European Journal of Agricultural and Rural Education (EJARE)
Available Online at: https://www.scholarzest.com
Vol. 4 No. 12, December 2023
ISSN: 2660-5643

USE OF GREEN MANURE IN GROWING POTATO VARIETIES

Usmanov Nosir Nurmanovich[1],
Doctor of Agricultural Sciences Professor
Karshi Engineering and Economic Institute, Karshi, Uzbekistan
usmon.nosir@inbox.ru

Article history:

Received: 06th October 2023
Accepted: 06th November 2023
Published: 11th December 2023

Abstract:

The growth, development, yield and seed quality of potato varieties after siderate crops were studied in the conditions of typical old-irrigated typical gray-earth soils of Kashkadarya region. The possibility of obtaining high yields with good seed qualities of mid-early potato varieties after the best green manure crops has been scientifically substantiated.

Keywords: Siderite crops, sideration, biomass, growth and development, vegetation period, potato varieties, leaf surface area, productivity.

INTRODUCTION. In world agriculture, the use of biomass of green manure crops as green manure improves soil fertility, increases yield and quality of potato seeds.

In the world, in the context of growing demand for food, in order to increase the productivity of agricultural crops and the quality of products that ensure food security, improve soil fertility in the crop rotation system when using green manure crops (as main, cover, intermediate crops, feed), it is necessary to determine the types of green manure crops , corresponding to various soil conditions, achieving high biomass and seed yield, constant improvement of agricultural technology for using it as green fertilizer. Therefore, research is urgently required to establish the timing of cultivation in order to achieve a high yield of green mass and seeds, increase soil fertility, potato yields, and improve the seed qualities of tubers.

The influence of green manure crops on soil fertility of crops, growth, development, infection of plants by weeds, diseases and productivity of cotton, grains and other crops has been studied [1,2,3,4], and in potato growing [5,6,7,8,11, 12,13,14].

In the short-term crop rotation used in potato growing, green manure crops are of great importance for preserving, increasing and protecting the natural fertility of the soil; these agrotechnical measures, firstly, enrich the soil with nutrients, preserve and increase the natural fertility of the soil, and secondly, having allelopathic properties, have positive effect on the mechanical, water-physical, agrophysical, agrochemical and microbiological properties of the soil. Therefore, conducting research on the use of biomass of green manure crops as green manure when cultivating potatoes in the conditions of old irrigated typical serozem soils is relevant.

CONDITIONS, MATERIALS AND RESEARCH METHODS. The research was carried out in the conditions of old-irrigated typical gray soils of the Khisor farm in the Yakkabag district of the Kashkadarya region in 2021-2023. The mechanical composition of the soil is medium loamy, with a groundwater depth of 7-8 m. In the experimental plot, the humus content in the arable layer (0-30 cm) of the soil was 1.19-0.084%, the volumetric mass was 1.28-1.34 g/cm^3, and the specific gravity was 2.6-2.9 g/cm^3, total nitrogen - 0.095-0.094%, phosphorus - 0.144-0.163%, potassium - 2.6-2.9%, nitrate nitrogen - 7.76-9.08 mg/kg, available phosphorus - 21-32 mg/ kg and exchangeable potassium - 279-298 mg/kg. The data obtained revealed that the amount of these nutrients is slightly less in the subsoil layer.

THE OBJECTS OF STUDY were old-irrigated typical gray soils, autumn rapeseed varieties Uygur-1; oilseed radish - Rainbow variety; peas (green peas) – Vostok-55 variety; blue mustard – Yubileiny varieties, mid-early potato varieties Sante, Silvana and Bardoshli-3.

The following green manure crops were studied for these potato varieties:

OPTIONS FOR WINTER GREEN MANURE (SPRING GREEN MANURE): 1. Winter plowing (control); 2. Rapeseed - variety Uygur-1; 3. Oilseed radish - variety Rainbow; 4. Peas - variety Vostok-55; 5. Blue mustard - Yubileiny variety; 6. Peas + oilseed radish.

The plot area for green manure is 328 m^2, and for varieties 14 m^2, the experiment was repeated four times. Sowing of green manure crops was carried out in the fall of October 19-21, seeding rates: rapeseed - 12.0; peas - 70; blue mustard - 8.0; oilseed radish - 16.0 kg/ha, and when sowing crops together, the norm was taken in half. Fertilizers were applied at a rate of $N_{30}P_{90}K_{45}$ kg/ha. After sowing winter green manure 3 times - in autumn and spring.

For winter green manure crops, 55-60 (06/15-21/06) days before planting potatoes, the yield was determined during the period of mass flowering, then using the KIR-1.5M unit they were crushed, disced and plowed to a depth of 28-30 cm.

In the experiments, all records, analyses, observations and activities were carried out on the basis of generally accepted methods and agricultural recommendations [9,10]. Statistical processing of the obtained data was carried out using Microsoft Excel and SPSS (Statustual Package for Soual Seeonce).

RESEARCH RESULTS. Autumn green manure crops rapeseed, blue mustard, oilseed radish spent a period of winter dormancy in the tops formation phase, peas - in the seedling germination phase, plant density per 1 m^2 of winter green manure crops was 474.1 for rapeseed, oilseed radish - 482.5, peas -199.0, blue mustard - 479.0, peas + oilseed radish - 491.0 pcs.; plant height is 115.0 cm for rapeseed, oilseed radish - 123.8 cm, peas - 207.6, blue mustard - 219.6 cm, peas+oilseed radish - 215.3 cm [table 1.].

The biomass yield of winter green manure crops was 26.4-34.6 t/ha by type of green manure. The highest biomass yield was 34.6 t/ha when sowing oilseed radish; a relatively high biomass yield (29.7-31.9 t/ha) when mixing peas + oilseed radish and blue mustard was noted in its pure form as green manure [table 2.].

When using the biomass of winter green manure as green manure crops, the mixture of peas + oilseed radish >0.25 mm (0-30 cm) was 19.8-25.9%, or higher than the control option by 8.2-13.0%. When sowing peas, blue mustard in its pure form amounted to 18.3-25.3%, which is 6.7-12.4% more than the control.

Table 1

Growth and development of winter green manure crops

No. p/p	Options	33-35 days after germination					Growing season											
		25-28/11					28.02-3/03			20-22/03				28-31/03				
		plant height, cm	number of plant bushes per 1 m^2, pcs.	number of stems, pcs.	number of side	root length, cm	root length, cm	number of plant bushes per 1 m^2, pcs.	root length, cm	plant height, cm	number of plant bushes per 1 m^2, pcs.	number of stems, pcs.	number of side branches, pcs.	plant height, cm	number of stems, pcs.	number of side branches, pcs.	root length, cm	number of plant bushes per 1 m^2, pcs.
	2021 year																	
1.	Rapeseed	28,8	478,2	1	3,2	25,5	38,9	474,0	67,9	96,1	1	7,7	97,9	115,6	1	10,4	140	474,0
2.	Oilseed radish	32,8	486,5	1	6	28,9	41,7	483,0	69,7	99,1	1	16,8	98,5	125,0	1	25,4	129,6	483,0
3.	Peas (green peas)	30,4	201,5	3,8	3,6	26,4	41,8	198,8	52,1	100,9	3,8	5,1	95,0	212,0	3,8	7,8	112	198,8
4.	Blue mustard	34,8	483,7	2	7,2	31,0	42,1	479,7	70,4	116,2	2	9,9	115,3	221,7	2	17,2	144	479,7
5.	Peas+oil seed radish	30,4	497,4	2,2/1	3,4	21,0	33,0	494,5	43,2	100,3	2,2/1	8,2	106,3	218,5	2,2/1	17,1	123	494,5
	2022 year																	
1.	Rapeseed	26,5	476,2	1	3,8	23,7	35,2	470,0	63,4	91,6	1	6,3	102,3	112,4	1	8,4	139,3	470,0
2.	Oilseed radish	30,5	481,5	1	6,1	27,0	35,3	475,6	66,8	88,2	1	14,4	98,0	111,5	1	20,9	120,3	475,6
3.	Peas (green peas)	28,4	200,1	4	4	24,8	33,1	195,7	49,5	101,5	4	4,4	95,3	193,8	4	6,7	108,6	195,7
4.	Blue mustard	29,7	472,5	2	7,4	30,9	35,2	467,4	66,4	112,3	2	8,8	115,8	210,3	2	14,4	140,3	467,4
5.	Peas+oil seed radish	26,7	482,4	2,7/1	4,3	23,8	30,3	475,7	39,6	96,6	2,7/1	5,8	103,3	204,9	2,7/1	12,3	119,1	475,7
	2023 year																	
1.	Rapesee	27	478	1	3,	29	32	475	65	98,	1	8,	104	117	1	11	140	475

	d	,1	,1		3	,8	,8	,0	,0	3		0	,0	,0		,9	,3	,0
2.	Oilseed radish	31,4	488,1	1	5,2	33,1	35,7	485,0	65,3	103,1	1	16,6	101,3	135,0	1	25,7	128	485,0
3.	Peas (green peas)	28,6	198,0	3,3	3,3	30,8	31,0	201,6	38,5	102,9	3,3	5,0	96,1	217,0	3,3	7,0	110,5	201,6
4.	Blue mustard	31,6	489,1	2	6,7	33,7	34,3	486,0	64,3	117,9	2	10,5	117,2	226,8	2	16,5	139,3	486,0
5.	Peas+oil seed radish	28,5	501,0	1,7/1	4	30,8	30,4	499,2	41,2	101,5	1,7/1	8,5	104,0	222,5	1,7/1	13,4	118,6	499,2

After various autumn green manure crops, mid-early potato varieties Sante, Silvana and Bardoshli-3 were also studied, in which it was observed that during the growing season of plants in potato varieties before the 1st watering when sowing peas + oilseed radish as green manure, it was provided in arable layer (0-20 and 20-30 cm) volumetric mass of 1.23 and 1.27 g/cm^3, or its decrease compared to the control (autumn plowing) by 0.05 and 0.07 g/cm^3.

When sowing peas and blue mustard in their pure form as green manure before the 1st watering, potato varieties during the growth period in the arable layer (0-20 and 20-30 cm) revealed a decrease in volumetric mass by 1.24 and 1.28 g/cm^3, which is lower compared to autumn plowing by 0.04 and 0.06 g/cm^3.

When using peas + oilseed radish as green manure before the last watering during the growth period in the arable layer, the volumetric mass was 1.24 and 1.28 g/cm^3, which provided the greatest reduction by 0.06 and 0.07 g/cm^3 compared to control. In the autumn, when sowing peas and blue mustard in pure form as green manure, according to potato varieties before the last watering in the arable layer, the volumetric mass of 1.25 and 1.29 or a decrease of 0.05 and 0.06 g/cm^3 ha was revealed.

No parasitic plants were found among green manure crops and potato crops. It is noted that they have an allelopathic effect on reducing the germination of weed seeds in the top layer of soil when sowing rapeseed, oilseed radish, peas, blue mustard in pure form and peas+oilseed radish in mixed form as green manure.

Table 2

Biomass yield of autumn green manure before plowing

№	Types of green manure crops	Yield of green manure by year, t/ha							
		2021		2022		2023		Средняя	
		Total	of which aboveground biomass	Total	of which aboveground biomass	Total	of which aboveground biomass	Total	of which aboveground biomass
1.	Rapeseed	28,5	25,7	27,5	23,8	28,6	24,9	27,6	24,8
2.	Oilseed radish	35,3	31,8	33,7	28,5	34,8	30,6	34,6	30,3
3.	Peas (green peas)	27,6	24,4	25,1	20,7	26,5	22,7	26,4	22,6
4.	Blue mustard	33,4	28,6	29,5	26,6	32,8	27,9	31,9	27,7
5.	Peas+oilseed radish	31,8	27,8	24,8	27,8	29,6	26,6	29,7	26,4
	$S_{\bar{x}} = (\%)$	**1,12**		**1,29**		**1,51**			
	NSR $_{0,5}$(t/ha)=	**0,39**		**0,58**		**0,79**			

In the autumn, a mixture of peas + oilseed radish, blue mustard and peas as green manure provided the highest humus content (1.20-1.23 or 0.01-0.03%) when sown in pure form. The C:N ratio was favorable when green manure crops were sown mixed and humification of the plant mass was increased. The highest concentration of N-NO_3 (12.38-33.56 mg/kg) was observed when sowing peas as green manure, relatively high when sowing peas+oilseed radish - (12.35-31.54 mg/kg). The greatest accumulation of mobile phosphorus in the soil (31.37-43.25 mg/kg) was observed in the autumn, when rapeseed and blue mustard were sown in pure form, peas + oilseed mustard. The amount of exchangeable potassium was brought to the maximum amount (310.7-326.2 mg/kg) when sowing rapeseed, blue mustard and peas + oilseed radish as green manure.

According to the data obtained, the germination of tubers of potato varieties in winter green manure was observed 11-15 days after planting, and the field germination of seed tubers was 99.2-99.9%. Compared to the control variant, seed potato seedlings appeared 3-4 days earlier, field germination of tubers -2.8-3.2%, budding -1-4 days, flowering - 1-5 days later, the growing season was increased to 4 -8 days.

When studying winter green manures in potato varieties Sante, Silvana and Bardoshli-3, in comparison with the control, the highest indicators were found when sowing peas as green manures - field germination of seed tubers is 3.4-3.5% higher, shoots are 4 days earlier, budding and flowering lengthened by 3-5 days, the duration of the growing season increased by 7-8 days. When using a mixture of peas + oilseed radish and blue mustard in its pure form as green

manure, a relatively high field germination of seed tubers (99.6-99.8 or 3.4-3.5%), seedlings (15 or 4 days earlier) were determined, budding (34 or longer by 4 days) and flowering (17-18 or longer by 3-4 days), duration of the growing season (87-89 or longer by 7 days).

Studies of mid-early potato varieties Sante, Silvana and Bardoshli-3, studied in winter green manure, showed that the growth, development and formation of growth organs (stems, leaves and side shoots) on the 30th day of cultivation amounted to 37.6-46.5 or above 2.9-7.6 cm, the growing season on the 40-70 th day ranged from 48.5 to 80.7 or above from 2.6 to 16.4 cm. The tallest plants were observed after sowing pea green manure in its pure form - compared to the control variant, the height of the plants on the 30th day of the growing season is 45.8-46.5 or 7.6 cm higher, in the next 40-70- th days of the growing season are longer, that every 10 days of the growing season 78.5-80.7 or 14.4-15.7 cm, after sowing peas + oilseed radish and peas in their pure form on the 30th day of the growing season by 5, 7-7.2 cm, on the 40-70th days of the growing season 72.6-77.8 or 12.5-14.2 cm higher than compared to the control (autumn plowing).

The highest formation of leaves, stems and side shoots from one bush in the potato varieties Sante, Silvana and Bardoshli-3, studied on winter green manure, was observed in the fall when sowing peas as green manure in its pure form, which compared to the control variant on the 40th day of the growing season amount per bush: leaves 140.6-145.6 or more 17.3-19.0; stems 4.5-4.6 or 1.0-1.3; side shoots 3.3-3.6 or 1.1-1.2, then on the 70th day of the growing season from the bush the number of leaves increases by 217.8-242.6 or 42.6-53.7, and side shoots up to 8.6-9.4 or 3.0-3.8 pcs. When sowing a mixture of peas + oilseed radish and blue mustard in its pure form as green manure on the 40th day of the growing season by variety, compared to the control, there are 16.2-16.9 more leaves per bush, 1.1-1.0 more stems, 0; lateral shoots 0.9-1.2, subsequently on the 50-70th days the leaves increased by 17.1-47.0; side shoots at 2.2-3.4. The leaf surface area was 70.6-71.6 thousand m^2/ha for mid-early potato varieties Sante, Silvana and Bardoshli-3 in the fall when sowing peas as green manure. It was noted that when using peas in the form of green manure, the leaf surface area is 21.3-21.8 thousand m^2/ha higher than the control.

When studying the formation of the yield and productivity of potatoes of mid-early varieties Sante, Silvana and Bardoshli-3 after winter green manure, the productivity of tubers per bush, the number of tubers and the average weight of one tuber were the highest when sowing peas as green manure, which compared to the control by 60- On the th day of the growing season, the yield of tubers per bush was 399.3-336.3 or 131.0-63.6, the average weight of one tuber was 76.7-74.7 or 18.4-11.3 g more, the number of tubers is 5.2-4.5 or more by 0.6-0.2 pieces, these indicators increase on the 70-80th days of the growing season in accordance with the law, in the last growing season (on the 90th day) quantity tubers increased accordingly per bush: 643.8-652.3 or 250.1-203.6, 78.5-93.1 or 8.0-17.1 grams, by 8.2-7.0 or 1, 7-1.1 pcs. After sowing a mixture of peas + oilseed radish and blue mustard in the form of green manure, which provided, in comparison with the control (fall plowing) in potato varieties tested on the 60th day of tuber harvest, vegetation on one bush: tuber yield 57.5-120 g, the number of tubers is 0.2-0.7 g, with an average tuber weight of more than 11.3-14.1 g, these figures increase according to the law after 70-80 days, and in the last period of growth (90th day) from bush: tuber yield 617.6-627.1 or 223.9-178.4 grams, the number of tubers is 7.0-8.1 or 1.1-1.6 pieces, with an average tuber weight of 76.2-89 .6 or 15.7-13.6 grams more.

Table 3

The influence of the biomass of autumn green manure on the yield of potato varieties (boarding period: 15-21/06)

№	Name of green manure crops	Productivity by year, t/ha			Average productivity, t/ha	Compared to control	
		2021	2022	2023		t/ha	%
		Varieties Sante					
1	Control (autumn plowing)	23,4	22,5	24,6	23,5	-	100
2	Rapeseed	27,7	27,3	29,3	28,1	4,6	119,6
3	Oilseed radish	26,9	26,4	27,4	26,9	3,4	114,5
4	Peas (green peas)	32,7	31,2	33,0	32,3	8,8	137,4
5	Blue mustard	30,9	29,9	31,3	30,7	7,2	130,6
6	Peas+oilseed radish	32,2	30,7	32,5	31,8	8,3	135,3
	$S_{\bar{x}} = (\%)$	**3,80**	**4,19**	**4,49**			
	$NSR_{0,5}$= (t/ha)	**1,39**	**1,60**	**1,20**			
		Varieties Silvana					
1	Control (autumn plowing)	30,3	26,4	27,9	28,2	-	100,0
2	Rapeseed	33,4	33,9	34,3	33,8	5,6	119,8
3	Oilseed radish	32,9	33,6	34,0	33,5	5,3	118,7
4	Peas (green peas)	35,4	37,5	39,2	37,3	9,1	132,2
5	Blue mustard	34,6	36,5	37,0	36,0	7,8	127,5
6	Peas+oilseed radish	35,0	37,2	37,7	36,6	8,4	129,7
	$S_{\bar{x}} = (\%)$	**2,21**	**2,75**	**2,85**			
	$NSR_{0,5}$= (t/ha)	**0,75**	**0,91**	**0,96**			
		Varieties Bardoshli-3					

1	Control (autumn plowing)	30,1	26,0	28,0	28,0	-	100,0
2	Rapeseed	31,9	32,3	33,0	32,4	4,4	115,7
3	Oilseed radish	31,9	31,4	32,7	32,0	4,0	114,2
4	Peas (green peas)	35,6	36,0	36,6	36,0	8,0	128,5
5	Blue mustard	33,0	33,6	34,8	33,8	5,8	120,7
6	Peas+oilseed radish	33,2	34,6	35,4	34,4	6,4	122,8
	$S_{\bar{x}} = (\%)$	**2,57**	**3,28**	**4,21**			
	$NSR_{0,5}$= (t/ha)	**0,87**	**1,12**	**1,37**			

It was noted that the yield of mid-early potato varieties Sante, Silvana and Bardoshli-3, studied in winter green manure, was the highest when using peas as green manure, and the yield was 32.3-37.3 tons per hectare or an additional yield of 8.8 -9.1 tons. Relatively high yields of 30.7-36.6 t/ha were obtained when sowing a mixture of peas + oilseed radish and blue mustard in its pure form as green manure and an increase in yield was obtained by 5.8-8.4 t/ha more than in the control (autumn plowing) [table 3].

The marketable potato yield of the varieties Sante, Silvana and Bardoshli-3, studied on winter green manure, amounted to 25.4-36.8 tons or 94.5-98.9% of the total yield, seed yield 17.2-27.5 tons /ha or 67.6-74.8% of the marketable harvest, and the reproduction factor is 5.7-8.6.

When using winter green manure crops, potato varieties showed a high positive correlation between yield and leaf surface area r = 0,788 (R^2 = 0,6256), between yield and the average weight of one tuber per bush - a high degree r = 0,875 (R^2 = 0,7686), between marketable and seed yields (high degree r = 0,994 (R^2 = 0,9908).

CONCLUSIONS

1. It was established that in the conditions of old-irrigated typical sierozem soils of the Kashkadarya region when cultivating rapeseed, oilseed radish, peas and blue mustard in their pure form, as well as a mixture of peas + oilseed radish as green manure crops in the autumn, the biomass yield per hectare was 26.4 in the spring -34.6 tons. The highest biomass yield in both periods was obtained under the conditions of sowing oilseed radish in its pure form and a mixture of peas + oilseed radish.

2. It was determined that the use of biomass of green manure crops as green fertilizers improved soil fertility, especially when cultivating peas, blue mustard, pure rapeseed and a mixture of peas + oilseed radish in the autumn; an increase in the proportion of macroaggregates was observed in the arable layer compared to the control option by 12.9-26.1%, reduction of microaggregates by 24.8-26.9%, water permeability increased by 70.8-123.8 m^3/ha or more by 14.8-25.89%, volumetric mass decreased by 0.01-0.07 g/cm^3, resulting in humus content up to 1.20 -1.23 or more 0.01-0.03%, gross nitrogen, phosphorus and potassium, especially nitrate nitrogen up to 12.38-33.56, and mobile phosphorus 31.37-43.25 and exchangeable potassium 310.7 -326.2 mg/kg soil.

3. It was established that all potato varieties tested after winter green manure crops had high field germination of seed tubers, intensive emergence of seedlings, growth and development, especially when using peas, blue mustard in its pure form and a mixture of peas + oilseed radish as green manure crops, an increase was noted field germination of seed tubers by 2.7-3.5%, emergence of seedlings earlier by 3-5 days and an increase in the growing season to 4-8 days for mid-early potato varieties.

4. It has been revealed that when using green manure crops, the growth and development of mid-early potato varieties occurs more intensively than early ripening varieties, forms tall (66.4-80.7 or 6.3-15.8 cm in height), multi-stemmed (4.3-5. 4 or more 1.0-1.6 pieces), powerful tops (404.4-495.3 g) and root system with a wide leaf surface (69.6-71.6 or more 18.7-21.8 thousand m^2). As a result, the productivity of these varieties was 617.5-998.8 g per bush, the number of tubers was 6.7-11.2, the average weight of one tuber was 76.2-93.1 grams.

5. The highest yield (30.7-37.3 or 7.2-9.1 t/ha additionally), of which marketable yield is 30.3-36.8 t/ha, seed tuber yield is 20.5-27.5 t /ha, multiplication coefficient in the range of 5.7-8.6 for mid-early potato varieties Sante, Silvana and Bardoshli-3 were recorded when using peas, blue mustard and a mixture of peas + oilseed radish as winter green manure crops.

LITERATURES

1. Oripov R.O. Phytosanitary and bioenergetic significance of intermediate crops. - T.: - 1988.- P.50.
2. Andy Mcluire at all. Green Manuring with Mustard. Agrichemikal and Environmental news// June. – 2003. issue 206, www. Ae news.wsu.edu/ june 03.
3. Glais L, M Tribodet, JP Gauthier, S Astier-Manifacier, C Robaglia, and C Kerlan. RFLP mapping of the whole genome of ten viral isolates representative of different biological groups of potato virus Y// J. Arch Virol. - 1998. – Vol. 143(8): - p. 2077-2091.
4. Бердников А.М., Косьянчук В.Р. Возделывание картофеля с использованием сидератов. // Ж. Земледелие. – М.:- 1999.- № 4. – С.26.
5. Свист В.Н., Марухленко А.В. При запашке сидератов урожай и качество картофеля повышаются. // Ж. Картофель и овощи. – 2010. - № 4. – С.16-17.
6. Гришин С.А., Брысозовский И.И. Совместное внесение сидератов и минеральных удобрений повышает доходность отрасли. // Ж. Картофель и овощи. – 2010. - № 1. – С.6-7.
7. Терехов И.В. Сидераты эффективны.// Ж. Картофель и овощи. - 2015. - № 7. - С.33-34.

8. Davis J.R., Huisman O.C., Westermann D.T., Everson D.O., Sorensen L.H. and Schneider A.T. Alternative approaches for control of Verticillium wilt of potato with sudangress// Amer. J. of Potato Res. – 1997. - Vol. 76(4): - p. 292-295.
9. Методика исследований по культуре картофеля. - М.: - ВНИИКХ. - 1967. - С.204.
10. Доспехов Б.А. Методика полевого опыта. - М.: "Агропромиздат". - 1985. - С.351.
11. Kirkegaard JA, Wong PTW, Desmarchelier JM. In vitro suppression of fungal root pathogens of cereals by Brassica tissues// Plant Pathol. - 1996. 45: 593-603.
12. Neubauer C, Heitmann B, Müller C. Biofumigation potential of Brassicaceae cultivars to Verticillium dahliae// Eur J Plant Pathol. – 2014. -140: 341-352.
13. Larkin RP, Honeycutt CW, Olanya OM. Management of Verticillium wilt of potato with disease-suppressive green manures and as affected by previous cropping history//Plant Dis. - 2011. 95: 568-576. http://www.apsnet.org/publications/plantdisease/2010/December/Pages/94.12.1491.aspx.
14. Larkin RP. Green manures and plant disease management. CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources// CAB Reviews. - 2013. 8-037: p. 1-10.