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INTEGRATED CONTROL OF PARASITIC CYST NEMATODE (*GLOBODERA ROSTOCHIENSIS*) ON POTATO FARMS OF GEGHARKUNIK MARZ, ARMENIA

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The investigation helped to reveal the prevalence of the nematode, bio-ecological features of its live cycle, number of generations per plant growing season, influence of *Globodera rostochiensis* on plant growth and development in Gegharkunik marz. The soil was desinfected with chemicals "Bazudin" and "Dazomed" and the same time seeds were desinfected with 2% Formalin and "Prestige" solutions. We first used chemicals "Bazudin" and "Prestige" as a preventive measures against potato cyst forming nematode and have received positive results.

Կատարված հետազոտություններից պարզվել է կարտոֆիլի ցիստառաջացնող նեմատոդի տարածվածությունը Գեղարքունիքի մարզում. կենսա-էկոլոգիական առանձնահատկությունները, զարգացման ցիկլը, սերունդների բանակությունը բույսի մեկ վեգետացիայի ընթացքում: Փորձարկվել է նեմատոդի դեմ պայքարի ինտեգրացված մեթոդ: Դոզը ախտահանվել է «Բազուդին» և «Դազոմեդ» քիմիկատներով, իսկ տնկանյութը ֆորմալինի և «Պրեստիժ»-ի լուծույթներով: «Պրեստիժ» և «Բազուդին» քիմիկատները, որպես կարտոֆիլի ցիստառաջացնող նեմատոդի դեմ պայքարի միջոց, առաջին անգամ փորձարկվել է մեր կողմից և ստացվել է դրական արդյունք:

Исследования в Гегаркуникской области выявили высокую зараженность картофеля *Globodera rostochiensis*. В ходе исследования выяснили биозекологические особенности цистобразующей нематоды, цикл развития, число поколений в период вегетации растений. Испытан интегрированный метод борьбы против картофельной нематоды. Почву обрабатывали химикатами "Базудин" и "Дазомед", а посадочный материал — растворами формалина и "Престиж". Впервые примененные нами химикаты "Престиж" и "Базудин", как средство борьбы против картофельной нематоды, дали положительные результаты.

Potato - nematoda - integration control method

Potato is one of the most important and essential crops in Armenia which ranks second priority after cereals. Among various infectious pests and diseases, parasite cyst nematode despite being a quarantine pest is widely spread all over the world and Armenia is not an exception. The losses in fields of high infestation level count to 70-80% [2]. Gegharkunik Marz is considered to be one of the main regions of potato cultivation and provides 36% of potatoes in the Republic.

Potato parasite nematode cyst (*Globodera rostochiensis*) causes *Globoderos* disease. It was first found in Armenia in 1978, in Lusakert village of Artik region [1]. Further studies show that the parasite nematode is widely spread throughout potato farms of the Republic (except for Ararat region farms where early-grown

potato is cultivated), especially in the Lake Sevan catchment area, causing high level of harvest loss. Present-day wide distribution of the nematode can be explained by import of seeds through various ways, which in their stead are not always carefully studied by quarantine inspection service.

Material and methods. On-farm surveys in Gegharkunik region include both transect and stationary methods. For identification of the spread of potato parasite cyst nematode, harm and other biological characteristics, soil and seed samples have been taken from the farms of Sevan, Lehashen, Drakhtik, Vahan Tchambarak, Karmirjugh, Sarukhan, Gandzak, Noratus, Hatsarat, Lanjaghbjur, lichk, Vaghashen, Vardenik, Eranos, Dzoragjugh, Zolakar, Astghadzor, Korchabjur, Vardenis.

Cysts were extracted from the soil in the laboratory, through washing and usage of special tailor-made meshes of various dimensions ranging from 64-100mm. Soil samples from different parts of the field were mixed, and 100g was extracted and poured into the cup and filled up with of water. It was stirred and left for some time, after which the experience with the aforementioned meshes was carried out. The meshes were then washed and the solution was poured into a Petri dish and studied through microscope binocular.

In order to identify the level of soil infestation the quantity of cysts per 100g was counted, as well as the number of eggs and larvae within one cyst.

To determine the level of infestation the number of cysts on 1 cm root was counted during different stages of plant growing season.

For on-farm surveys a territory of 900m² in Karmirjugh of Gegharkunik Marz with very high level of infestation - 500-600cysts per 100gr has been chosen. An appropriate contract was signed with the farmer. For integrated method a plot of 400m² has been extracted. For nematode resistant potato sort identification 3 sorts were studied "Sandra", "Dinara", "Likara". The seeds were treated using 2% Formalin solution for 5 minutes and afterwards with "Prestige" solution 100ml per 100kg. The seeds were spread on the polythene strip, "Prestige" solution was applied with a syringe and then covered with another polythene strip and left for an hour, after which they were planted. "Bazudin" solution was used simultaneously with seed planting for soil disinfection. The experiment carried out was done using randomization method with 5 treatments, 3 replications and appropriate controls for each sort (scheme 1).

The rest of the field part, 500m², was disinfected with "Dazomid" chemical month before potato planting 270t/ha dosage, where sort Isabella was studied. Potato cultivation was done according to practices locally adopted in the area. Dimensions used for planting are 75cm for row spacing and 30-35cm for plants spacing. The potato was planted on May 20-25 and collected on October 4-8. Periodically once in 15 days samples from soil and plant root system were taken from experimental field to identify the impact of chemicals on the parasite, the level of infestation of the plant, as well for identification and study of some bio-ecological traits. During the harvest season the following calculations were done. We counted the number of the plants of each sort in each treatment and in controls, the quantity of the harvest, identified the average yield per plant and the whole harvest gathered from the experienced field.

a. Distribution of potato parasite cyst nematode in Gegharkunik Marz.

All potato farms of Gegharkunik Marz were studied and parasite cyst nematode was found in Sevan, Lehashen, Drakhtik, Vahan, Tchambarak, Karmirjugh, Sarukhan, Gandzak, Noratus, Hatsarat, Lanjaghbjur, lichk, Vaghashen, Vardenik, Eranos, Dzoragjugh, Zolakar, Astghadzor, Korchabjur, Vardenis villages where "Isabella", "Palma", "Mona Lisa", "Sandra", "Dinara", "Likara", "Impulse", "Seralin" sorts are cultivated. Potato fields in villages of Vahan, Karmirjugh, Sarukhan, Noratus, Vardenik, Eranos, Vaghashen, Karchaghbjur are highly infected - 60-560 cysts per 100g of soil. Sorts "Palma", "Dinara", "Mona Lisa" are more susceptible to infestation, whereas "Isabel", "Likara", "Sandra", "Impulse" are less infected. The growth and development of infected plant slows down. It remains dwarf, has a poor exterior, does not flower or flowers

Scheme I. Experiment scheme according to randomizing method

"Sandra" Sort

	I replication					II replication					III replication					Cont
	Treatments					Treatments					Treatments					
	3	2	4	1	5	4	1	5	3	2	3	1	4	2	5	
10m ¹	-Ch	-Ch	+Ch	+Ch	+Ch	+Ch	+Ch	+Ch	-Ch	-Ch	-Ch	+Ch	+Ch	-Ch	+Ch	-
	+P	+F	+F	untreated seed	+P	+F	untreated seed	+P	-P	+F	+P	untreated seed	+F	+F	+P	-

"Dinara" Sort

	I replication					II replication					III replication					Cont
	Treatments					Treatments					Treatments					
	2	4	5	3	1	3	1	4	2	5	1	3	4	5	2	
10m ²	-Ch	+Ch	+Ch	-Ch	+Ch	-Ch	+Ch	+Ch	-Ch	+Ch	+Ch	-Ch	+Ch	+Ch	-Ch	-
	+F	+F	+P	-P	untreated seed	-P	untreated seed	+F	+F	+P	untreated seed	+P	+F	+P	+F	-

"Lakara" Sort

	I replication					II replication					III replication					Cont
	Treatments					Treatments					Treatments					
	3	2	4	1	5	2	4	3	5	1	2	1	4	3	5	
10m ³	-Ch	-Ch	+Ch	+Ch	+Ch	-Ch	+Ch	-Ch	+Ch	+Ch	-Ch	+Ch	+Ch	-Ch	+Ch	-
	+P	+F	+F	untreated seed	-P	+F	+F	+P	+P	untreated seed	+F	untreated seed	+F	+P	+F	-

- 1 Chemical + untreated seed
- 2 No chemical + Formalin treated seed
- 3 No chemical + Prestige treated seed

- 4 Chemical + Formalin treated seed
- 5 Chemical + Prestige treated seed
- 6 Control (traditional soil and seed)

Chemical Bazudin

are rare, have no tubers, or they are few, small and are used as forage. Highly infected plants dry in the early season of plant growing and are useless (Fig. 1,2).

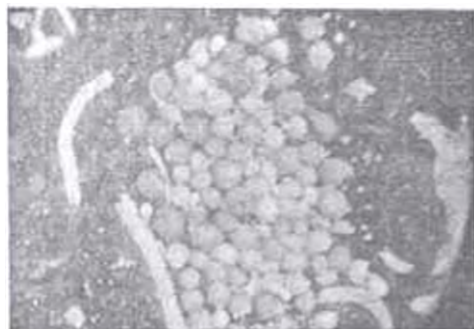


Fig. 1. Infested stage females and cysts extracted from soil (microphoto)



Fig. 2. Infected field in Karmirunggh

d. Experiment Discussion

Potatoes were planted on May 20-25. Observations of plant growth, development were carried, which revealed that the chemicals at the given dosage do not effect plant development and growth. Harvest started after full dry of plant's upper green part in the beginning of October. Periodically root and soil samples were taken and nematode life cycle was checked. In March-April cysts taken from soil were filled with eggs and larvae 400-500 per cyst.

In the end of May up to the beginning of June 2nd stage larvae appeared had already stylet. At this stage the nematode is able to infect the roots. As soon as plant root system develops they concentrate around the radicles, in the zone of growth, stay parallel to the roots and start feeding from root juices. The further development takes place inside the plant and on the roots.

In the end of June "Dinara" and "Likara" controls revealed the root infestation by 3rd stage larvae 8-10 and 3-5 larvae on 1 cm root respectively. However "Sandra" sort controls have not been infected. At the same time in the 2nd treatment 3-5 larvae on 1cm root were found only within "Dinara" sort. Roots of "Likara" and "Sandra" were clear in all treatments.

31-35 white and yellowish females were noticed on controls of "Dinara" sort in July and in all treatments of the same sort 15-20 yellowish females were detected on 1cm root. Whereas in case of "Likara" sort only in the 1st treatment 2-3 yellowish females were found, and in case of "Sandra" sort in 5th replication 3-4 juvenile eggs on 1cm were detected.

In August 8-10 and 15-25 white and yellow juvenile eggs were found in 1st, 2nd, 3rd treatments of "Dinara" sort, whereas in 4th and 5th ones the roots had not yet been infected. Controls on the contrary to treatments were highly infected 15-20 juvenile females on 1cm root. In the 3rd treatment of "Sandra" there were 4 young females, while in 1st, 2nd, 4th, 5th treatments no nematodes were found on roots. 1st, 2nd treatments of "Likara" sort showed the following results: 1-2 young eggs on 1cm root. 3rd, 4th, 5th treatments and no nematodes were found, whereas

in the control 25 young yellow females were detected.

The roots of "Likara" and "Sandra" sort were nematode-free in September. In controls there were 8 juvenile females. In case of "Dinara" sort 5-10 brown nematodes were found in 2nd, 3rd treatments on 1cm root. 1st, 4th, 5th treatments did not reveal any nematodes, in controls 12-18 brown cysts on 1cm root were found.

Soil samples were taken in October as female cysts had already been in it. From the samples taken from the sorts under investigation there were found 3-5 cysts per 100g soil in "Likara", 2-3 in "Sandra" and in case of "Dinara" 16 brown cysts, and in controls results were the following: "Likara" – 100, "Sandra" – 130 and "Dinara" 140 brown cysts.

After harvest the number of cysts per 100gr. soil was counted in the territory of controls. We got the following results: within "Likara" sort 90, "Sandra" – 120, "Dinara"-130 brown cysts. And on the territory of experiments the following: "Likara"– 3, "Sandra"– 3, "Dinara"–6. The dynamics of cysts in soil and plants in controls and all treatments are presented in Fig. 3-6.

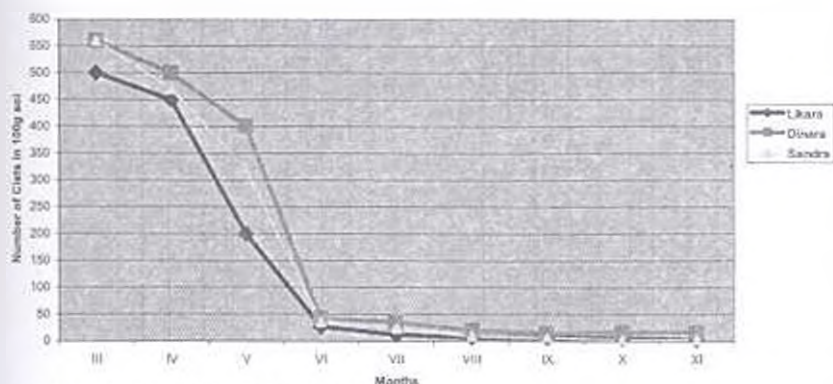


Fig. 3. Cyst number dynamics in soil in treatments.

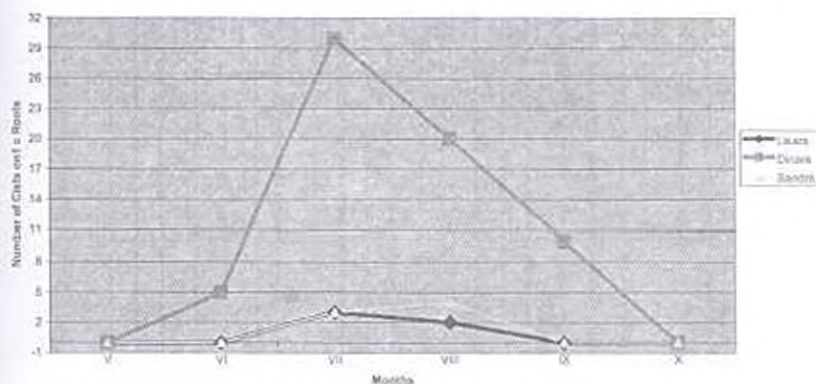


Fig. 4. Cyst quantity dynamics on roots in treatments.

Harvest results are presented in details in Table 1. Having studied the results we can conclude that from all 3 sorts under discussion, "Dinara" is more susceptible to parasite cyst nematode. From the chemicals used positive results

Table 1. Experiment results according to randomizing method

"SANDRA" Sort

"SANDRA" Sort	I replication					II replication					III replication					
	Treatments					Treatments					Treatments					
	3	2	4	1	5	4	1	5	3	2	3	1	4	2	5	
Plant qnty.	33	31	30	32	30	30	30	30	30	30	31	32	28	30	29	30
Harvest qnty/kg	20.5	25.5	35.5	24	27	21	14	37.5	15	16.5	21.5	23	27	25	35	17
Average yield per plant/kg	0.62	0.83	1.2	0.75	0.9	0.7	0.46	1.25	0.5	0.55	0.69	0.7	0.96	0.83	1.2	0.56
Harvest total/kg	132.5					104					131					17
Total/kg						368										-

"DINARA" Sort

	I replication					II replication					III replication					
	Treatments					Treatments					Treatments					
	2	4	5	3	1	3	1	4	2	5	1	3	4	5	2	
Plant qnty.	34	31	31	31	31	27	28	31	27	31	30	26	28	27	32	28
Harvest qnty/kg	22	24	23	22.5	14.5	22	18.5	25	19.5	27	22	23	24	24.5	23.5	14
Average yield per plant/kg	0.65	0.77	0.74	0.73	0.47	0.81	0.66	0.8	0.72	0.87	0.73	0.88	0.86	0.91	0.73	0.5
Harvest total/kg	106					112					117					14
Total/kg						335										-

Table 1 (continuation)

"LIKARA" Sort

	I replication					II replication					III replication					
	Treatments					Treatments					Treatments					
	3	2	4	1	5	2	4	3	5	1	2	1	4	3	5	
Plant qnty	32	33	30	28	28	28	29	29	30	29	32	29	30	30	30	28
Harvest qnty/kg	22	24	28.5	23	29	22.5	24.5	24	27.8	22.5	25.5	20.5	28.5	25	27	18
Average yield per plant/kg	0.69	0.73	0.95	0.82	1.04	0.8	0.84	0.82	0.93	0.78	0.8	0.71	0.95	0.83	0.9	0.64
Harvest total/kg	126.5					121.3					126.5					18
Total/kg						374.3										-

TOTAL HARVEST FROM 3 SORTS 1077.3 kg

1. Chemical + untreated seed
2. No chemical+ Formalin treated seed
3. No chemical+ Prestige treated seed

4. Chemical+ Formalin treated seed
5. Chemical +Prestige treated seed
6. Control (traditional soil and seed)

Chemical Bazudin

were got in 4 and 5 treatments where soil has been disinfected by "Bazudin" and seeds by 2% Formalin solution and Prestige. From that part of the field where experiments had been carried — 370m² (regardless control territory) harvest was 1077 kg. The part where seeds were treated by Prestige in comparison with other parts of the field no Colorado beetles were noticed.

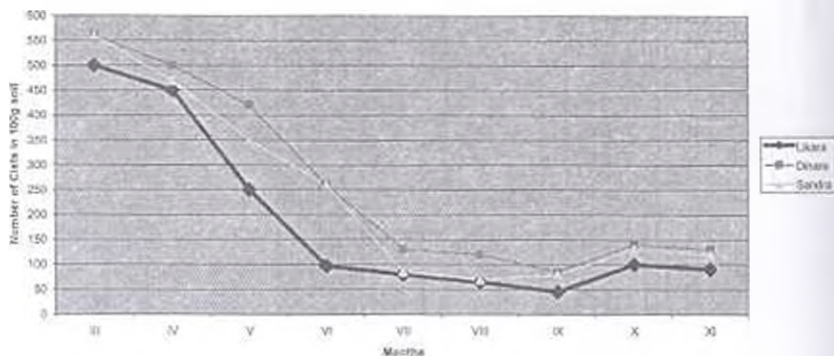


Fig. 5. Cyst number dynamics in soil in controls

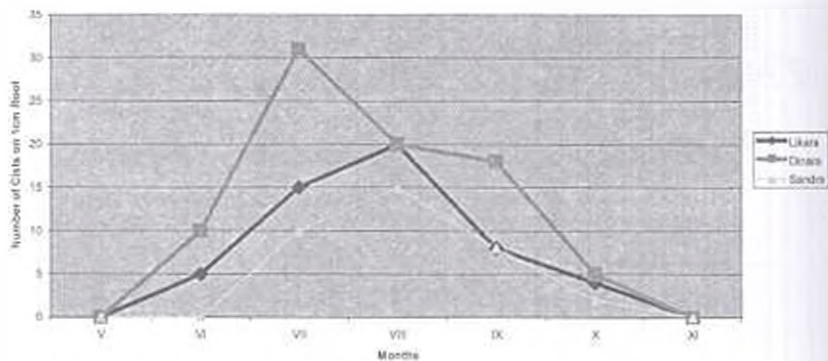


Fig. 6. Cyst number dynamics on roots in controls.

Positive results were detected also from the part treated by "Dazomed" (500m²) where "Isabel" sort was planted. Soil and roots of potato plant have been studied during the whole process of plant growing season. As a result roots were nematode-free, and in soil there was relatively small quantity 10-15 cysts per 100gr. From this part the harvest was 2000kg. According to the farmer from the same part the previous year he had not collect enough harvest. Plants dried in mid-July and in result they had small yield, which was used as forage.

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