CODEN [USA]: IAJPBB ISSN: 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES

http://doi.org/10.5281/zenodo.2669529

Available online at: http://www.iajps.com Research Article

BIOLOGIZING TECHNOLOGIES FOR CROPS CULTIVATION

[1]A.T. Farniev, [2]A.Kh. Kozyrev, [3]A.A. Sabanova, [4]Kh.P. Kokoev, [5]D.K. Khanaeva, [6]L.M. Bazaeva, [7]P.V. Alborova

[1]Gorsky State Agrarian University, Russia, Vladikavkaz, 37 Kirov Street, FA-T@yandex.ru.

Article Received: March 2019 **Accepted:** April 2019 **Published:** May 2019

Abstract:

It is established that the pre-sowing treatment of seeds and vegetative Galega orientalis plants with new microbial preparations and Albite on the background of rhizotorfin inoculation has positive effect on the symbiotic apparatus formation, promotes increasing the green mass yield by 37,0-38,4 t/ha and protein from 3,82 to 4,01 ctw/ha. Pre-sowing treatment of spring rape seeds with microbial preparations (strain 17-1, 38-22, strains mixture 17-1+38-22) increases the seeds yield by 0,22-0,83 t/ha or 18- 68% and the seeds quality: oil – 40,7-44,9%, crude protein – 23,3-26,0%, increases oil yield from 415 to 920 kg/ha and crude protein from 238 to 533 kg/ha. Similar treatment of seeds and vegetative soybean plants with strains 17-1, 38-22 and their mixture increased the seeds yield for the variety Bistritsa 2 from 1,87 to 2,27 t/ha and varieties Mageva from 1,45 to 1,83 t/ha. At this the higher efficiency was observed when treating seeds and vegetative plants than one pre-sowing seeds inoculation. High efficiency was observed in the case of pre-sowing treating the winter barley seeds with fungicides (Dividend star and Vincit), microbial preparations (strains 17-1, 38-22, strains mixture 18-5+38-22), their tank mixes (Dividend star– 1 kg/t+18-5+38-22, Vincit–0,75 kg/t+18-5+38-22). The yielding capacity increased by 0,3-1,9 t/ha for the experience variants (variety Mikhaylo) and by 0,75-1,09 t/ha for variant 8 (Vincit (0,75 kg/t + mixture starins18-5+38-22) respectively on varieties. Testing of fungicides tank mixes Dividend star 1 kg/t, Vincit SC 0,75 kg/t and microbial preparations 18-5 and 38-22 against root rot pathogens of winter barley was firstly applied according to the results of our research. This suggests that the fungicides Dividend star and Vincit SC in the given concentrations do not inhibit the fungicidal activity of microbial preparations, and the application of tank mixes increases their biological efficacy and yielding capacity of winter barley.

Key words: *Galega orientalis, spring rape, soybean, winter barley, microbial preparations, productivity, quality.*

Corresponding author:

A.T. Farniev,

Gorsky State Agrarian University, Russia, Vladikavkaz, 37 Kirov Street, FA-T@yandex.ru.

QR code

Please cite this article in press A.T. Farniev et al., ***Biologizing Technologies For Crops Cultivation.,*** *Indo Am. J. P. Sci, 2019; 06(05).*

INTRODUCTION:

At present the ecological situation dictates the necessity to create highly effective agricultural technologies for the efficient impact on cultivated plants in order to obtain high yields of qualitative plant production. In this regard the development and application of ecologically safe microbial preparations with adaptogenic phytoprotective properties is a vital task for researchers [1]. Nowadays such microbial preparations that act as alternatives to mineral fertilizers and chemical pesticides are more and more applied in agriculture. These include preparations based on rhizobacteria strains promoting plants growth and having the complex of applicationful properties that beneficially affect plants growth, development and productivity [2].

In this regard, the aim of our research was to reveal the role of microbial preparations to improve the crops productivity (Galega orientalis, spring rape, soybean and winter barley).

Research technique:

Studies were conducted on carbonate chernozem of Kirov state crop-testing station (collective farm by K.I. Shanaev) in Pravoberezhny district of North Ossetia-Alania.

Soil is subcaucasian carbonate chernozem that according to grain-size composition is medium loamy with 5% of humus; nitrogen by Tyurin-Kononova-47; phosphorus by Machigin – 10; potassium by Machigin – 217 mg/ 1kg of soil.

In the experiments for pre-sowing seeds inoculation were applicationd bacterial preparation rhizotorfin strain 14-W (All-Russia Research Institute for Agricultural Microbiology, St. Petersburg), new microbial preparations (strain 17-1, strain 38-22) developed on the basis of associative local grasses rhizobacteria and biological preparation Albite in the laboratory of the agroecology and plant protection department of Gorsky State Agricultural University in collaboration together with the laboratory of symbiotic and associative microorganisms ecology of the All – Russian scientific research institute for agricultural microbiology in St.-Petersburg.

Strain 17-1 Pseudomonas fluorescens is deposited under the registration number “All – Russian scientific research institute for agricultural microbiology 622D” on May 5, 2006 in the group of epiphytic microorganisms as growth-promoting highly effective for seeds inoculation and vegetative grain plants treatment, as well as having high antifungal activity against phytopathogenic fungi.

Strain 38-22 Sphingobacterium spiritivorum is deposited under registration number “All – Russian scientific research institute for agricultural microbiology 620D” on May 5, 2006 in the group of epiphytic microorganisms as growth-promoting, actively producing indoleacetic acid and are highly effective for seeds inoculation and treating the vegetative plants of grain and forage crops.

Biopreparation – Albite is the growth regulator and fungicide, contains the active substance poly-beta-hydroxybutyric acid from soil bacteria Bacillus megaterium and Pseudomonas aureofaciens, as well as a balanced starting set of macro - and micro-elements, terpenic acids of coniferous extract.

Research results:

The biologics application - strains 17-1, 38-22 and Albite on the background of inoculation with rhizotorfin for Galega orientalis plants significantly increase the size of its symbiotic apparatus and productivity [3].

The activity of nitrogen fixing the atmospheric nitrogen with legumes rhizobium depends on many factors. One of the most important of these is the soil-specific, virulent, active strain of rhizobia [4].

The rhizotorfin inoculation of seeds allowed increasing the number and weight of Galega orientalis nodules by 8-17 million pieces/ha and 4-16 kg/ha, respectively, compared to the control. Seeds treatment with biologics on the background of rhizotorfin inoculation contributed to the formation of the better symbiotic apparatus. If during the shooting period the number of active nodules in the control variant was 48 million pieces/ha, but when separate treating with strains 38-22 and 17-1 on the background of inoculation was 64 and 76 million pieces/ha or their number increased by 16 and 28 million pieces/ha.

At this the nodules weight increased too by 11-35 kg/ha, respectively. Comparing two preparations strains 38-22 and 17-1, it is necessary to note the advantage of the latter. The application of strains mixture 38-22+17-1 on the background of inoculation increased the number of active nodules up to 97 million pieces/ha but the biologic Albite on the background of inoculation up to 118 million pieces/ha.

Thus the mass of active nodules increased to 135 and 146 kg/ha. The treatment of seeds and vegetative plants was more effective than a single inoculation.

Maximum symbiotic apparatus size parameters had the variants with the application of the strains mixture 17-1+38-22 on the background of inoculation and the biologic Albite on the background of inoculation.

Powerful symbiotic apparatus intensified photosynthesis that promoted the increase of Galega orientalis productivity.

So the yielding capacity of Galega orientalis green mass changed from 30,5 to 38,4 t/ha (table 1). All variants with the application of microbial preparations exceeded the control indexes. Thus a single treatment with strains 38-22 and 17-1 on the background of inoculation gained 3 and 4,2 t/ha but only pre-sowing rhizotorfin inoculation of seeds gained 2,1 t/ha. Double treatment with these strains increased the gain to 3,6 and 4,8 t/ha. More effective was the treatment with the strains mixture 38-22 +17-1, the yield increased to 5,7 t/ha (single treatment) and 6,5 t/ha (double treatment).

On the effectiveness the variant with Albite treatment on the background of inoculation have outdone variants 7 and 8 (treatment with the strains mixture), the yield increased by 1,4 t/ha.

Table 1. Influence of biopreparations on Galega orientalis productivity (on average for 3 years)

№	Variant	Treatment ratio	Yield of green mass	Increase		Protein collection ctw/ha	Increase	
				t/ha	%		ctw/ha	%
1.	Control	-	30,5	-	-	2,94	-	-
2.	Inoculation	-	32,6	2,1	6,9	3,08	0,14	4,8
3.	Inoculation+38-22	1	33,5	3,0	9,8	3,27	0,33	11,2
4.	Inoculation + 38-22	2	34,1	3,6	11,8	3,34	0,4	13,6
5.	Inoculation + 17-1	1	34,7	4,2	13,8	3,45	0,51	17,3
6.	Inoculation +17-1	2	35,3	4,8	15,7	3,60	0,66	22,4
7.	Inoculation+17-1+38-22	1	36,2	5,7	18,7	3,71	0,77	26,2
8.	Inoculation+17-1+38-22	2	37,0	6,5	21,3	3,82	0,88	29,9
9.	Inoculation +Albite	1	37,6	7,1	23,3	3,89	0,95	32,3
10.	Inoculation +Albite	2	38,4	7,9	25,9	4,01	1,07	36,4
	NSR_{05}		0,5					

The protein collection per the yield directly correlates with the productivity level. The protein collection ranged from to 2,94 ctw/ha (control) to 4,01 kg/ha (variant 10). The gain varied from – 4,8% to 36,4 %.

Therefore, treatment of seeds and vegetative plants of Galega orientalis with microbial preparations is the effective method to increase productivity and quality.

For spring rape, as a valuable oilseed and fodder crop, the main quality indexes of seeds yield are the content of fat and crude protein that may vary within 36-50 and 20-33 % respectively. According to the sum of these major quality components rape exceeds soybean and nears sunflower [5].

Rapeseed oil belongs to the group of edible fats; according to the quality of the fat-acid composition is second only to olive oil and high-oleic sunflower varieties. In the fat and protein content rapeseed exceeds soybean but is second to sunflower and mustard [6].

Despite these rapeseed advantages, its sowing areas for last five years in the Republic of North Ossetia - Alania have not exceeded 1600 ha, while seeds yield was only 4-8ctw/ha [7].

In this regard, the aim of our research was: “To develop ecologically clean resource-saving technology of rape cultivation for seeds”.

For field experiments we used spring rape varieties: Yarvalon, Siesta, Tavrion and also microbial preparations strains 17-1, 38-22 and strains mixture 17-1+38-22.

The research results suggest that the different susceptibility of spring rape varieties Yarvalon, Siesta and Tavrion to phytopathogens has had a significant influence on their growth, development and seeds productivity.

Table 2. *Effect of microbial preparations on seeds productivity and quality of spring rape (on average for 3 years).*

Variants	Crop capacity t/ha	Increase		Oil content	Crude protein	Collection/1ha	
		t/ha	%			Oils kg	Crude protein kg
Yarvalon							
Control (without treatment)	1,22	-	-	43,1	24,4	526	298
Strain 17-1	1,44	0,22	18,0	43,8	25,0	631	360
Strain 38-22	1,76	0,54	44,2	44,3	25,3	780	445
Strains mixture 17-1+38-22	2,05	0,83	68,0	44,9	26,0	920	533
NSR_{05}	0,06			0,49	0,40		
Siesta							
Control (without treatment)	1,02	-	-	40,7	23,3	415	238
Strain 17-1	1,16	0,14	13,7	41,3	23,9	479	277
Strain 38-22	1,40	0,38	37,2	41,5	24,0	581	336
Strains mixture 17-1+38-22	1,58	0,56	54,9	42,0	24,6	664	389
NSR_{05}	0,04			0,34	0,48		
Tavrion							
Control (without treatment)	1,10	-	-	41,7	24,2	459	266
Strain 17-1	1,28	0,18	16,3	42,4	24,9	543	319
Strain 38-22	1,52	0,42	38,1	42,7	25,2	649	383
Strains mixture 17-1+38-22	1,76	0,66	60,0	43,2	25,9	760	456
NSR_{05}	0,03			0,44	0,43		

The biologics application significantly increased the yield of rape seeds. Thus, the most productive was– from 1,22 to 2,05 t/ha, less productive variety Siesta –1,02-1,58 t/ha (the most susceptible to diseases). Treating variety Yarvalon with strain 17-1 gave the yield increase 0,22 t/ha, or 18% but varieties Siesta and Tavrion 0,14 t/ha (13,7%) and 0,18 t/ha (16,3 %) respectively (table 2).

Of two applied for the studies microbial preparations (strain 17-1 and strain 38-22) growth-promoting and actively producing indoleacetic acid strain 38-22 proved to be more effective. The increase for the varieties amounted to 0,54, 0,38 and 0,42 t/ha, or 44,2 and 37,2 and 38,1%.

The pre-sowing seeds treatment and spraying the vegetative plants with the strains mixture 17-1+38-22 was more efficient.

When determining the quality of spring rape seeds we found that the oil and crude protein content in seeds depended upon the variety. So, the seeds in the control variant of variety Yarvalon contained 43,1 % of oil but seeds of varieties Siesta and Tavrion – 40,7% and 41,7% respectively.

A similar increase of crude protein for these varieties was marked when treating with the microbial preparations. The treatment with strain 17-1 increased the content of crude protein by 0,6-0,7%, in the case of strain 38-22 – 0,7-1,0% and when the strains mixture – 1,3-1,7%.

Seeds of spring rape variety Yarvalon contained more crude protein 24,4-26,0%, accordingly to variants, and the least contained varieties Siesta – 23,3-24,6% respectively.

It should be noted that in response to microbial preparations oil and crude protein yield per 1 hectare significantly increased.

Thus, strain 17-1 helped to increase oil yield from variety Yarvalon seeds by 19,9% compared to the control variant; strain 38-22 – by 48,2%, and the strains mixture – by 74,9%. For variety Siesta indexes were significantly lower: 15,4; 40,2 and 60,0% respectively. Crude protein yield per 1 hectare from variety Yarvalon seeds significantly increased as well - from 20,8 to 78,8%, accordingly to the variants but for variety Siesta from 16,3 to 63,0%. Indexes for variety Tavrion occupy a middle position.

Consequently, the application of microbial preparations increases the yield and quality of spring rape seeds.

Pre-sowing treatment of soybean seeds with

microbial preparations increased soybean seed productivity but with different efficiency (table 3). So, variant 2 – pre-sowing seed treatment with strain 17-1 variety Bistritsa 2 increased the yield by 0,22 t/ha or 11,8%, compared with the control variant. More significant increase 0,31 t/ha or 16,6% was obtained for variant 4 when pre-sowing treating the seeds with the strains mixture 17-1+38-22, the lowest 0,14 t/ha or 7,5% was for variant 3 when seeds treating with strain 38-22.

The yield of ultra-early ripening variety Mageva seeds was slightly lower than variety Bistritsa 2, but the efficiency of microbial preparations was similar.

Therefore, pre-sowing seed treatment with microbial preparations kills pathogens on seeds surface, thereby improves the conditions for plants growth and development that promotes seeds yield.
The soil contains a great number of different soybeans pathogens that during the growth process move to the plants surface and cause the spread of these diseases [8]. In addition to the pre-sowing seeds treatment, spraying of vegetative plants with these preparations prevents further development of diseases.

Table 3.*Influence of microbial preparations on the yield of soybean seeds (on average for 3 years).*

№	Experiment variants	Treatment type	Varieties					
			Bystrica 2			Mageva		
			yield, t/ha	increase		yield, t/ha	increase	
				t/ha	%		t/ha	%
1.	Control	without treatment	1,87	–	–	1,45	–	–
2.	Strain 17-1	pre-sowing seeds treatment	2,09	0,22	11,8	1,68	0,23	15,9
3.	Strain 38-22		2,01	0,14	7,5	1,58	0,13	8,9
4.	Strains mixture 17-1+38-22		2,18	0,31	16,6	1,78	0,33	22,8
5.	Strain 17-1	pre-sowing seeds treatment + plants spraying	2,23	0,36	19,3	1,80	0,35	24,1
6.	Strain 38-22		2,08	0,21	11,2	1,61	0,16	11,0
7.	Strains mixture 17-1+38-22		2,27	0,40	21,4	1,83	0,38	26,2
	NSR_{05}			0,10			0,11	

Thus, pre-sowing seeds treatment and plants spraying with strain 17-1(variant 5) contributed to the yield increase 0,36 t/ha or 19,3% compared with the control and 0,14 t/ha compared with one pre-sowing seeds treatment with strain 17-1 (variant 2). Similar double treatment but with strain 38-22 (variant 6) was less effective. The increase amounted to 0,21 ctw/ha or 11,2% compared with the control.

The highest efficiency gave the similar treatment with the strains mixture 17-1+38-22 (variant 7). The yield increase amounted to 0,4 t/ha or 21,4% compared with the control.

The availability of new chemical fungicides in the market does not fundamentally change the total situation in the diseaseless management. Dangerous diseases often have epiphytotic nature, there is not only increase in the harmfulness of known, but also the emergence of new dangerous types of pathogens, including quarantine [9].

Therefore, preference should be given to the integrated approach to the plants protection characterized by the wide application of biological preparations and immunoregulators. Biological fungicide preparations and growth regulators with immunizing activity reduce partially the infection in the plants seeds (bio-logical efficiency – 40-60%), second to chemical fungicides (70-95%).

Complex application of biological preparations and fungicides gives new possibilities for phytopatogene regulation [10].

In addition to definite bactericidal and growth-regulating effect these preparations increase the plants protective reaction to the abiotic and biotic stresses (drought, frost), the intensity of metabolic processes, including photosynthesis.

The research was carried out on the extensive background. In the field experiment we studied barley varieties: Mikhaylo, Volzhsky 1, Kozir, Pavel, Platon, and Rosava.

Research was conducted applying the new liquid microbial preparations (containing 2 billion cells per

1 ml) made basing on the local associative rhizobacteria races Psedomonas sp., strain 18-5 (experimental) isolated from wild barley rhizoplane (Hordeum leporinum); strain 38-22, as well as chemical fungicides Dividend star and Vincit SC. Winter barley seeds were treated with fungicides and microbial preparations before sowing according to the experiment scheme (table 4).

The results of our research indicate that winter barley varieties to varying degrees were affected with root rot. So, the affection of variety Mikhaylo plants amounted to 40,9% but of variety Volzhsky 1 - only 9,6%. Other varieties were affected with root rot in the range from 11,4 to 36,1% (table. 4).
Pre-sowing treatment of winter barley seeds with microbial preparations and fungicides dramatically reduced the root rot spread.

The most effective variants were: 3 (Vincit SC 1,5 kg/t) and 8 (Vincit SC 0,75 kg/t + strains (18-5+38-22). If the root rot affection in the control variant of variety Mikhaylo plants was 40,9 %, so variants 3 and 8 – only 3,2 and 2,1 %, respectively. Significantly less were affected plants of variety Volzhsky 1 – only 9,6; 1,2 and 1,5 %, respectively for those variants. The same pattern was marked for varieties Kozir, Pavel, Platon, and Rosava.

The research identified another pattern in all varieties: variants 4, 5 and 6 in which the seeds had pre-sowing treatment with microbial preparations strains 18-15 and 38-22, were slightly second in the effectiveness to variant 2 (Dividend star 2 kg/t) but the seeds treatment with the mixture of these strains (18-5+38-22) exceeded the efficiency of the specified variant.

At the same time the efficiency of microbial preparations in variant 4 (strain 18-5), variant 5 (strain 38-22) and variant 6 (mixture of strains 18-5+38-22) was significantly lower than the efficiency of variant 3 (Vincit SC 1,5 kg/t).

Also we note for all varieties the high level of economic efficiency of variants 4 (strain 18-5) and 6 (mixture of strains 18-5+38-22), at the level of variants 2 (Dividend star 2 kg/t) and 3 (Vincit SC 1,5 kg/t). This can be explained by the fact that when the seeds treating with chemical protectants the yield increase compared to the control is due to the reduction in the diseases development but microbial preparations, in addition, influence the formation of extra yield, by intensifying growth and immunization processes in plants.

The most productive were varieties Volzhsky 1 and Rosava, the yield of which, on average, for two years was in the control variant 2,81 and 2,73 t/ha, and in variant 8 (Vincit SC 0,75 kg/t + strains 18-5 + 38-22) 3,82 and 3,77 t/ha, respectively that increases the yield of variety Mikhaylo st in the control variant by 49,7–43,7 %, and 27,8–26,1% in variant 8 (Vincit SC 0,75 kg/t + strains 18-5 + 38-22).

Table 4.*Winter barley affection with root rots depending on the seeds treatment, %. (on average for 3 years).*

№	Variant	Varieties					
		Mikhaylo st	Volzhsky 1	Kozir	Pavel	Platon	Rosava
1.	Control without the treatment	40,9	9,6	36,1	20,9	21,5	11,4
2.	Dividend star (2 kg/t)	7,2	1,9	6,6	4,1	4,2	2,2
3.	Vincit (1,5 kg/t)	3,2	1,2	3,0	2,4	2,6	1,6
4.	Strain 18-5	8,9	2,4	8,2	5,0	5,2	2,9
5.	Strain 38-22	7,8	2,2	7,2	4,5	4,6	2,6
6.	Strains (18-5+38-22)	6,5	1,7	5,9	3,7	3,8	2,0
7.	Dividend star (1 kg/t + 18-5+38-22)	5,9	1,4	5,4	3,3	3,4	1,6
8.	Vincit (0,75 kg/t+18-5+38-22)	2,1	1,5	1,9	1,5	1,5	1,7

The highest efficiency was when the pre-sowing winter barley seeds treatment with the tank mix Vincit SC (0,75 kg/t + 18-5+38-22). In varieties Volzhsky 1, Kozir and Rosava its efficiency exceeded the chemical fungicides Dividend star 2 kg/t and Vincit SC 1,5 kg/t. In other varieties Mikhaylo st, Pavel and Platon its efficiency was higher that the efficiency of Dividend star 2 kg/t and at the efficiency level of variant 3 (Vincit SC 1,5 kg/t).

In the course of research it was first tested tank mixes of fungicides Dividend star 1 kg/t and Vincit SC 0,75 kg/t and microbial preparations 18-5 and 38-22 against winter barley root rots. These data indicate that the fungicides Dividend star 1kg/t and Vincit SC

0,75 kg/t in these concentrations do not inhibit the action of the microbial preparations and the application of tank mixes increases their biological efficacy and the winter barley yield.

CONCLUSIONS:

1. Treatment of seeds and Galega orientalis vegetative plants with new microbial preparations on the background of rhizotorfin inoculation has a positive effect on the symbiotic apparatus size and increases the yield of green mass from 30,5 t/ha to 37,0-38,4 t/ha and protein collection from 4,01 to 3,82 ctw/ha.
2. Pre-sowing treatment of spring rape seeds with microbial preparations (strains 17-1, 38-22 and the strains mixture 17-1+38-22) increases the seeds yield by 0,22-0,83 t/ha or 18-68%. The seeds quality is also improved, oil content increases from 40,7 to 44,9%, crude protein – from 23,3 to 26,0% according to varieties and variants. The oil collection from 1 hectare is increased from 415 to 920 kg/ha and crude protein – from 238 to 533 kg/ha.
3. Pre-sowing treatment of seeds and vegetative soybean plants with microbial preparations allows to consistently obtain ecologically clean seed yields 1,83-2,27 t/ha.
4. Pre-sowing treatment of seeds with fungicides, microbial preparations and their tank mixes contributes to the significant reduction of root rots spread in all studied varieties from 40,9% to 2,1% (variety Mikhaylo) and significantly increases the yield by 0,3-1,09 t/ha in the variants (variety Mikhaylo) and by 0,75-1,09 t/ha in variant 8 Vincit (0,75 kg/t+ strains mixture 18-5+38-22) according to varieties.

LITERATURE:

1. A.A. Zavalin Application of biological preparations when cultivating field crops // Achievements of Science and Technology of AIC.-2011, №8, p. 9-11.
2. A.T. Farniev, A.Kh. Kozyrev, A.R. Pukhaev Biological efficacy of PGPR strains against of winter wheat pathogens / Proceedings of Gorsky State Agrarian University, Vol. 49, parts 1-2, Vladikavkaz, 2012, p. 65-70.
3. A.T. Farniev, A.A. Sabanova, Kh.P. Kokoev Nitrogen fixing activity and productivity of Galega orientalis on leached chernozem in North Ossetia-Alania / Proceedings of Gorsky State Agrarian University, Vol. 51, part 3, Vladikavkaz, 2014, p. 66-71.
4. A.V. Dozorov, A.V. Voronin Symbiotic potential of soybean varieties // International Agricultural Journal. – 2012. - №3. – p. 55-58.
5. I.V. Artemov, A.M. Kisilev Ways of increasing feed production and plant oil // Feed production, 1997, №4, p.3.
6. V.A. Gulidova Theoretical basis for improving the yield and reducing energy consumption in the rape crop rotation under different systems of basic soil tillage in the forest-steppe of the Central Chernozem Region / author's abstract of doctoral dissertation. Voronezh. 2000, p. 48.
7. I.V. Alikova, A. A. Sabanova Influence of microbial preparations on the crop capacity and quality of spring rape seeds / Proceedings of Gorsky State Agrarian University, Vol. 48., part 1, 2011. p. 62-65.
8. O.A. Monastyrsky "Problems and prospects of crops biological protection"/Agro XXI. №4-6, 2010, p. 3.
9. V.S. Sadykova, P.N. Likhachev, P.N. Bondar Limitatin for developing the complex of barley root rots with genus Trichoderma antagonists / Journal "Microbiology and Phytopathology". Vol. 44. №6, 2010., p. 556-561.
10. A.T. Farniev, R.V. Kulchieva, M.L. Bazaeva, A.R. Pukhaev, M.D. Kozireva, V.R. Aguzarova The way to protect cereal crops against root rot and dwarf rust. The patent for the invention № 2461199. M , 2012.