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AGRO-BIOLOGICAL EFFICIENCY OF ORGANIC FERTILIZERS AND MICRO-BIOLOGICAL CONCENTRATES IN THE TOMATO AND PEPPER SOWINGS

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ՕՐԳԱՆԱՀԱՆՔԱՅԻՆ ՊԱՐԱՐՏԱՆՅՈՒԹԵՐԻ և ՄԻԿՐՈԿԵՆՍԱԲԱՆԱԿԱՆ ԽՏԱՆՅՈՒԹԵՐԻ ԱԳՐՈԿԵՆՍԱԲԱՆԱԿԱՆ ԱՐԴՅՈՒՆԱՎԵՏՈՒԹՅՈՒՆԸ ՊՈՄԻԴՈՐԻ և ՏԱՔԴԵՂԻ ՑԱՆՔԵՐՈՒՄ

Միքայելյան Հ.Ա.

АГРОБИОЛОГИЧЕСКАЯ ЭФФЕКТИВНОСТЬ ОРГАНОМИНЕРАЛЬНЫХ УДОБРЕНИЙ И МИКРОБИОЛОГИЧЕСКИХ КОНЦЕНТРАТОВ В ПОСЕВАХ ТОМАТА И ПЕРЦА

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ABSTARCT

In 2017-2019 the relative agro-biological effect of equal doses of mineral fertilizers, half rotten manure, granulated guano, organomix and that of the bacterial (Azoto + Phosphate Barvar) concentrates on the plants' yield capacity and vegetative mass, as well as on the content of nitrates, total sugar, vitamin C and dry matters in the ripe fruits was investigated during the tomato and pepper field experiments in conditions of the Ararat valley. The highest effect has been observed in the mineral fertilizers ($N_{150}P_{80}K_{150}$ and $N_{150}P_{80}$ kg/ha), half rotten manure (30 t/ha) and granulated guano (5 t/ha), while the lowest indicators have been recorded in the variants of organomix and bacterial concentrates after the control one. Within the three-year experiments the nitrate content in the mature fruits of the tomato variety "Lia" excessed the MPC value (150 mg/kg for the open ground), which seems to be a varietal characteristics.

Արարատյան դաշտի պայմաններում 2017 - 2019թթ. պոմիդորի և տաքդեղի դաշտային փորձերում ուսումնասիրվել է հանքային պարարտանյութերի, կիսափտած գոմաղբի, հատիկավորված թռչնաղբի, օրգանոմիքսի համարժեք չափաքանակների և բակտերիալ (Azoto + Phosphate Barvar) խտանյութերի ագրոկենսաբանական համեմատական ազդեցությունը բույսերի բերքատվության և վեգետատիվ զանգվածի, հասունացած պտուղներում նիտրատների, ընդհանուր շաքարի, C վիտամինի և չոր նյութերի պարունակության վրա: Պարզվել է հանքային պարարտանյութերի ($N_{150}P_{80}K_{150}$ և $N_{150}P_{80}$ կգ/հա), կիսափտած գոմաղբի 30 տ/հա և հատիկավորված թռչնաղբի 5 տ/հա չափաքանակների առավել բարձր արդյունավետությունը, իսկ ամենացածր ցուցանիշները ստուգիչից հետո արձանագրվել են օրգանոմիքսի և բակտերիալ խտանյութերի տարբերակներում: Փորձի երեք տարիներին պոմիդորի «Լիա» սորտի հասունացած պտուղներում նիտրատների պարունակությունը գերազանցել է ՍԹԽ-ի ցուցանիշը (150 մգ/կգ բաց գրունտի համար), որն ըստ երևույթին սորտային առանձնահատկություն է:

АННОТАЦИЯ

В условиях Араратской равнины в полевых опытах томата и перца за 2017 - 2019 гг. изучено сравнительное агробиологическое влияние эквивалентных доз минеральных удобрений, полуперепревшего навоза, гранулированного птичьего помета, органомикса и бактериальных (Azoto+Phosphate Barvar) концентратов на урожайность и вегетативную массу растений, а также на содержание нитратов, общих сахаров, витамина С и сухих веществ в спелых плодах. Была выявлена более

высокая эффективность доз минеральных удобрений ($N_{150}P_{80}K_{150}$ և $N_{150}P_{80}$ кг/га), полуперепревшего навоза – 30 т/га, гранулированного птичьего помета, а наименьшие показатели после контроля зарегистрированы в вариантах с органомиксом и бактериальными концентратами. За три года опыта в спелых плодах помидора сорта "Лиа" содержание нитратов превосходило ПДК (150 мг/кг для открытого грунта), что по-видимому связано с сортовыми особенностями.

Keywords: mineral and organic fertilizers, bacterial concentrates, tomato, pepper, yield qualitative indicators, vegetative bio-mass.

Introduction. In the sowings of cereal and vegetable crops cultivated on the rural farms of Armenia, as well as in the perennial plantations the basal/single nitrogenous, and in individual areas, very little phosphorus-potassium and organic fertilizers are mainly used. The expiry dates of the pesticides are also violated causing serious threats to the ecological safety of the products and, therefore to the health of population. The waiting times of the pesticides are also violated. This is the reason why in a number of countries the application of saltpeter in the sowings of vegetation crops has been already rejected and the phosphorus-potassium fertilizers are used in combination with the organic fertilizers. On the other hand, the use of mineral (particularly nitrogenous ones) fertilizers promotes the increase of dehumification and the fast humus consumption, the main struggling way against which is the use of organic fertilizers [1].

Nowadays, among all vegetables, tomato, pepper and eggplant are the most used ones by the Armenian population, besides, they are used both fresh and canned, thus, the land areas allocated for those crops are gradually being expanded and it's a pity that the considerable part of those land areas are used for the cultivation of introduced (imported) varieties, which are though transportable and have good appearance, obviously stay behind the local varieties regarding their organoleptic and qualitative indicators. In view of the above mentioned in the last decade some investigations have been conducted related to the comparative evaluation of agro-biological and ecological properties of the local tomato varieties and those imported from different countries, as a result of which the advantages of the yield capacity and qualitative indices of the Armenian tomato varieties, including those cultivated in the Artsakh Republic [14,17] have been revealed.

Vegetable crops are vital sources for vitamins and carbohydrates in the human food ration. It is proved that in order to satisfy the optimal demand of human organism for the proteins, fats and carbohydrates their ratio in the food diet should make 1 : 1,2 : 4, besides, the proteins in the food energy content should make 12%, fats- 30% -35%, the rest part should be complemented by carbohydrates [3, 12, 13].

In the field and vegetation experiments numerous investigations have been implemented on the tomato varieties "Lia" and "Sunrise", as well as on the pepper variety "Nush-55" concerning the plants' mineral nutrition and the industrial and biological disposals of the nutrients [7, 9 - 11]. Testing of bacterial concentrates of mycorrhizal fungi, azotobacter, nitroxine and Phosphate Barvar together with the organic and mineral fertilizers or through the single application on various crops of Iran (tobacco, maize, barley, zamia, savory, date palm, etc.) has resulted in some positive effects, particularly in dry conditions [5, 6, 8, 16].

The efficiency of microbiological concentrates in the agrocenosis of vegetables or that of other crops has hardly been studied in Armenia; therefore they haven't been used in production. Due to the research and production needs, in 2014-2016 we experimented bacterial concentrates of Azoto Barvar-1 and Phosphate Barvar-2 imported from Iran in the tomato vegetation trials, the efficiency of which was compared with full mineral fertilizers. The obtained results indicated about the low activity and weak effect of those concentrates on the plants [15].

Considering the fact that the microbiological concentrates have a broad industrial production and also bio-ecological significance in a number of countries, including Iran, and taking into account that they have production perspectives in Armenia as well, it has become urgent to conduct new in-depth investigations with expanded diagrams in the tomato and pepper sowings, the aim of which is to disclose the application efficiency of the bacterial concentrates Azoto Barvar-1 and Phosphate Barvar-2 in soil conditions of the Ararat valley and to compare the obtained results with the doses used in the production of organic and mineral fertilizers. According to the certificated data, the mentioned concentrates increase the soil biological activity, enhance nitrogen fixation in the atmosphere, make the complex phosphorus ores of the soils available for the plants, improve the soil self-purification capacity and promote the humification process.

Materials and Methods.

The field experiments were conducted in 2017 – 2019 on the Voskehat teaching-experimental farm of ANAU on the local Armenian tomato variety "Lia" and pepper variety "Nush-55" with three repetitions. The experimental schemes are introduced in the tables 3, 4 and 5. The principles of the only difference and comparativeness between the variants are observed in the schemes. Out of the mineral fertilizers the ammonium saltpeter (N - 33%), common superphosphate (P_2O_5 -18%) and potassium salt (K_2O - 40%) have been used. The composition of organic fertilizers is presented in table 1.

Table 1

Composition of organic fertilizers

Fertilizer	Humidity, %	pH	Ash, %	As of dry matter, %		
				total N	P_2O_5	K_2O
Half rotten manure according to laboratory analyses	60,7	7,5	15,3	0,48	0,23	0,55
Organomix (ORWACO) according to the certificate	40,0	7,5	14,7	2,0	0,52	1,20
Granulated guano according to the certificate	10,5	7,4	13,8	3,45	3,64	2,87

The fertilizers had been introduced into the soil furrows and covered with soil before setting the seedlings and the bacterial concentrate was sprayed on the furrows in the form of water solution. The planting of seedlings was implemented within the end of April and the start of May. In May and June (before the fruits maturation) sprayings were organized thrice against different pests and diseases (Whiteflies, South-American leaf miners, Powdery mildew, Apical Rot disease, etc.) and water solutions of Ridomil Gold - 0.25%, Pegas -0.1 %, Actellic-0.15 % and Topaz-0.08 % were applied. For yield accounting 30 plants were taken from each repetition and 5 plants were taken for the vegetative mass.

The soil laboratory analyses have been conducted through the following methods: the soil mechanical composition has been determined through the Kachinsky's method [2], pH has been measured through potentiometer, humus content – through Tyurin's method, hygroscopic humidity – through weighing method, the carbonates – according to CO_2 (calcimeter), the dry residue from the water extract-through incandescent method, the total nitrogen was determined through Kyeldal's method, the available nitrogen- through Tyurin and Konnonova's methods, while the available phosphorus and potassium through Machigin's method [18]. The yield and vegetative mass has been computed through the weighing method. The nitrate content in the mature fruits of tomato and pepper has been determined through "SOEKS" nitrate tester (NUC-019-2). The yield mathematical calculation has been implemented through the method of dispersion analysis [4].

Results and Discussion.

Experimental plots belong to irrigated meadow brown soil types. Two land plots have been used for the researches and their agro-chemical characteristics are introduced in table 2.

Table 2

Agro-chemical characteristics of the experimental plots

Soils	Mechanical composition < 0,01 mm sum of particles, %	pH	Humus, %	Hygroscopic humidity, %	$CaCO_3$ according to CO_2, %	Dry residue of water extract, %	Total N-n, %	Plants available nutrients, mg/100 g soil		
								N	P_2O_5	K_2O
Field № 1 in 2017 and 2019	25,4	7,54	1,30	3,62	1,51	0,025	0,068	1,40	3,40	34
Field № 2 in 2018	32,4	7,46	1,84	4,34	4,60	0,064	0,120	2,15	3,08	36

The data of the second table testify that in 2017 and 2019 the mechanical composition of experimental field plot is light loamy (physical composition- 25.4%) and the soil of the other field (№2) is classified among those having mid loamy mechanical composition (32,4%). The soils have alkaline reaction, the content of humus and available nutrients is low (except for K_2O); anyhow in conditions of appropriate irrigation and fertilization abundant and high quality vegetable yield is harvested in these land areas.

In the experimental years considerable differences in the yield amount of the investigated crops were recorded. The data of table 3 indicate that according to the data of the overall examined variants the average tomato yield for three years fluctuates from 518 c/ha (control) to 753 c/ha ($N_{150}P_{80}$ kg/ha). In the other fertilization variants the yield has fluctuated within the range of 626 c/ha (Azoto + Phosphate Barvar) to 745 c/ha ($N_{150}P_{80}K_{150}$ kg/ha), i.e. in all target variants the yield surplus over the control one has made 108-235 c/ha.

Table 3

The effect of organo-mineral fertilizers and micro-biological concentrates on the quantity and quality of tomato yield

Variants	Yield, c/ha				Nitrates, mg/kg				The average for 3 years		
	2017	2018	2019	Average	2017	2018	2019	Average	Dry matters, %	Total sugar, %	Vitamin C –mg %
1. Without fertilization (control)	511	647	395	518	185	191	159	178	5,00	4,0	25,3
2. Mineral fertilizers ($N_{150}P_{80}K_{150}$ kg/ha)	665	907	663	745	173	203	180	185	5,09	4,4	25,7
3. Half rotten manure-30 t/ha	630	922	664	739	178	197	171	182	4,90	4,8	29,8
4. Granulated guano -5 t/ha	612	887	658	719	174	195	178	182	4,75	5,2	26,6
5. Organomix (ORWACO)-9 t/ha	589	900	610	700	179	196	179	185	5,09	4,1	22,9
6. Azoto+Phosphate Barvar (100+100 g/ha- in 1000 L water)	599	698	582	626	173	202	174	183	4,78	4,3	26,4
7. Mineral fertilizers ($N_{150}P_{80}$ kg/ha)	716	897	645	753	173	190	177	180	5,11	3,6	22,7
Sx, %	5,2	2,8	3,9	4,0							
$LSD_{0,5}$, g	99,4	72,8	72,4	83,9							

The average pepper yield for three years (Table 4) fluctuates within the range of 191 c/ha (control) to 320 c/ha (granulated guano), besides, the surplus in the experimental variants has made 96 c/ha-129 c/ha over the control variant. It is also worth mentioning that the excess of tomato yield amount in the variants of organomix (2017) and bacterial concentrates (2017 and 2018) against the control variant isn't so much significant. The same variants have shown low results for pepper in 2017 as well. The data of table 3 and 4 testify that the yield of the two crops in 2018 considerably exceeded the yield resulted in the other two years, which is due to the favorable conditions of the second field (where winter wheat was the previous crop) and sufficient irrigation conditions, while in the first field no crop rotation occurred and the irrigation conditions were more poor. As to the low efficiency of organomix and bacterial concentrates, it is probably due to the low content of needed nutrients and poor bacterial activity.

In each harvesting period of the abovementioned crops the nitrate contents in the mature fruits was determined (Tables 3 and 4), thus, throughout the three-year experiments these compounds in the tomato fruits exceeded the value of MPC (150 mg/kg for open ground), while in the pepper fruits they were much lower than MPC value (MPC = 200 mg/kg). Nevertheless, it is quite possible that the high nitrate content in the tomato variety "Lia" is related to the varietal peculiarities. To disclose the aforementioned it is necessary to study a number of tomato varieties within the frame of the same experiment. It has been also found out that in the mature fruits the nitrate content hardly undergoes any changes during the vegetation period; this evidences that the plants actively imbibe mineral elements, including nitrates, throughout the whole vegetation period.

Table 4

The effect of organo-mineral fertilizers and micro-biological concentrates on the quantity and quality of pepper yield (field experiment)

Variants	Yield, c/ha				Nitrates mg/kg				The average for 3 years		
	2017	2018	2019	Average	2017	2018	2019	Average	Dry matters, %	Total sugar, %	Vitamin C – mg %
1. Without fertilization (control)	147	412	135	231	52	56	48	52	6,98	5,9	163
2. Mineral fertilizers ($N_{150}P_{80}K_{150}$ kg/ha)	216	545	191	317	59	76	68	68	7,87	5,4	138
3. Half rotten manure -30 t/ha	221	545	184	317	54	81	64	66	6,64	5,4	150
4. Granulated guano-5 t/ha	234	548	177	320	59	73	62	65	6,80	5,8	146
5. Organomix (ORWACO)-9 t/ha	190	533	176	300	57	60	66	61	6,74	5,3	150
6. Azoto+Phosphate Barvar (100+100 g/ha- in 1000 L water)	208	492	161	287	58	72	58	62	6,18	6,8	146
7. Mineral fertilizers ($N_{150}P_{80}$ kg/ha)	227	548	181	319	58	67	51	59	6,43	5,6	158
Sx, %	9,5	1,7	3,2	3,7							
$LSD_{0,5}$, g	60,7	26,8	17,0	33,6							

According to the three year's average data the dry matters of the mature tomato fruits in the investigated variants have demonstrated insignificant fluctuations (4.8 %-5.1 %) and in the pepper (which includes the queen cell and fruit stem) they have ranged within 6.2 %-7.9 %. The content of total sugar in the tomato fruits according to the overall data received from all variants has fluctuated within the range of 3.6 % – 5.2 %, while that of vitamin C – 22.7 – 29.8 mg%. The mentioned indicators in pepper have amounted to 5.3 – 6.8% and 138 - 163 mg% respectively. It should be mentioned that in some fertilization variants these indicators were lower than the control one, which may occur due to the increase of the general commercial and non-commercial bio-mass in the mentioned variants.

The tomato and pepper plants generate rather huge vegetative mass in a unit area during the whole vegetation period (about 6 months) and every year considerable amount of nutrients are removed with this mass, thus, accounting of this mass is also considered to be an urgent task. For the computation of the tomato and pepper vegetative mass the reference data of 50000 plants/ha and 60000 plants/ha have been respectively applied, i.e. 15 plants were picked up from the last vegetation soil for each crop, the aboveground/top and root mass were split out from the root collar/neck, then they were weighed individually and the average data per a plant were multiplied by the mentioned numbers (Table 5).

Table 5

The effect of organo-mineral fertilizers and micro-biological concentrates on the vegetative mass of tomato and pepper, c/ha per fresh weight

Variants	Tomato				Pepper			
	Aboveground mas/root				Aboveground mas/root			
	2017	2018	2019	average	2017	2018	2019	average
1. Without fertilization (control)	157,7 / 17,5	293,1 / 29,6	123,6 / 18,9	191,5 / 22,0	79,4 / 7,7	65,9 / 12,5	67,0 / 7,3	70,8 / 9,2
2. Mineral fertilizers ($N_{150}P_{80}K_{150}$ kg/ha)	182,1 / 23,4	383,1 / 45,4	238,8 / 31,8	268,0 / 33,5	83,1 / 8,5	89,8 / 22,2	82,4 / 10,4	85,1 / 13,7
3. Half rotten manure – 30 t/ha	181,3 / 24,2	359,4 / 38,4	254,4 / 33,9	265,0 / 32,2	74,9 / 7,7	93,5 / 17,6	81,1 / 10,9	83,2 / 12,1
4. Granulated guano-5 t/ha	176,4 / 21,0	359,2 / 31,0	230,7 / 31,0	255,4 / 31,1	89,5 / 8,5	85,2 / 17,5	74,9 / 9,5	83,2 / 11,8
5. Organomix (ORWACO)- 9 t/ha	177,8 / 19,8	325,4 / 33,2	223,7 / 29,0	242,3 / 27,3	67,1 / 6,6	92,1 / 19,8	75,0 / 10,0	78,1 / 12,1
6. Azoto+Phosphate Barvar (100+100 g/ha - in 1000 L water)	170,7 / 19,0	296,7 / 29,2	133,6 / 22,7	200,3 / 23,6	101,1 / 10,1	78,4 / 15,8	68,7 / 7,9	82,7 / 11,3
7. Mineral fertilizers ($N_{150}P_{80}$ kg/ha)	177,4 / 22,2	366,8 / 45,1	241,1 / 32,0	261,8 / 33,1	104,8 / 7,3	90,5 / 21,1	78,9 / 10,7	91,4 / 13,0

The table data testify that in the investigated variants the three-year average aboveground fresh bio-mass in the "Lia" tomato variety fluctuates from 191.5 c/ha (control) to 268.0 c/ha ($N_{150}P_{80}K_{150}$ kg/ha), and the root mass is within the range of 22 – 33.5 c/ha. In all

fertilization variants the vegetative mass has exceeded the control one by 20 %-50 %.

As a matter of fact, together with the commercial yield the primary biological product of tomato and pepper crops is rather high in the irrigated conditions of the Ararat valley and the amount of nutrients consumed for its production is going to be derived in the next article.

Conclusion. The combined mineral fertilizers ($N_{150}P_{80}K_{150}$ and $N_{150}P_{80}$ kg/ha) and the equal doses of half rotten manure and granulated guano tested on the tomato variety "Lia" and pepper variety "Nush-55" have almost the same impact on the growing capacity, yield quantity and quality of tomato and pepper. The bacterial concentrates of organomix and Azoto+Phosphate Barvar have demonstrated poor effect on the mentioned indictors, which is probably related to their inaccurate certification and low bacterial activity. In the fertilization variants no increase in the contents of dry matter, total sugar and vitamin C in the ripe tomato and pepper fruits has been recorded as compared to those found in the control one, which is evidently related to the increase of the total bio-mass in the mentioned variants. Throughout the three-year experiments the nitrate content in the mature tomato fruits in all variants (including the control one) has exceeded the MPC (maximum permissible concentration) standard, which may be accounted for the varietal characteristics, while in the pepper fruits it has been lower than MPC standard in about 3 times.

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ИЗУЧЕНИЕ КАЧЕСТВЕННЫХ ОСОБЕННОСТЕЙ ВОЛОКНА ХЛОПЧАТНИКА ПОД ВЛИЯНИЕМ ВНУТРЕННИХ ФАКТОРОВ.

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АННОТАЦИЯ

В статье приводятся данные по изучению трёх групп растений мутантной линии МЛ-180 имеющих различную степень опущения семян и разный выход волокна. Показано, что самые высоко выходные растения опушенносемянные, средний выход волокна у них составил 40,3 %. По группе растений голосемянных, с незначительным подпушком на микропиле, средний выход волокна составил 36,9%. Самый низкий выход волокна у абсолютно голосемянных растений, средний выход волокна 27,9%.

ABSTRACT

The data on the study of three groups of ML-180 mutant line plants with different degree of seeds pubescence and fiber output are presented in this article. It is been shown that the feathery cotton have the highest fiber output. The average fiber output was 40.3%.

The average fiber output of the group of gymnosperm plants with a slight pubescence on Место для формулы. micropile was 36.9%.

The absolutely gymnosperm plants had the lowest fiber output. The average fiber output of these plants was 27.9%.

Ключевые слова: подпушек, волокно, волокнообразование, технология, голосемянные, опущенносемянные, выход волокна, микропиль.

Keywords: downs, fiber, fiber formation, technology, gymnosperm feathery seeds, fiber output, micropile.

ВВЕДЕНИЕ

Продукция хлопчатника широко используется не только в легкой промышленности, но и во многих отраслях тяжелой индустрии.

Наряду с увеличением производства хлопка-сырца необходимо улучшать и качество волокна. Особую актуальность данный вопрос приобретает на современном этапе, когда к качеству продукции и сырья во всех отраслях народного хозяйства представляются высокие требования.

Для создания новых сортов хлопчатника с хорошими технологическими свойствами волокна, а также для сохранения и улучшения качественных показателей урожая производственных сортов необходимо всесторонне и глубоко исследовать его. Несмотря на обширные сведения, имеющиеся в отечественной и зарубежной литературе по биологии и технологии хлопкового волокна, целый ряд вопросов в этой области остаётся невыясненным. Не установлено, что влияет на дифференциацию клеток в волокнообразующем слое семяпочки; не выявлены потенциальные возможности по созданию форм, сочетающих высокое качество волокна с хорошей