

Biological effectiveness of onion plant protection scheme

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ABSTRACT

The average yield of bulb onions is still quite low. The purpose of this study was to improve the techniques and methods of cultivating onions using new generation preparations against the background of $N_{180}P_{60}K_{60}$ in a drip irrigation method. To achieve the objective of this study, field surveys, observations and measurements were carried out using generally accepted methods. The experimental data obtained from the studies were processed using analysis of variance in Excel, which is part of the Microsoft Office installation package. Field experience included both background application of mineral fertilizers, as well as integrated nutrition of plants with Aminofol Plus and Novosil bulb onion growth stimulants and its biological protection with drugs Gaitang, KE, Akzifor, KE and with Monarch, VDG preparations. According to the results of tests carried out in the 3rd soil-climatic zone, they positively influenced the growth processes and yield of the cultivated crop. The use of this scheme gave a significant increase in the number of commercial bulbs and the weight of commercial bulbs relative to the control version, which significantly affected the yield, which was 121.8 tons/ha (commercial yield). Based on the results of the obtained experimental data, the following was identified, the difference in yield is due to the effect of drugs that have a positive effect on the variety and hybrid of onions, which are under study.

Keywords: Bulb onions, Processing, Herbicide, Trips, Weeds, Yield.

Eficácia biológica do regime fitofarmacêutico da cebola

RESUMO

O rendimento médio de bulbos de cebolas ainda é bastante baixo. O objetivo deste estudo foi ampliar técnicas e métodos de cultivo de cebola utilizando novas preparações nutricionais no contexto da adubação de base $N_{180}P_{60}K_{60}$ em um método de irrigação por gotejamento. Para atingir o objetivo deste estudo, pesquisas de campo, observações e medições foram realizadas utilizando métodos geralmente aceitos. Os dados experimentais obtidos a partir dos estudos foram processados usando análise de variância no Excel, que faz parte do pacote de instalação do Microsoft Office. A experiência de campo incluiu tanto a aplicação de base de fertilizantes minerais, bem como a nutrição integrada de plantas com Aminofol Plus e Novosil estimulantes de crescimento de bulbo de cebola e sua proteção biológica com drogas Gaitang, KE, Akzifor, KE e com preparações Monarch, VDG. De acordo com os resultados dos testes realizados em solos da terceira zona climática, eles influenciaram positivamente os processos de crescimento e o rendimento do cultivo. A utilização deste esquema de adubação permitiu um aumento significativo do número e peso de bulbos comerciais em relação ao tratamento controle, que afetou significativamente o rendimento, que foi de 121,8 toneladas/ha (rendimento comercial). Com base nos resultados dos dados experimentais obtidos, foi identificado que a diferença de rendimento deve-se ao efeito dos fármacos que têm efeito positivo na variedade e no híbrido de cebolas deste estudo.

Palavras-chave: Bulbo de cebolas, Processamento, Herbicida, Viagens, Ervas daninhas, Rendimento.



1. Introduction

Expert assessments show that the average yield of bulb onions is still quite low. One of the reasons for this is the lack of scientifically sound resource-saving technologies for cultivating this crop, as well as a new generation plant protection scheme. For the first time, for the arid conditions of Russia (North-West Caspian Sea), a study was carried out of the scheme for protecting bulb onions with a drip irrigation method. By the method of split dividers with systematic placement of dividers according to the classical method.

Today, the volume of agricultural products and their processing increases annually, but is not fully satisfied. This is primarily due to the fact that the expansion of the areas where bulb onions are grown is not enough. The priority direction in the development of crop production is the introduction of innovative resource-saving technologies and modern technology when cultivating as bulb onions (Havey, 2018; Jenni, 2014; Peter, 2015; Punit, 2018; Tavella, 2015; Yolando, 2019).

The aim of the study was to determine the biological effectiveness of the scheme for protecting plants with new-generation preparations for onion plants during the vegetation period, aimed at increasing yields in the zone of light chestnut solonchic soils of the arid climate of the North-Western Caspian Sea. The scientific novelty of researches consisted in justification and practical application of agrochemicals of new generation at cultivation of onion of the high rates of marketability and productivity of the cultivated culture directed to formation.

2. Material and Methods

A two-factor field experience on bulb onion culture was laid in three times repetition. Placement of dividers - systematic. Factor A - a variety and hybrid of bulb onions of medium maturation: Bayram F1, Christina. Factor B: anti-stress agrochemicals Aminofol Plus, growth stimulator Novosil. Aminofol Plus (1st feeding in the 3-5 leaf phase, 2nd and 3rd feeding with an interval of 10-14 days after the last feeding). The consumption rate of the preparation is 1.0 l/ha. Working solution consumption - 200.0 l/ha, according to the standards from the manufacturer.

Novosil (1st in the formation phase of 4 sheets, 2nd in 15 days after the first spraying). The consumption rate of the drug is 100 mL/ha. Working solution consumption is 300 L/ha, according to the standards from the manufacturer. To fulfill the tasks, field accounting, observations and measurements were carried out using the method of field experience of Dospekhov B. A., methods of experimental business in crop production Nikitenko G.F. 1982, methods of

experimental business in vegetable and melon growing edited by Belik V.F., Litvinova S.S., methods of the State Variety Testing of Crops 2015, as well as according to the Methodological Guide for the Registration Tests of Agrochemicals in Agriculture 2018.

The two-factor field experience was laid down in the irrigated area. Factor A - Bayram F1 hybrid and Christina variety. Factor B - growth stimulants - Novosil and Aminofol Plus. The area under experience is 240 m². The predecessor for the laying of field experience this year was pure steam. Preparatory works for laying experiments in 2021 were started in 2020.

In the fall of 2020, a ghost ploughing was carried out with the formation turnover to a depth of 22...24 cm with a plow. Spring tillage began as it became physically mature. Cultivation was carried out, with the subsequent introduction of mineral fertilizers in the amount of 200 kg f.v. azofosc by mineral fertilizer spreader. In total, 2 cultivations were carried out by a cultivator. Before sowing, milling was carried out. Onion was sown with the simultaneous laying of drip ribbons (Figure 1).

During the vegetation period, mineral fertilizers (complex mineral fertilizer azofosc N₁₆P₁₆K₁₆) were introduced from the calculation N₆₀P₆₀K₆₀ for the main treatment of soils by a spreader of mineral fertilizers. Additionally, during the vegetation period, ammonium nitrate was introduced with irrigation water. As a result, the total amount of mineral fertilizers added amounted to N₁₈₀P₆₀K₆₀. Care of the crop consisted in keeping the onion of the bulb clean from weeds and regulating the water and food regime of the soil. Agrochemical analysis of pilot site soils are in the Tables 1 and 2.



Figure 1. Sowing bulb onions

Table 1. Results of agrochemical analysis of the soil of the test area (horizon 0... 0.2 m)

Indicators	Unit of measurement	Actual value
water extract pH	Ed.	8.29
Mass fraction of mobile phosphorus compounds	mg/kg	24.75
Weight fraction of mobile potassium compounds	mg/kg	442
Mass fraction of organic matter	%	0.92
Weight fraction of ammonium nitrogen	mg/kg	3.85
Mass fraction	mg/kg	4.40

Table 2. Results of agrochemical analysis of the soil of the test area (horizon 0.2... 0.4 m)

Indicators	Unit of measurement	Actual value
water extract pH	Ed.	8.60
Mass fraction of mobile phosphorus compounds	mg/kg	25.4
Weight fraction of mobile potassium compounds	mg/kg	172
Mass fraction of organic matter	%	0.81
Weight fraction of ammonium nitrogen	mg/kg	2.80
Mass fraction	mg/kg	6.0

3. Results and Discussion

The analysis of the observations revealed that the period of passage of phenological phases according to the research options did not have any special differences. Bulb onion plants both in the control version and in the treatment, version simultaneously entered both the 4...5 leaf phase, the bulb formation phase, leaf folding, etc. The growing season lasted 120 days. When analyzing biometric measurements for three years of studies, it was found that in the bulb formation phase, the maximum values were noted in the Cristina onion variety, on the version using the preparation Novosil. So, in this variety, the number of leaves on average per plant was 5 pcs.

The mass of the bulb with the bot was 78.2 g, the mass of the bulb after cutting 41.7, the diameter of the bulb 3.8 g. At the beginning of technical ripeness (leaf drying), a biometric measurement was similarly carried out, as a result of which, Cristina onion variety was also isolated, the length of the largest leaf was 55.6 cm, the mass of the bulb before cutting was 287.6 g, after cutting 240.7 g (Table 3). The yield of bulb onions is on average per 2019... 2021 g. According to the results of three years of study, it is necessary to distinguish the high-yielding hybrid Bayram F1 on the variant using sheet processing by the natural growth regulator Novosil.

The biological yield averaged 129.6 tons/ha, the commercial yield 121.8 tons/ha. The increase relative to the control in this embodiment was + 48.3 t/ha, the bulb product was 93.9% with an average weight of 165 g (Table 4). Experimental data obtained from the studies were processed using two-factor variance analysis in Excel, which is part of the Microsoft Office installation package. As a result of the dispersion analysis, it was found that factor A (varieties and hybrid) and factor B (leaf treatments variants) had a significant effect on the

yield of bulb onions. F (actual) turned out to be $\geq F$ (theoretical). The interaction of the two factors also had a significant impact on yields. F (actual) turned out to be $\geq F$ (theoretical), experience error = 0.52. Bulb onions are one of the most valuable and common vegetable crops (Abdelsattar, 2019; Ansari, 2019; Ardell, 2008; Feryal, 2015; Francisco, 2019; Gupta, 2013; Hanci, 2018; Jiffinvir, 2018; Khosa, 2018; Khvan 2016; Larushin, 2019; Moretti, 2019; Reilly, 2013; Yadav, 2015).

An important and priority task for today in the cultivation of onions is also the analysis of protective measures. Phenological observations were made on 10 fixed accounting plants of each variant. Phases were noted: the appearance of seedlings; phase of 4... 5 leaves; bulb formation; folding of leaves; leaf drying; technical ripeness. The effectiveness of soil herbicides was determined by the formula:

$$Sk = 100 - V0/SK \cdot 100$$

Where SK - reduction of the number of weeds in% to control; V0 - number of weeds per 1 m² in the experience at the first (second or third) accounting; VK - number of weeds per 1 m² in control at the first (second or third) accounting; the efficacy of herbicides used for vegetating plants was determined by the formula:

$$C = 100 - V0/ A0 \cdot 100 \cdot ak/bq$$

Where C is a decrease in the number of weeds in% of the initial clogging in the test, adjusted for control; V0 - number of weeds per 1 m² with the second (or third) account in the experience; AO - number of weeds per 1 m² at the first account in the test (initial clogging); ak - number of weeds per 1 m² at the first check (initial clogging); bk is the number of weeds of 1 m² with the second (or third) accounting under control.

Table 3. Biometric indices of bulb onions depending on sheet processing options, average for 2019... 2021 g.

Variety, hybrid	Options	Phase 4...5 of the present sheet		-----Phase 4...5 of the present sheet-----				Start of technical ripeness (Leaf drying)				
		Number of leaves, pcs.	Longest length sheet, cm.	Number of leaves, pcs.	Longest length sheet, cm	Mass bulbs with botwa, g	Mass bulbs after trimming, g	Bulb diameter, cm	Quantity leaves, pcs.	Longest length sheet, cm	Mass bulbs with botwa, g	Mass bulbs without botwa g
Bayram F1	Control	4	25.6	7	43.9	53.3	20.9	3.3	8	42.7	162.5	126.5
	N ₁₈₀ P ₆₀ K ₆₀ +Aminobol Plus	4	28.7	8	49.2	63.9	26.2	4.2	8	49.4	225.8	171.5
	N ₁₈₀ P ₆₀ K ₆₀ ⁺ Novosil	5	31.1	8	49.3	76.5	26.8	4.3	8	50.2	237.5	185.0
Christina	Control	4	24.9	7	40.0	53.0	27.7	2.9	7	47.1	190.6	152.6
	N ₁₈₀ P ₆₀ K ₆₀ +Aminobol Plus	5	26.9	8	46.8	64.4	32.2	3.5	7	53.5	224.3	178.2
	N ₁₈₀ P ₆₀ K ₆₀ ⁺ Novosil	5	27.3	9	48.5	78.2	41.7	3.8	9	55.6	287.6	240.7

Table 4. - Yield of bulb onions depending on sheet processing options, average for 2019... 2021 g.

Variety, hybrid	Options	Number of bulbs from the plot, pcs.			Total fee from the plot, kg			Average bulb weight, g	Biological yield, t/ha	± to control, t/ha	Commodity yield, t/ha	Merchandise,%
		in total	commodity	non-commodity	in total	products	non-commercial products					
Bayram F1	Control	473	395	78	65.0	60.5	4.5	137	81.3	-	75.6	93.1
	N ₁₈₀ P ₆₀ K ₆₀ +Aminobol Plus	545	419	126	89.2	83.2	6.0	164	111.5	30.2	104.0	93.3
	N ₁₈₀ P ₆₀ K ₆₀ ⁺ Novosil	629	491	138	103.7	97.4	6.3	165	129.6	48.3	121.8	93.9
Christina	Control	434	303	131	68.1	59.8	8.3	157	85.1	-	74.8	87.8
	N ₁₈₀ P ₆₀ K ₆₀ +Aminobol Plus	529	429	100	89.1	82.3	6.8	168	111.4	26.3	102.9	92.4
	N ₁₈₀ P ₆₀ K ₆₀ ⁺ Novosil	597	440	157	100.6	93.7	6.9	169	125.8	40.7	117.1	93.1
	SSD ₀₅ (A)	-	-	-	-	-	-	-	0.8	-	0.7	-
	SSD ₀₅ (B)	-	-	-	-	-	-	-	0.7	-	0.9	-
	SSD ₀₅ (AB)	-	-	-	-	-	-	-	0.7	-	0.7	-

Factor A - grade, factor B - mineral nutrition mode, factor C- sowing rate.
SSD₀₅ - smallest significant difference.

In the following formula, the expression:

$$100 - VO/AO \cdot 100$$

Shows the percentage of weeds killed without adjustment for control (C), and ak/vk ratio is an adjustment for control (it can be calculated immediately for all experience options related to one control). Abbott's formula was used to calculate biological efficacy:

$$E = 100 * (A-B) / A$$

Where E is the efficiency expressed by the percentage of reduction in numbers; A is the average number of insects before treatment; B is the average number of insects after treatment. Also on the culture of onions during vegetation, protective measures against diseases were carried out with the following drugs: Metaxil SP, Ridomil Gold, Kurzat, in accordance with the standards recommended by the manufacturer. Protective measures were taken against weeds and thrips. The results are as

follows. Treatment with the preparation Gaitang, KE was carried out before onions of bulb onions. The second treatment in phase 2...6 of the real leaves in weed plants was carried out with the preparation Akzifor, KE.

The third treatment related to the detection of the first signs of the pest (trips) was carried out by Monarch, VDG. Accounting for onion for herbicides. The first accounting was carried out before onions of bulb, before spraying with the drug Gaitang, KE (consumption rate – 3 l/ha). Throughout the field where the experience was laid, weeds were practically absent (Figure 2). The second registration was made on the 30th day after processing (Figure 3). When inspecting and taking into account experimental dividers, both on the control and on the version with treatments, weeds such as: bluish tinsel, camel barb, common mint dominated (Table 5).

According to the program of scientific research, in the phase of 2...6 leaves in weed plants, a second treatment with the drug Akzifor, KE (consumption rate - 500 g/ha) was carried out (Figure 4.). During the inspection of the experimental plots, such weeds were present as bluish tinsel; field bathing; camel barb; swan (garden) gray; common mint, common solyanka (kurai), millet, gray wormwood, gorchak. When assessing the effectiveness of the drug Akzifor, KE (consumption rate – 500 g/ha) it was found that with the second and third accounting, the decrease in the number of weeds in% to control on the treated version ranged from an average of 56.9% to 64.1% (Table 6). Figures 5 and 6 show the results of the preparations at the experimental site (Figure 5, Figure 6). The third treatment related to the detection of the first signs of the pest was carried out by (Figure 7).

The average number of adults per escape before treatment with Monarch, VDG (consumption rate – 25 g/ha) was 1... 2 pcs. The decrease in numbers relative to the initial one, adjusted for control after processing

according to the days of accounting, was equal to 100% (Table 7; Figure 8).

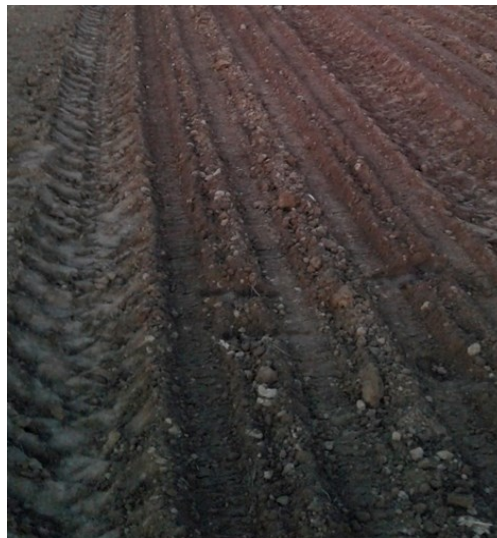


Figure 2. First weed count



Figure 3. After treatment for 30 days

Table 5. Effectiveness of Gaitang, KE herbicide on Bayram F1 hybrid

Experience Variant	Frequency	Average number of weeds per 1m ²		Reduction of weeds in% to control
		1 st accounting before processing	2 nd accounting after processing on 30 days.	
Control - no processing	I	2	4	-
	II	0	2	-
	III	1	3	-
	Average	1	3	-
Variant with treatments	I	1	2	99...92
	II	0	1	99...96
	III	0	0	100...0
	Average	0	-	-
SSD ₀₅	-	1...43	2...48	-

SSD₀₅ - smallest significant difference



Figure 4. Phase 2 - 6 leaves in weeds (control)



Figure 5. 30 - days after treatment

Table 6. Herbicide Efficacy Akzifor, KE on Bayram F1 hybrid

Variant	Frequency	Average number of weeds per 1 m ² , pcs.				Decline in numbers weeds in% to control		
		After processing by day of accounting				2 accounting before 30	3 accounting 50	4 accounting before cleaning
		1 accounting before processing	2 accounting 30	3 accounting 50	4 accounting before cleaning			
Control - no processing	I	10	14	15	15	-	-	-
	II	12	14	14	16	-	-	-
	III	17	19	20	21	-	-	-
	average	13.0	15.7	16.3	17.3	-	-	-
Variant with treatments	I	7	4	4	9	59.6	62.6	15.5
	II	6	3	4	8	57.5	43.9	-0.25
	III	7	2	3	7	75.1	64.3	41.0
	average	6.7	3.0	3.7	8.0	64.1	56.9	28.3
SSD ₀₅		8.7	9.3	9.3	10.3	-	-	-

SSD 05 - smallest significant difference



Figure 6. 50 days after processing on Bayram F1 hybrid



Figure 7. First accounting before spraying

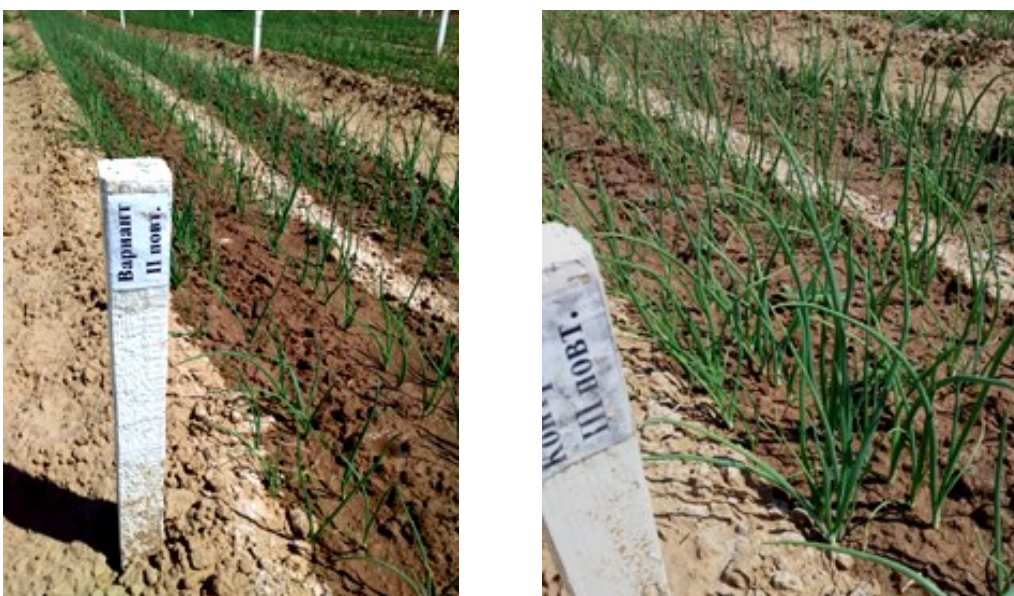


Figure 8. 14th day after spraying

Table 7. Biological effectiveness of the drug Monarch, VDG against tryptophan on onions repchat on Bayram F1 hybrid

Experience Variant	Frequency	Average number of trips per escape, pieces			Reduction of the number relative to the initial one, adjusted for control after processing according to the days of accounting, %			
		Before processing	After processing by day of accounting			3	7	14
			3	7	14			
Control - no processing	I	2	2	2	2	-	-	-
	II	0	0	1	2	-	-	-
	III	1	1	1	3	-	-	-
	average	1	1	1	2	-	-	-
Variant with treatments	I	2	1	0	0	100	100	100
	II	1	0	0	0	100	100	100
	III	0	0	0	0	100	100	100
	average	1	0	0	0	100	100	100

SSD₀₅SSD₀₅ - smallest significant difference

The fourth treatment with the preparation Monarch, VDG was not carried out because the pest's EPV was not exceeded, i.e. 10 adults per plant.

4. Conclusions

The practical effectiveness and significance of the proposed agro-receptions makes it possible to choose a more promising option that contributes to a significant increase in the yield of onion for arid conditions or regions similar in soil and climatic conditions. The use of a modern system of biological protection of bulb onions will contribute to the formation of a higher crop with a marketability of bulbs over 95%. The use of the drugs Akzifor, KE and Monarch, VDG at the first signs of detection of the imago trips will lead to a significant reduction in its population.

Authors' Contribution

Bondarenko Anastasia was directly involved in the development and laying of the field experiment, processing the data obtained and writing this manuscript. Tyutyuma Natalia was directly involved in the planning, execution and analysis of this study.

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