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SUGAR BEET NEMATODE *HETERODERA SCHACHTII* DISTRIBUTION AND HARMFULNESS IN UKRAINE

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Aim. To determine the distribution of sugar beet cyst nematode *Heterodera schachtii* in Ukraine, to define its population density in soil, the degree of damage and the efficiency of control measures. **Methods**. Field survey for soil samples, cyst extraction by flotation and sieving method, light microscopy. **Results.** The examination of 12,130 ha of agricultural fields in six regions of Ukraine, conducted in 2010–2015, recorded the sugar beet cyst nematode to occur in five of them (Kyiv, Chernihiv, Cherkasy, Khmelnytsky, and Vinnytsia), at a total area of 2,572 ha. Taking into consideration the results of previous nematological surveys, the presence of sugar beet cyst nematode has now been documented for 18 regions of Ukraine. In most regions *H. schachtii* was present in 10–11 % of the examined sugar and seed producing farms with nematode population densities reaching up to 142,000 eggs and juveniles in 100 cc of soil (710-fold above the economic threshold). **Conclusions.** The main reasons for this wide distribution of *H. schachtii* in Ukraine are seen in the negligence of prevention measures, unavailability of documented data on its occurrence (missing surveys), crop rotations with over 20 % of host plants, and unavailability of efficient nematicides and domestic nematode-resistant sugar beet cultivars.

Keywords: Sugar beet cyst nematode, distribution, harmfulness, control measures.

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INTRODUCTION

According to studies conducted in Ukraine by different scientists, about 59 species of nematodes from 6 orders, 26 families, and 43 genera were detected in association with sugar beet. Among those, the following species of plant parasitic nematodes were found: *Heterodera schachtii* Schmidt, 1871; *Paratylenchus nanus* (Cobb, 1923) Brzeski, 1936; *Ditylenchus dipsaci* (Kühn, 1857) Filipjev, 1936; *Pratylenchus pratensis* (de Man, 1880) Filipjev, 1936; *Helicotylenchus dihystera* (Cobb, 1893) Sher, 1961; *Longidorus elongatus* (de Man, 1876) Thorne et Swanger, 1936; *Tylenchorhynchus dubius* (Bütschli, 1873) Filipjev, 1936 [1–12].

Infestations of plants by nematodes may occur without causing any aboveground symptoms, which are inconsistent (wilting, early death, reduced growth) and can vary with the age of plants, time of season, temperature, or organic content of the soil. The most evident sign of infestation can be detected on the root surface where tiny, pinhead size, lemon-shaped bodies of *H. schachtii* or galls of root knot nematodes can be seen [1–15]. Species such as *P. nanus, Pr. pratensis, H. dihystera* and *T. dubius* do not cause any specific symptoms, but their feeding on the roots promotes the inhibition of plant growth and development [1, 2, 13–15].

In Ukraine sugar beet fields are mostly affected by *H. schachtii* [5–12] and *L. elongatus* [3]. The sugar beet cyst nematode *H. schachtii* is wide-spread

around the world and occurs in most countries where sugar beets are grown [13–18]. *H. schachtii* was first reported from Germany where it caused the so called "Rübenmüdigkeit des Bodens" or "sugar beet replant disease" [16, 17]. Besides Germany, *H. schachtii* was found in other European countries as well: the Netherlands and Poland (25 % of the fields), former Czechoslovakia (20 %), Italy (19 %), former Yugoslavia (10–12 %), Sweden (10–15 %), Spain and Great Britain (10 %), and France (3%). In addition, *H. schachtii* has been reported from Albania, Austria, Belgium, Bulgaria, Denmark, Finland, Greece, Hungary, Ireland, Portugal, Romania, Switzerland and Turkey. Outside of Europe, *H. schachtii* is known to occur in USA, Canada, Latin America, Israel, Iran, Iraq, Jordan, Pakistan, Syria, China, Japan, Australia, New Zealand, and on the African continent – Algeria, Cape Verde, Egypt, Gambia, Libya, Morocco, Tunisia, Senegal and South Africa (EPPO database and CABI datasheet) [13–15].

In the former USSR, the sugar beet cyst nematode was first discovered by Professor Korab in Ukraine in August of 1923 on the fields of the Pii sugar beet farm (Kyiv region) [5]. Since then different republics of the former USSR started detailed examination of sugar beet fields for the presence of this parasite in the soil. Regular soil surveys in Ukraine, Russia, Western Siberia, and Middle Asia in 1926–1930 resulted in the detection of 657 nematode-infested fields in the vicinity of 144 sugar refineries covering a total area of 108,800 ha [6]. In 1932 the sugar beet cyst nematode was found in Lithuania [19], and in 1939 in Kazakhstan [20]. According to the studies of T. S. Skarbilovich in the 1950's in Russia, *H. schachtii* was found in Belgorod, Kursk, Tula, Kaliningrad, Leningrad, Pskov, Novgorod, Rostov, Tambov, Smolensk, and Kirov regions as well as the Krasnodar territory, Western Siberia, and Transcaucasia [21]. Much later, in 1964, outbreaks of *H. schachtii* were reported from Moldova [22], and in 1966 from Kirghizia [23]. Similar outbreaks were noted in Belarus, Estonia, Tajikistan [22], Uzbekistan [24], and Georgia [25].

Studies on determining the range of sugar beet cyst nematode and its damage potential are urgently needed to define its current economic threat. For instance, regular examinations of sugar beet fields in different regions of Ukraine documented further distribution of *H. schachtii*. For example, in the 1980's *H. schachtii* was registered in 16 [7] and in the late 1990's – early 2000's – in 17 regions of the country [8]. Selective nematological examinations of the fields and plantings of sugar beet in the course of recent twenty years revealed new *H. schachtii* outbreaks in traditional sugar beet growing districts of Ukraine. In particular, in 1995–2000 the examination of 5,744 ha revealed that 4,833 ha (or 84.1 %) were infested with *H. schachtii* [9]. Outbreaks of this dangerous pathogen were registered in Vinnytsia (Bershad district – 570 ha, Trostianets district – 185 ha; Lityn district – 888 ha; Khmilnyk district – 1,184 ha), Zhytomyr (Brusyliv district – 100 ha), Kyiv (Kyiv-Sviatoshyn district – 300 ha; Baryshivka district – 100 ha), Kirovograd (Novoukrayinsk district – 663 ha), and Khmelnytsky (Teofipol district – 1,022 ha) regions. In most infested areas (3,709 ha) the population of sugar beet cyst nematode did not exceed 100 eggs + + juveniles/100 cc of soil. At an area of 317 ha the rate of soil infestation with this pathogen ranged from 101 to 300 eggs + juveniles/100 cc of soil, and at an area of 809 ha the population density exceeded 300 eggs + juveniles/100 cc of soil [9].

During the same period there was the examination of 6,649 ha of sugar beet fields in Vinnytsia, Poltava, Ternopil, and Khmelnytsky regions, where 1,150 ha, or 17.3 %, were found to be infested with sugar beet cyst nematode – only single females were observed on plant roots [9].

During the subsequent four years (2001–2004) nematological surveys were conducted in Vinnytsia (13 seed farms – 3,069 ha) and Khmelnytsky (seven farms – 3,507 ha) regions with the total area of 6,576 ha [10]. It was determined that 81 % of fields were infested with sugar beet cyst nematode. For instance, 2,235 out of 3,069 ha, or 72.8 %, were infested in Vinnytsia region, where it was intended to grow beet for industrial production. In four out of 13 farms examined, the population of sugar beet cyst nematode exceeded its threshold level of 200 eggs + juveniles/100 cc soil with numbers ranging between 228 and 773 eggs + juveniles/100 cc of soil. This density of nematode population in soil had a negative impact on the yield of sugar beet seeds, the weight of 1,000 seeds and its germination. With the increase of the initial infestation up to 300 eggs + juveniles/100 cc of soil, there was a decrease in the yield of sugar beet seeds by 6.6%, in the weight of 1,000 seeds by 8.7 %, and in the germination rate of seeds by 3.5 %. With an increase in the nematode population up to 700 eggs + juveniles/100 cc of soil, these indices were 47.4, 26.8, and 13.3 %, respectively. Yield reductions of industrial sugar beets and grafters at *H. schachtii* densities above 700 eggs + juveniles/100 cc of soil were 34.5 % [10].

Examination of 3,507 ha (seven farms in Teofipol district) in Khmelnytsky region resulted in 3,092 ha or 88.2 % being infested with *H. schachtii*. It should be noted that in an area of 1,589 ha (51.4 %) the nematode population exceeded 300 eggs + juveniles/100 cc of soil, and in some fields the number of eggs + juveniles/100 cc of soil reached peaks between 1,102 and 2,310 eggs + juveniles/100 cc soil [10].

In 2010–2015 our studies were aimed at conducting the nematological survey in six regions of Ukraine to determine the distribution of sugar beet nematode, to define its population density and the degree of its harmfulness in sugar beet fields, to register the specific plant symptoms associated with it and to check for the effectiveness of practical control measures.

MATERIALS AND METHODS

The nematological survey was conducted to document the occurrence of the sugar beet cyst nematode in six regions of Ukraine, namely Kyiv, Chernihiv, Cherkasy, Khmelnytsky, Kirovograd and Vinnytsia. Five soil cores per sample were taken every 5–10 m from the top 20 cm of soil along two diagonals of the field or in a zigzag form, using a soil auger or spade. An average sample size of 200–250 cc was placed in a polyethylene bag, labeled with sampling site, date of examination, and transported to the laboratory for further analysis [26].

The flotation and sieving method was used to extract the cysts of *H. schachtii* from the soil samples [26]. For identification, cysts were prepared by Kyrianova's method [14]. Morphology and morphometrics of cysts, vulva cone, and juveniles were studied using light microscopy. The number of eggs and juveniles extracted from cysts were calculated per 100 cc of soil (eggs + juveniles/100 cc of soil) and served as an index of nematode population density in soil [26].

During the vegetation period, the presence of sugar beet cyst nematode and the degree of plant infestation was determined by external disease symptoms as well as the number of white females on the roots and brown cysts in the soil [26].

The crop rotation was analyzed for the presence of host plants in accordance to determine the reasons for high densities of the sugar beet cyst nematode.

RESULTS AND DISCUSSION

In 2010–2015 the nematological survey was conducted on a total area of 12,130 ha. The sugar beet cyst nematode *H. schachtii* was found in Kyiv, Chernihiv, Cherkasy, Khmelnytsky, and Vinnytsia regions, but not in Kirovograd region, at the total area of 2,572 ha or 21,2 % of the area examined (Table 1).

The majority (50.4 %) of fields infested with sugar beet cyst nematode (1,296 ha) had a high rate of nematode population exceeding 600 eggs + juveniles/100 cc of soil. Medium infestation rates ranging from 201 to 600 eggs + juveniles/100 cc of soil were found at 515 ha or 20.0 % of the infested area. Low infestation rates of *H. schachtii* with up to 200 eggs + juveniles/100 cc of soil were found at 761 ha or 29.6 % of the infested area.

In Kyiv region the nematological survey was conducted at the total area of 965.0 ha (Stavyshche dis-

Table 1. Infestation of different regions of Ukraine with the sugar beet cyst nematode *Heterodera schachtii* (2010–2015)

Region	Examined area (ha)					
	Total	Infested with *H. schachtii*		Degree of *H. schachtii* infestation (eggs + juveniles/100 cc of soil)		
		ha	%	Low < 200	Medium 201–600	High > 600
Kyiv	965.0	867.0	89.8	531.0	152.0	184.0
Chernihiv	820.0	820.0	100.0	230.0	263.0	327.0
Cherkasy	350.0	350.0	100.0	0.0	0.0	350.0
Khmelnytsky	435.0	435.0	100.0	0.0	0.0	435.0
Kirovograd	9460.9	0.0	0.0	0.0	0.0	0.0
Vinnytsia	100.0	100.0	100.0	0.0	100	0.0
Total	12130.9	2572.0	21.2	761.0	515.0	1296.0

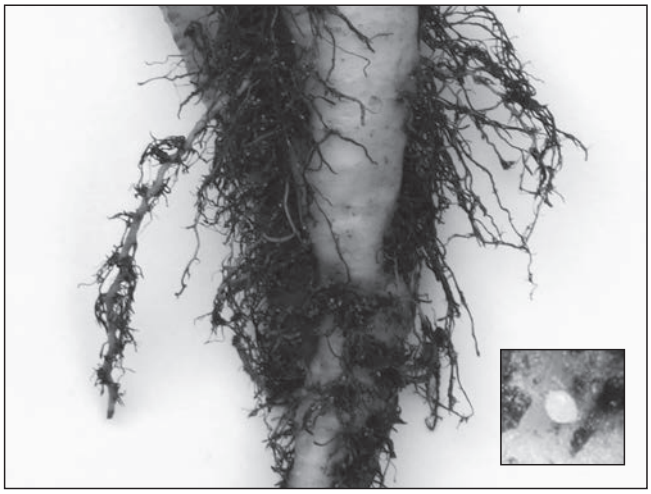

Fig. 1. A sugar beet root heavily infested with *Heterodera schachtii* showing intensive lateral root growth ("root beard") and white females attached to the root (Cherkasy region, 2014)

Fig. 2. Sugar beet roots affected by the sugar beet cyst nematode *Heterodera schachtii* showing severe biforking and deformation (Khmelnytsky region, 2015)

trict – 920 ha, Tetiyiv district – 45 ha). Out of this, 867.0 ha (or 89.8 %) were found to be infested with *H. schachtii*. Low rates of *H. schachtii* were found at 531 ha, with population densities ranging between 32 and 198 eggs + juveniles/100 cc of soil. At 152 ha the population of *H. schachtii* did not exceed the medium index of 339 eggs + juveniles/100 cc of soil, while 184 ha were found to be heavily infested with 3,666 eggs + juveniles/100 cc of soil on 89 ha and 10,432 eggs + juveniles/100 cc of soil on 95 ha. Only on two fields with the total area of 98 ha sugar beet cyst nematode was not detected.

Similar results were obtained for the Chernihiv and Cherkasy regions. For instance, *H. schachtii* was found at a total area of 820 ha in Chernihiv region. A high rate of *H. schachtii* was recorded at an area of 327 ha with population densities of 721 to 66,144 eggs + juveniles/100 cc of soil, or 10 to 312 cysts, respectively. A further 230 ha had a low rate of *H. schachtii* infestation with densities below 85 eggs + juveniles/100 cc of soil, respectively 1–2 cysts. Medium nematode densities were found at 263 ha ranging from 355 to 492 eggs + juveniles/100 cc of soil.

Considerable infestation with *H. schachtii* was registered while examining 350 ha of sugar beet fields in Cherkasy region (Korsun-Shevchenkivsky and Lysianka districts). All fields were found to be infested. Analysis of sugar beet plants resulted in the detection of 13 to 136 white females per root (Fig. 1). The soil density of *H. schachtii* was in the range between 72,352 and 142,788 eggs + juveniles /100 cc of soil.

In Khmelnytsky region (Krasyliv district) a total of 435 ha of sugar beet fields were monitored. Between 1 and 34 white females were found on sugar beet roots and soil population of *H. schachtii* ranged between 173 and 11,780 eggs + juveniles/100 of soil. Visual examination of sugar beets collected from infested areas showed reduced growth and development, outer leaves with yellow shade and brown spots, and root weight less than half of healthy beets (Fig. 2).

In Vinnytsia region a total area of 100 ha was monitored. The number of sugar beet nematode cysts in soil ranged from 1 to 77 per 100 cc of soil, and the average number of eggs + juveniles was 227 per 100 cc of soil.

The largest area with 9,460 ha of fields was examined in Kirovograd region. Unfortunately, in none of the samples was *H. schachtii* detected, although the nematode has been found in this region before.

Taking into consideration the results of the previous studies, it is reasonable to state that as of January 01, 2016 sugar beet nematode is present in 18 regions of Ukraine: Kyiv, Cherkasy, Vinnytsia, Sumy, Zhytomyr, Chernihiv, Khmelnytsky, Ternopil, Rivne, Volyn, Lviv, Ivano-Frankivsk, Chernivtsi, Kharkiv, Poltava, Kirovograd, Dnipropetrovsk, and Donetsk regions (Fig. 3). In most mentioned regions the infestation level of *H. schachtii* is around 10–11 % of the examined fields. The distribution zone for *H. schachtii* coincides with the borders of the sugar beet growing area neither in the northern nor in the southern part of Ukraine, as sugar beet nematode was found both in industrial fields and in small private holdings, where it infested both common and red beet [9].

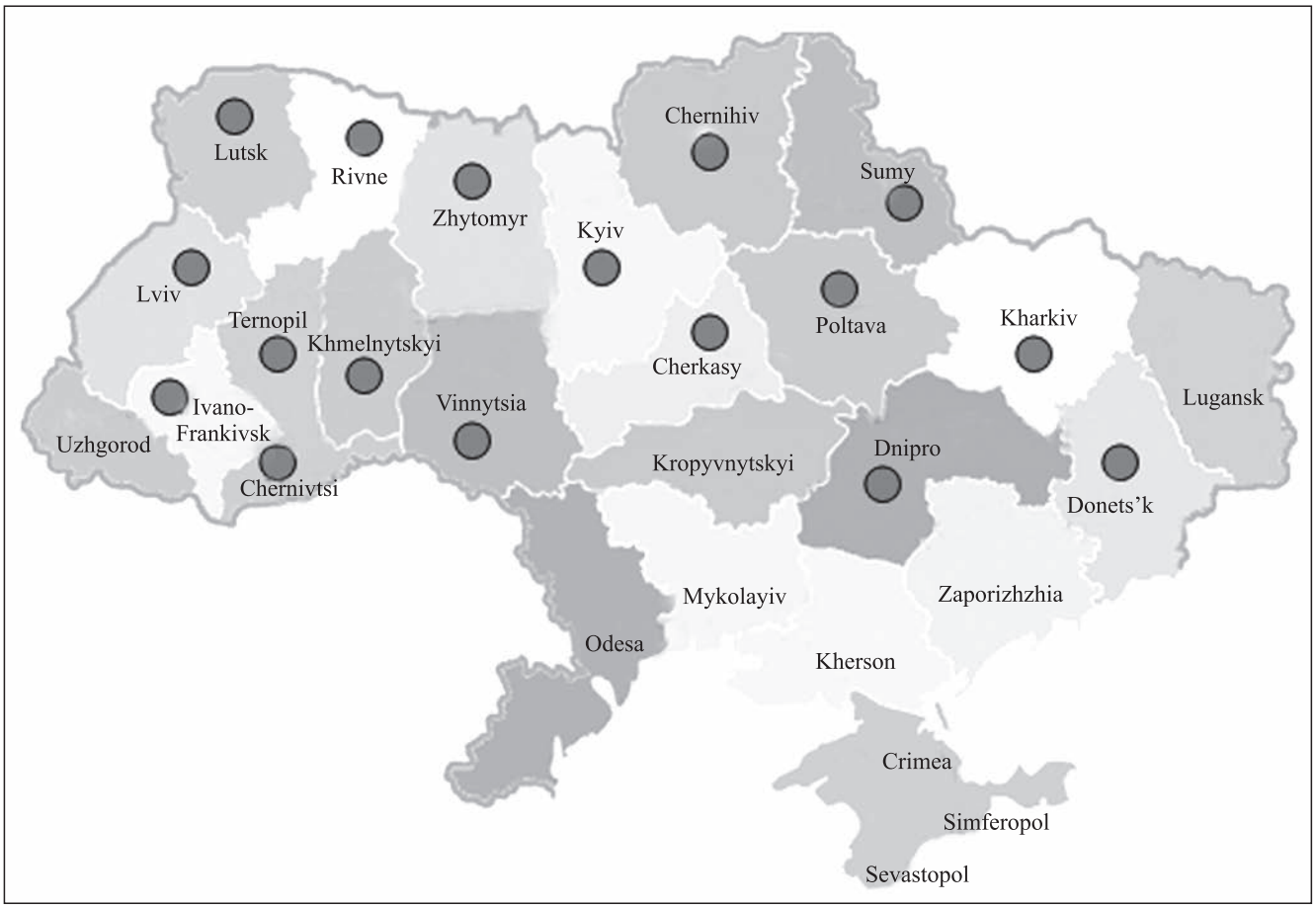

Fig. 3. The distribution (marked with red dots) of the sugar beet cyst nematode *Heterodera schachtii* in different regions of Ukraine (as of January 01, 2016)

The problems associated with *H. schachtii* are not accidental. Although the nematode itself cannot move more than 50 cm, long-distance transport is possible via soil attached to farm machinery, sugar beet waste from industry delivered back to the field and wind erosion. However, all those means will only set the initial infestation but not cause economic damage straight away. Only if good host plants like sugar beet or rape are planted in distances less than 3–4 years, *H. schachtii* can build up to damaging levels. Therefore, the observed increase in the number of sugar beet cyst nematodes is most likely related to poor agricultural practice, i.e. too short intervals between host plants [6, 9–11, 27]. This was confirmed for the heavily infested fields by their documented history, showing that sugar beet was grown once in every three years, either as peas – wheat – sugar beet or corn – wheat – sugar beet.

At a first glance, the increasing importance of *H. schachtii* over the past years might be surprising considering the decline of sugar beet cropped area from 1,605,400 ha in 1990 to 238,900 ha in 2015 (Table 2). However, at the same time production area of rape, also an excellent host for *H. schachtii*, increased from 89,700 ha in 1990 to 684,400 ha in 2015. Therefore, the total area cropped with good host plants for *H. schachtii* did not vary so much in the last 25 years, and there must be a different explanation for the recent increase in *H. schachtii* damage on sugar beets.

During the survey it became evident, that some farms planted sugar beet and rape every other year [9]. This clearly explains the observed massive multiplication of *H. schachtii* in the studied fields and its associated yield losses of up to 70 % in sugar beet and 50 % in rape. Further planting of sugar beet or rape in nematode-infested fields becomes unprofitable [27]. The fundamental principle of good agricultural practice, that host plants for *H. schachtii* should not exceed 20 % within the rotation, was clear [9, 10, 27]. Farmers should be made aware about this critical situation and trained in recognizing the typical symptoms caused by *H. schachtii*, *e.g.* patches of reduced growth, biforking of main root, bearded root, white/brown cysts on the

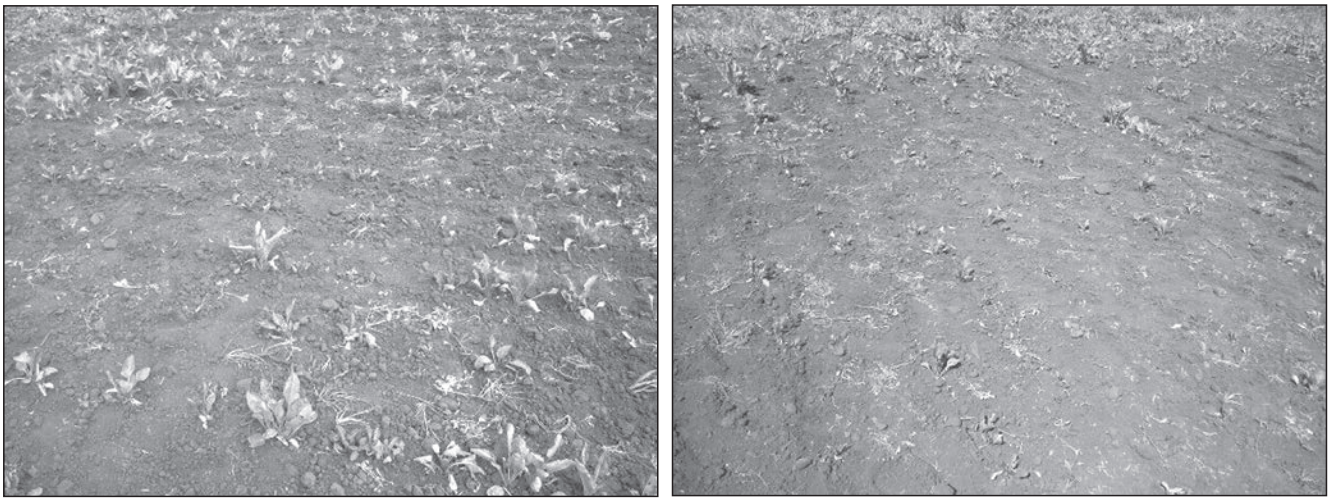

Fig. 4. Poor seedling emergence of sugar beet seedlings due to early infestation by the sugar beet cyst nematode *Heterodera schachtii* (Vinnytsia region, 2015)

root surface, and how to improve their rotation. The farmer should also know that as soon as patches of poor growth are first visually recognizable in the field (Fig. 4), yield losses are already more than 10 %, which in many cases is equal to the profit of the entire crop.

Table 2. The harvested areas under sugar beet and rape in Ukraine

Year	Harvested area under crop*, ×1000 ha		
	Sugar beet	Rape	Total
1990	1605.4	89.7	1695.6
1995	1448.5	49.1	1497.6
2000	757.5	214.3	971.8
2001	852.6	120.0	972.6
2002	764.6	81.4	846.0
2003	665.0	68.6	733.6
2004	699.0	117.0	816.0
2005	623.3	207.4	830.7
2006	788.0	414.2	1202.2
2007	584.0	890.7	1474.7
2008	387.0	1411.8	1798.8
2009	319.7	1059.5	1379.2
2010	492.0	907.4	1399.4
2011	515.8	870.0	1385.8
2012	448.9	566.0	1014.9
2013	270.5	1017.0	1287.5
2014	329.6	881.6	1212.2
2015	238.9	684.4	922.3

*****According to the data of the State Statistics Service of Ukraine.

Farmers and extension specialists should be motivated to let suspected fields be checked for sugar beet cyst nematodes, especially in those areas where the nematode is known to be wide spread. Therefore, the collection of soil samples, which should be conducted in autumn after harvest (highest numbers expected) or in spring prior to sowing (most accurate numbers) allows both revealing the area, infested with this nematode, and forecasting future losses due to the infestation with *H. schachtii* [27].

According to the nematode analysis measures can be taken. At nematode numbers below 200 eggs + juveniles/100 cc of soil susceptible, high yielding sugar beet cultivars can be grown. At critical numbers of 200–600 eggs + juveniles/10 cc of soil a tolerant sugar beet cultivar should be selected or planting can be delayed to allow a feaster seedling that can better tolerate early nematode infestations. If numbers exceed 600 eggs + juveniles/100 cc of soil the options are growing a resistant cultivar (see below) or a non-host. Both will reduce the *H. schachtii* density in the field [6, 9–15, 21, 27, 28].

Additional measures could be adjusting the time span between two host plants to the actual nematode level in the field, *i.e.* at high nematode levels grow sugar beets only once in 5–6 years until nematode densities have declined to acceptable levels and then go back to sugar beets once in 3–4 years.

Some farms practice planting of resistant fodder radish cultivars (*e.g.* Colonel, Pegleta, Matador, Zhurav-

ka) or yellow mustard cultivars (e.g Accent, Concerta, Maxi, Pidpecheretska) as a green manure after wheat and before sugar beet [11].

If rape is grown, make sure that the volunteer rape that usually comes up shortly after harvest is destroyed 4–5 weeks after emergence at latest. If done correctly, *H. schachtii* juveniles have penetrated the rape seedlings, become trapped in the roots and if the seedlings are killed mechanically of with a herbicide before females have developed, the nematode will get killed, too. This is an example of the so-called trap crop.

Besides, farmers should not neglect taking curative measures, aimed at preventing the introduction of nematode cysts to other fields along with equipment, soil tillage tools, etc. In addition, as data clearly demonstrated, the largest outbreaks of *H. schachtii* are often on the farms located near sugar refineries that have received the sugar beet wastes from these refineries, a main source of *H. schachtii* distribution to non-infested fields. Thus, the wastes should be checked for the presence of nematode cysts, and in case of positive findings, should be treated by heat, anaerobic fermentation or similar and by no means brought onto land intended for growing sugar beets or rape [6, 9–15, 27].

Other agrotechnical measures controlling *H. schachtii* include the compliance with recommended crop rotation, timely and thorough seed bed preparation, use of certified seeds, optimal time for planting, application of organic-mineral and microfertilizers in balance to the crop requirements, accurate weed control on all fields of the crop rotation, short-term planting of trap crops such as mustard, oil seed rape, rape, which are sown in August-September, then cut and plowed under latest after 40–45 days [6, 9–15, 21, 27].

As for chemical means of protecting the fields from sugar beet nematode, there are no nematicides in the domestic market, and the insecticides, used to treat sugar beet seeds, are efficient only against its first nematode generation. By the end of vegetation of sugar beet, due to the development of a second and subsequent generation, nematode numbers restore and are generally higher than before planting [27, 28].

In addition to the abovementioned measures, the most economically and environmentally safe and efficient method of controlling *H. schachtii* and securing sugar beet yield at the same time is planting of resistant cultivars [12–15, 29–35]. In recent years, scientists have conducted intense search for donors of resistance to this parasite. Modern scientific methods allowed mapping of genes in wild beet species that provide resistance towards the sugar beet cyst nematode, such as $Hs1^{pro-1}$, $Hs2^{pro-7}$, $Hs1^{web-1}$, $Hs1^{web-7}$, $Hs1^{web-8}$, and $Hs1^{pat-1}$ [29–32]. Out of those, $Hs1^{pro-1}$ was successfully bred into modern high yielding sugar beet cultivars: Nemata, Paulina, Rianna, Sanetta. When grown, those cultivars will lower the *H. schachtii* infestation of the soil. Unfortunately, those cultivars have a lower yield potential in the absence of nematode infestation and therefore are only economically grown at *H. schachtii* densities above 1000 eggs + juveniles/100 cc of soil. An alternative could be tolerant sugar beet cultivars. Those cultivars do not react within a certain range to *H. schachtii* infestation with reduced plant growth, i.e. they can tolerate the damage the nematode does. However, they do increase nematode densities in the field, although less than normal cultivars. So if repeatedly grown, care needs to be taken that nematode densities do not increase to such high levels that sugar beet yield finally starts to decline. Tolerant cultivars produce similar, sometimes even higher yields than normal cultivars and therefore are successfully grown in areas infested with *H. schachtii*. Tolerant cultivars in 2016 include: Adrianna, Annalisa, Belladonna, Brix, BTS440, BTS8750N, Corvetta, Daphna, Finola, Firoella, Kepler, Kleist, Kristallina, Kühn, Lisanna, Pauletta, Theresa and Vasco [33]. Additional nematode-tolerant sugar beet cultivars, including Corrida, Slawa, Bison, Federika, Balu [12] and Attack were registered in Ukraine [34]. In Ukraine the breeding of resistant or tolerant cultivars has not yielded considerable results yet. It is currently possible to talk about some tolerance – the ability of the domestic sugar beet cultivar, Bilotcerkivsky monosperm 45, to withstand some damage.

CONCLUSIONS

Sugar beet remains a strategically and economically important crop in Ukraine. Taking into account the wide distribution of the sugar beet cyst nematode *H. schachtii* in the country, the problem of protecting the fields from this devastating nematode is urgent.

The examination of 12,130 ha of agricultural fields in six regions of Ukraine, conducted in 2010–2015, detected the sugar beet cyst nematode in five of them (Kyiv, Chernihiv, Cherkasy, Khmelnytsky, and Vinnytsia), at a total area of 2,572 ha. Having taken into consideration the results of previous nematological studies, the presence of the sugar beet cyst nematode has now been confirmed for 18 regions of Ukraine, with an average of 10–11 % of the sugar and seed producing fields being infested.

The severity of the situation was confirmed by extreme infestation levels up to 142,000 eggs + juveniles/100 cc of soil which represents 710-fold of the economic threshold level.

The main reasons for this wide distribution of *H. schachtii* in Ukraine seen in the negligence of prevention measures, unavailability of documented data on its occurrence (missing surveys), crop rotations with over 20 % of host plants, and unavailability of efficient nematicides and domestic nematode-resistant sugar beet cultivars.

Поширеність та шкідливість бурякової нематоди *Heterodera schachtii* в Україні

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Мета. Визначити поширеність бурякової нематоди *Heterodera schachtii* в Україні, встановити щільність її популяції в ґрунті, ступінь шкідливості та ефективність застосування системи заходів захисту посівів цукрових буряків від гетеродерозу. **Методи.** Лабораторний, «флотаційно-лійковий» метод, електронно-світлова мікроскопія. **Результати.** Під час обстеження 12130,9 га сільгоспугідь шести областей України, проведеного в 2010–2015 рр., бурякову нематоду виявлено в п'яти з них (Київській, Чернігівській, Черкаській, Хмельницькій і Вінницькій) на загальній площі 2572 га. З урахуванням результатів попередніх нематологічних обстежень констатовано наявність бурякової нематоди у 18 областях України, в більшості з них вогнища гетеродерозу знайдено на 10–11 % обстежених площ виробничих та насіннєвих посівів цукрових буряків. Про складність фітосанітарної ситуації у деяких господарствах свідчить присутність вогнищ гетеродерозу, у яких щільність популяції нематоди в 100 см^3 ґрунту становить понад 142 тис. личинок і яєць (перевищення порогу шкідливості у 710 разів). **Висновки.** Основними причинами значного поширення *H. schachtii* в Україні є нехтування заходами профілактики (зокрема, відсутність планомірних нематологічних обстежень), насиченість сівозмін рослинами − господарями нематоди у межах 20 %, відсутність на ринку доступних високоефективних нематицидів та вітчизняних нематодостійких гібридів цукрових буряків.

Ключові слова: бурякова нематода, поширеність, шкідливість, заходи контролю.

Распространение и вредоносность свекловичной нематоды *Heterodera schachtii* в Украине

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Цель. Определить распространенность свекловичной нематоды *Heterodera schachtii* в Украине, установить плотность ее популяции в почве, степень вредоносности и эффективность системы защиты посевов сахарной свеклы от гетеродероза. **Методы.** Лабораторный, «флотационно-лейковый» метод, электронно-световая микроскопия. **Результаты.** При обследовании 12130,9 га сельхозугодий в шести областях Украины, проведенном в 2010−2015 гг., свекловичную нематоду выявили в пяти из них (Киевской, Черниговской, Черкасской, Хмельницкой и Винницкой) на общей площади 2572,0 га. С учетом результатов предыдущих нематологических обследований констатировано присутствие свекловичной нематоды в 18 областях Украины, в большинстве из которых очаги гетеродероза обнаружены на 10−11% обследованных площадей производственных и семенных посевов сахарной свеклы. О сложности фитосанитарной ситуации в отдельных хозяйствах свидетельствует наличие очагов гетеродероза, в которых численность популяции нематоды в 100 см^3 почвы составляет более 142 тыс. личинок и яиц (превышение порога вредоносности в 710 раз). **Выводы.** Основными причинами широкого распространения *H. schachtii* в Украине является пренебрежение мерами профилактики (в частности, отсутствие планомерных нематологических обследований), насыщенность севооборотов растениями − хозяевами нематоды в пределах 20 %, отсутствие на рынке доступных высокоэффективных нематицидов и отечественных нематодоустойчивых гибридов сахарной свеклы.

Ключевые слова: свекловичная нематода, распространенность, вредоносность, меры защиты.

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