the pests and deseases of agricultural crops. Kyiv: The harvest. 292 pp.