

REPUBLIC OF AZERBAIJAN

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ABSTRACT

of the dissertation for the degree of Doctor of Philosophy
(Doctor of Science)

**INTEGRATED CONTROL MEASURES OF WEEDS IN THE
VINEYARDS OF THE REPUBLIC**

Speciality: **3103.06 - Plant Protection**

Field of science: **Agrarian sciences**

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The work was performed at the Azerbaijan State Agrarian University.

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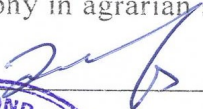
Official opponents: - doctor of agrarian sciences, correspondent member of ANAS, professor
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GENERAL DESCRIPTION OF THE WORK

The urgency of the topic. The development of viticulture and improvement of its structure are of particular importance for the growth of economy of the Republic. It is possible to obtain more yield and profits from a single area in viticulture, in comparison with other spheres.

In connection with soil-climatic conditions of Azerbaijan which are favorable for the development of viticulture, our people have been engaged in viticulture and cultivated a lot of grape varieties from ancient times. In the 1980s, about 30% of the total profits in agriculture accounted for vineyards. In those years, viticulture played a significant role in formation of the state budget, competing with the oil industry, the leading sector of the economy. After Azerbaijan gained independence, despite the growing popularity of vineyards in the new economic environment, the people's demand for table grapes as well as non-alcoholic beverages from grapes remains a problem. Also, production of raisins and beverage products received from grapes does not meet the needs of the population.

The most global problem of agriculture in modern crop production is protection of plants from pests, diseases and weeds.

Weeds adversely affect the growth and development of cultivated crops, make difficult soil cultivation and create serious barriers to harvest. These plants are better adapted to growing conditions and successfully compete with cultivated ones.

Weeds not only reduce the amount and quality of products, but also increase the risk of infection by creating alternative conditions for the development of pests and pathogens. The main food source of pathogens and pests common in grape cultivations are weeds. Weeds are the main food source of diseases and pests in vineyards. Thus, pests such as grape clusters, leafhoppers and mites, and diseases such as mildium, oidium and anthracnose that spread in the vineyards begin the initial stages of their developments on weeds.

It is possible to reduce pests and disease causing organisms mentioned above by application of herbicides at the beginning of the

vegetation season, so weeds and overload of the fields with poisons can be controlled.

In order to provide the increase of the level of agriculture, it is important to control weeds, which cause loss of crop yields.

As a result of nonstop cultivation, grape plantations are strongly infected with all kinds of annual and perennial weeds. When the rows and inter-rows of vines are cultivated in a high agro-technical manner, weed seedlings are destroyed and their damage becomes relatively small. While perennial weeds predominate in vineyards, farmers believe that their pruning awakens the dormant buds (inactive buds) of the root system and increases their number. So a complex control measures should be taken, by taking into account the degree of weeding and species content of those weeds in vineyards.

Control measures of annual and perennial weeds that have seriously damaged vineyards in our Republic is one of the actual issues. Agrarian science puts before the plant protection system a combination of organizational, agro-technical and chemical measures that create favorable conditions for the growth and development of cultivated plants.

At present, herbicides are inseparable part of modern technologies in cultivation of agricultural crops.

Each year, the active ingredients of herbicides are improved. Although they are registered, many herbicides have no specialized scientific evaluation in the regions or are unsatisfactory. The lack of information on phytosanitary status in the field often makes both agro-technical measures and herbicides less effective.

All of these necessitate the study of a whole range of grape protection measures against weeds, as well as the study and application of new environmentally secure pesticides and herbaceous mixtures, and their widespread use in production.

The purpose and objectives of the research: The purpose of working out of the control measures against annual and perennial weeds is identification of highly effective, environmentally safe and economically effective herbicides, agroecological evaluation of herbicides in the vineyards of the Republic.

The following issues have been put forward in order to develop control measures of annual and perennial weeds in the vineyards of the Republic:

- study of the species composition and distribution of weeds in the vineyards of the Republic;
- study of threshold limits in vineyards;
- to reveal the effect of different herbicides applied on saplings on annual and perennial weeds;
- determine the characteristics of influence of various herbicides used in agrosenosis on the growth and development of plants;
- to clarify the effect of herbicides applied on grape seedlings on grape productivity.

Research methods. The research is aimed to combat weeds in vineyards. As materials of the study, annual and perennial weeds from the vineyards and herbicides applied to them, soil, planting layer and beneficial fauna were taken. The experiments were performed in 4 repetitions, each in 50m², in the control (herbicide-free) and experimental (with herbicide) variants.

The use of herbicides in grape seedlings was based on the methodology developed by the All-Union Institute for Plant Protection. In the Republic vineyards weeds species and distribution was studied according to the method of

A.V. Fisyunov and V.I. Trukhachev. The threshold of weeds in the grape plantations was determined according to the method of A.A. Ivashenko and V.A. Zakharenko. Biological and yield efficiency of all herbicides applied to all annual and perennial weeds, was calculated based on the formula worked out by A.V. Voyevod, following the reporting of weeds:

Studying of the influence of applied herbicides on the height and growth of plants was based on the method of B.A. Dospekhov. The effect of application of herbicides on the quality characteristics of grapes- sugar content was determined by the Bertran method, general acidity according to B. Pleshkov. Effect of herbicides on the soil microflora determined by L.S. Yegorova's method. The bacterial cerebral peptani was analyzed in agar, Sapeq spedispedas in actinomycet, and azotobacteria by semi-automatic counter in 1 gram

of soil. Effect of herbicides on nitric acid was determined by the method of disulfoxenol, Grandwal - Lyajn, on phosphorus by colorometric method and on potassium by the flame photometry method of B.P. Machigin. Effect of applied herbicides on beneficial fauna had been determined by V.A. Tryapisinin and V.R. Adashkevich's method according to a report was made every 10 days by counting the good fauna on leaves. Grape yield was determined by Dospekhov's method (1985). The residues of the herbicides applied in the product were determined by thin-layer chromatographic method. The economic efficiency of the applied herbicides had been calculated. SPSS-26 program package has been used to verify the accuracy of the results of the researches.

The main provisions for the defence:

- Study of the distribution and species identification of weeds in the vineyards of the Republic, study of the loss threshold in the vineyards,

- The determination of biological and economic effectiveness of herbicides used against all kinds of annual and perennial weeds.

- The impact of applied herbicides on the growth and development of plants,

- The effect of herbicides on the quality of grapes (sugar content, sourness),

- Study of the effect of applied herbicides on soil microflora (azotobacter, actinomycetes and bacteria), on soil nutrients, (Nitrogenous, Phosphorus, Potassium) on beneficial fauna (gold-eyed and seven-pointed ladybird),

- Determination of the amount of residues in the product,

- Calculation of applied herbicides on yield and the economic efficiency of herbicides.

Scientific novelty. The identification of species of weeds in grape plantations were studied, their distributions in the regions were clarified and the thresholds for economic damage of weeds were determined. In the research works, chemical control was preferred among the complex control measurements along with agro-technical manners, by taking the environmental safety into account. As a result of the research, the optimal time of application

of herbicides to harvest an environmentally pure product was determined and highly effective, environmentally safe herbicides have been found for significant reduction of annual and perennial weeds in vineyards (82,8-92,1%): Uragan Forte (2,0 lt/ha), Boxer (5,0 lt/ha), Knock Out (3,0 lt/ha), Volsaglif (3,0 lt/ha), Reglon Super (2,0 lt/ha), Raundup (3,0 lt/ha), Fusilad Forte (2,0 lt/ha). Grape productivity increased for 10,1-14,9 centners, and economic indicators of grape production significantly rised.

The high efficiency of the presented herbicides against the complex of single-lobed and double-lobed weeds has been established.

Theoretical and practical significance of the research.

Totally 68 species of weeds have been discovered in the vineyards of the Republic, 28 of which are spread throughout the regions of the Republic. The average incidence of weeds in the Republic was 33,3% (63,2% annuals, 7,3% biennials and 29,5% perennials).

In the experiments, carried out in vineyards of Ganja-Kazakh and Absheron regions the effectiveness of herbicides used in experiments of grape crop cultivation significantly increased in all kinds of annual and perenial weeds from 11,0-15,4% which is important for effective use of soil and climatic potential of the Republic. The applied herbicides also had a positive effect on the quality of grapes, in comparison with the control option, the sugar content of grape increased for 0,5-1,2%, the toxicity of vegetative organs and crops was not detected, economic efficiency formed 123,32 and 143,71%.

All of these enhance the practical significance of the work and provides a basis for viticulture to obtain highly environmentally safe products.

The research materials obtained during the dissertation work are of scientific and practical importance in terms of enrichment of plant protection, other agricultural scientific fields as well as for viticulture in the Republic with modern information.

Approval and application of work. The main results of the dissertation work were discussed in the Academic Council of the Azerbaijan State Agrarian University, 2015-2018, in proceedings of

the International Scientific and Practical Conference on "Innovative Development of Agrarian Science and Education: World Experience and Modern Priorities", dedicated to the announcement of the "2015-Agricultural Year", at Azerbaijan State Agrarian University, In proceedings of the 8th International Scientific and Practical Conference "Development of Agrarian Science, Food Security and Environmental Protection" of Azerbaijan State Agrarian University in 2016, in the proceedings of the Kurgan State Agriculture Academy Collection of articles based on the materials of the international scientific-practical conference dedicated to the 125th anniversary of T.S Maltsev "Development and application of modern technologies in order to modernize the complex of agro-industry", in the materials of the scientific-practical conference of the Institute of Soil Science and Agrochemistry of ANAS on "Problems of the environment and its conservation strategy: view to the future" (Baku, 2020), dedicated to the "Science Day" were discussed. 8 scientific articles on the dissertation were published in local and foreign journals.

The results of the experiments were applied on 8 hectares in Absheron region, 8 hectares in Tovuz region, 7 hectares in Samukh region with a total area of 23 hectares.

Name of the organization where the dissertation work was carried out: The thesis has been carried out at the Azerbaijan State Agrarian University "Crop production and plant protection" department.

The scope and structure of the thesis. The dissertation consists of an introduction, 6 chapters, results, recommendations to farmers, references and appendices. The context of the research contains 16 tables, 2 graphs, 23 pictures. The introduction to the content of the dissertation is 7 pages and 13667 characters, the first chapter is 26 pages, 55060 characters, the second chapter is 17 pages, 30430 characters, the third chapter is 14 pages, 21334 characters, the fourth chapter is 28 pages, 50166 characters, the fifth chapter is 29 pages, 52872. The chapter is 9 pages and consists of 16210 characters, the results are 2 pages and 2871 characters, the recommendations for production are 1 page and 506 characters and

the list of 194 references(40 local, 124 Russian and 30 English) is 22 pages and 39696 characters. The volume of the dissertation consists of 178 pages of computer writing, the total volume is 310464 characters (241822 characters excluding the list of references and appendices). 108 pages of computer writing or 22660.

BASIC CONTENT OF WORK

The introduction The actuality of the topic and general description of the dissertation have been provided in the introduction part.

Chapter 1. Literature review. A summary of scientific papers published by prominent local and international scientists on weeds observed in vineyards, their effect on productivity, yield and quality, soil moisture and the amount of nutrients in the soil, the spread of pathogens and some pests, dangerous weeds, the biological features and agricultural importance of grasses, the effect of fertilization and other agro-technical measures to weeds, a variety of control measures of weeds, various weed control measures, including the use of safe chemicals for the product, which ensure a high level of ecological pureness of the fields and maintain phytotoxicity in all weather conditions.

Chapter two. Presents the soil and climatic conditions of the study areas, research material, and methodology. The research was conducted in 2015-2018, in Ganja-Gazakh and Absheron regions of the Republic with contrasting soil and climatic conditions.

The Ganja-Gazakh economic region constitutes 15% of the territory of Azerbaijan. Dark gray-brown, gray-brown, light gray-brown, meadow soils are more common in the region.

According to meteorological data, the average perennial temperature in the Ganja-Gazakh region was 15,8⁰C, while the average annual temperature during the research period was 16,9-17,1-16,6⁰C. The average temperature in January was 3,6-3,9⁰C, and the average monthly temperature in July changed in the range of 28,3-29,7⁰C. The maximum temperature rose to 32,2-41⁰C. The average perennial precipitation was 269,8 mm, and 208,2-332,0-278,9 mm during the

research period. The average perennial relative humidity was 66,6% and annual relative humidity varied between 72,5; 72,0 and 75,2% over the years of the research. Being the main viticulture region of the Republic, this region is the main center for the spread of viticulture and winemaking technology in the regions of the Republic.

The Absheron economic region covers 3,8 percent of the Azerbaijan territory. A dry subtropical climate is typical for the region. The average annual temperature was 15,1-15,5-15,6°C, the average perennial temperature was 14,0°C, the average temperature in January was 4,5-5,1°C, and the average monthly temperature in July ranged between 26,3°C and 27,4°C in the Absheron region. The maximum temperature rose to 32-40°C. The average perennial precipitation on the peninsula was 276,8 mm, and the average annual precipitation was 244,0-352,6-450,4 mm during the research period. The average perennial relative humidity was 76,2%, the average annual relative humidity varied in the range of 75,3-77,8-80,3%.

Viticulture, grain growing, and vegetable growing have been developed in the peninsula. Rare grape varieties such as Agh shani and Gara shani are cultivated in the area.

Chapter three. Species composition of weeds in vineyards of viticulture regions of the Republic. All weeds compete with host plants by absorbing more water, air, and nutrients from the soil, and cause great damage to viticulture. To plan weed control measurements, to develop and properly apply optimal methods of control, the comprehensive assessment of the weed levels, determination of the reliable information on the biology of weeds - the species composition and species composition dynamics - should be performed at the first stage of the research. Through monitoring, the prevalence of weeds in the diagonal direction was studied in the vineyards during the flowering phase of grapes using a frame (50x50 cm) in 5 sites of 1 hectare each and the average composition of weeds for each region was determined.

The research performed along the route in 2015-2016 revealed that weed species were more prevalent in Shamakhi (68 species on average) and Ismayilli regions (60 species on average), which were provided with more amount of moisture. On average, 51 species were found in the Shamkir, Gakh, and Jalilabad regions, 48 species in the Salyan

region, 47 species in the vineyards of the Tovuz region, 46 species in vineyards of the Samukh and Gabala regions, 43 species in vineyards of the Goygol region and 41 species of weeds in the Gazakh region.

The species composition of weeds identified as a result of our route observations in the vineyards of the Republic are generally grouped into 21 main families: Brassicaceae, Cereals, Asteraceae, Fabaceae, Apiales, Saltbushes, Chenopodiaceae, Solanales, and Convolvulaceae, etc.

As a conclusion of the research in the vineyards of the Republic, a total of 68 species of weeds were identified and biologically grouped (Figure 1).

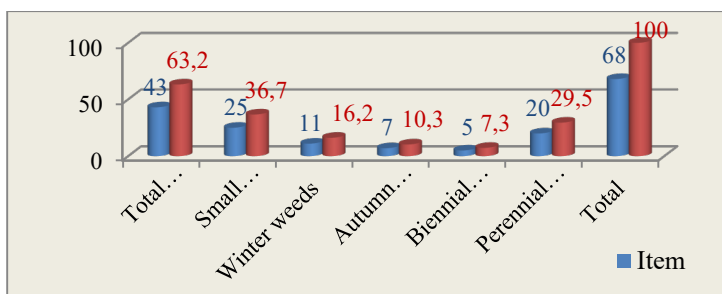


Figure 1. Biological grouping of weeds in vineyards

It has been established that 63,2% of the total weeds observed in vineyards are annuals and biennials. There are 25 species of young spring weeds, which constitute 36,7% of the total weeds. There are 11 species from overwintering groups of annuals and biennials, which accounted for 16,2% of the total weeds. Seven autumn weeds constitute 10,3% of the total weeds. Biennials with only 5 species make up 7,3% of the total weeds. The perennials observed as a result of monitoring consisted of 20 species, accounting for 29,5% of the total weeds.

On average 33,3% of the vineyards of Azerbaijan are infested with weeds, in addition 63,2% of them are annual plants (and 36,7% of them are young spring weeds), 7,3% of them are biennials and 29,5% are perennials. Spring weed species observed in our vineyards are oat, field pea, lolium, galium, saltbush, green foxtail, Silybum marianum; autumn Adonis, field carnation, small-leaved Adonis species are among overwintering weeds; autumn weeds are Alopecurus, field Bromus,

Agrostis species; among perennials, pink Cirsium, Cardaria, Barbarea, and Chondrilla are more widespread and cause more damage.

Chapter four. Damage threshold of annual and perennial weeds in the vineyards. Chemical control without determining whether the harmful organisms are dangerous to the product leads to unnecessary expenses. Chemical control can only be started when the amount of harmful organisms or the degree of infestation is really dangerous for the crop. According to the result of the research, it is expedient to carry out chemical control methods when there are 9 weeds in 1m² area.

As a result of the study of the threshold levels of annual and perennial weeds in vineyards, the productivity of grapes was found to be 95,1 cwt/ha when there were 3 weeds per 1m², and the productivity of grapes was 92,3 cwt/ha when there were 21 weeds per 1 m² / ha. The results of the research indicate that with the increase in the number of weeds, yield loss of the crop has also increased. The productivity of the control (farm) variants was found to be 94,3 cwt/ha. The highest productivity, 95,7 cwt/ha, was detected in the control variants free from weeds. The difference between the two control variants (free from weeds and farm variants) was $95,7 - 94,3 = 1,4$ cwt/ha. (Figure 2).

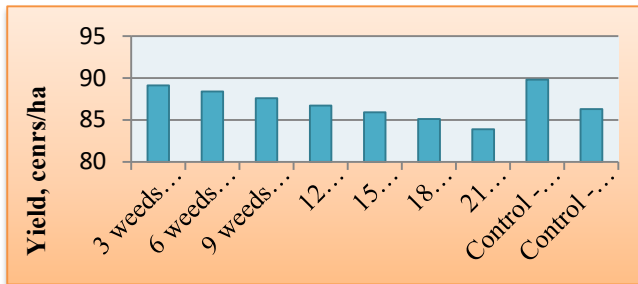


Figure 2. The study of damage threshold in vineyards (average values for 2015-2016)

As there is a little yield loss in the farm variant, it is accepted as the damage threshold.

Chemical control was carried out when there were 9 weeds per 1m² in the vineyards and the economic efficiency of control measures was evaluated for all variants and repetitions.

First, the weed damage threshold was determined, and to evaluate the cost and income gained by the chemical control, which prevents crop loss, the cost-effectiveness threshold was determined after spraying the preparations. The yield of grapes in the control variant was 82,4 cents / ha, additional 13,8-26,0 cents / ha yield was obtained in the variants where herbicides were applied. As a result of the research, it was concluded that if additional funds were spent for the application of herbicides in the range of 80-152 manats per hectare, in return, the net income was 1115-988 manats more than the control. The cost of 1 sentner of product was azn. 23,17 in the control variant, In the treated variants it was cheaper at 18,38-21,08 manats, in the range of azn. 4,79-2,9. Although the cost per hectare was lower in the control variant compared to all the experimental variants studied, the net income per hectare and the level of profitability were higher due to the reduction in the cost of one quintal of product.

Thus, in the control of weeds, excessive spraying and overapplication of chemical control was prevented using a cost-effectiveness threshold, plants were fully protected from harmful objects, toxic substances and fund was saved economically.

The biological effectiveness was applied to destroy annual and perennial weeds in research years. The experiments were conducted to study the biological effectiveness of herbicides. In vineyards, since the soil is soft and moist, it creates favorable condition for the growth of weeds. During the years of research, the species composition and abundance of annual and perennial weeds were determined, and the biological effectiveness of herbicides applied to destroy them was studied. The research was performed in two different regions, the Goygol site of the Ganja-Gazakh region and vineyards of the Absheron region.

Spraying of herbicides against weeds was carried out in the first decade of April, depending on meteorological factors. At that time, the height of weeds was approximately in the range of 8-12 cm. The application dose of the solution is 400 lt / ha during the morning and

evening hours, in the order respectively in the working program, ie Hurricane Forte-2.0 lt / ha, Boxer-5.0 lt / ha, Knock-Out-3.0 lt /ha, Volsaglif - 3.0 lt / ha, Reglon-Super - 2.0 lt / ha, Raundap - 3/0 lt / ha, Fuzilad Forte (standard) - 2.0 lt / ha.

Observations of the use of herbicides in the chemical control of weeds showed that the biological efficiency of the herbicides in both regions were 82,8-92,1% after 25 days and 83,3-90,3% after 50 days. It was clear from the results of the last pre-harvest report that the biological effectiveness of the herbicides used was as high as in the previous days of spraying (83,2-91,7%). The lowest efficiency was obtained when Fuzilad Forte (standard) was applied, and the highest efficiency was gained in the variants using Raundap and Uraquan Forte herbicide preperates. The study identified high biological efficiency of herbicides applied against annual and perennial weeds in both regions and no resistance to herbicides was observed in the weeds.

The growth dynamics of the height and diameter of plant shoots was studied to determine the effect of herbicides applied to weeds, which weaken the growth of the main crop cultivated in vineyards by absorbing nutrients (Figure 3).

The research was carried out 25, 50 days after the herbicide application and before harvest by measuring the height and diameter of the shoots on the labeled plants and establishing average values. Studies conducted in 2015-2018 show that 25 days after the application of herbicides controlling weeds competing with grape plants in the experimental variants, the height of plant stalks was 20,0-40,5% higher compared to the control variant, and the diameter was 21,4-41,1% longer already developed in the range. Observations showed that after 50 days of application of herbicides, the height of the shoots in the experimentally treated variants was 16,8-30,2% compared to the control variant; diameter development is 23,8-46,3% higher. Compared to the control variant in the pre-harvest research, the growth of the shoots in the treated experimental variants was 12,2-22,2% higher; the development of the diameter was found to be 15,8-34,7% higher.

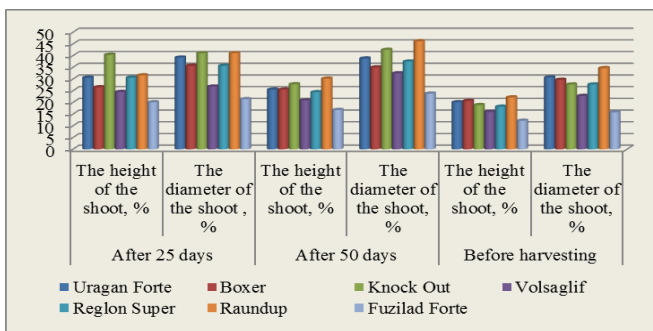


Figure 3. Influence of herbicides on grape plant growth and development compared to the control variant, in percentage.

Quality indicators are one of the most important parameters in the productivity. The effect of applied herbicides on grape product quality indicators was determined by performing analyses in the laboratory of Plant Protection and Technical Plant Research Institute, "Study of weed control and residual toxins" in 2015-2018. Herbicides were found to destroy weeds and had a positive effect on the technological characteristics of the grape. The research revealed that the application of herbicides led to an increase in the sugar content of grapes by 0,5-1,2% (table 1).

Table 1. Effect of herbicides applied on vineyards on quality characters of grape (Caberne-Savinyon variety) (Average for 2015-2018)

№	Experience options	Expenditure norm of herbicides, lt/ha	Effect on quality characters			
			Sugar content, %	Compared with control	Acidity, %	Compared with control
1	Uragan Forte	2	19,5	1,0	3,5	0,2
	Boxer	5	19,7	1,2	3,4	0,1
	Knock Out	3	19,6	1,1	3,5	0,2
	Volcaglif	3	19,6	1,1	3,5	0,2
	Reqlon Super	2	19,4	0,9	3,3	0,1
	Raundup	3	19,5	1,0	3,5	0,2
	Fyuzilad Forte	2	19,6	0,5	3,4	0,1
	Control	Herbicide free	18,5	-	3,3	-

Taking into account the terms of use, herbicides applied did not adversely affect the technological properties of grapes, and in many cases significantly improved them/

Chapter five. Influence of herbicides on soil microflora, food regime, and beneficial fauna in vineyards of the Ganja-Gazakh economic region. The biological activity of the soil is associated with its microflora.

In areas where weeds are widespread, the temperature on the soil surface decreases by 2-3⁰C. The lowering of the temperature in the soil weakens the vital activity of beneficial microorganisms and adversely affects the conversion of nutrients into assimilated form for the plant. Various factors affect the change in the number and activity of soil microorganisms, and some of them are herbicides. It is important to study the soil microflora to clarify the action mechanism of herbicides.

The results of the analysis showed that herbicides applied to weeds in vineyards significantly reduced the total amount of bacteria, actinomycetes, and the growth rate of azotobacters on the 3rd day. On the 10th day, these indicators approached the control variant, and on the 30th day, their total amount in the experiments was at the same level as in the control variant. The application of herbicides at the specified rate did not cause a sharp deterioration of the soil microflora.

One of the main indicators of soil fertility depends on the amount of nutrients absorbed by plants in the soil (figure 4).

Mineral nutrition of the plant is one of the main factors ensuring the normal of development of the plant To study the effect of herbicides on the nutrients assimilated by plants in the soil, samples were taken from the 0-20 cm soil layer of the experimental area and analyzed 10 days, 30 days, and 3 months after the herbicide application (according to the methodology). The effects of herbicides on nitrogen, phosphorus, and potassium contained in soil were determined.

Herbicides applied to weeds in vineyards resulted in a decrease in nitrogen, phosphorus, and potassium levels in the soil 10 days after the application compared to the control. Analysis of herbicides 30 days after the application showed that these values were close to the results of the control herbicide-free variant, and after 3 months, all values were at the same level as the control variant, and some were higher. Thus,

herbicides applied to weeds in vineyards in the specified doses do not significantly affect the accumulation of nitrogen, phosphorus, and potassium in the soil.

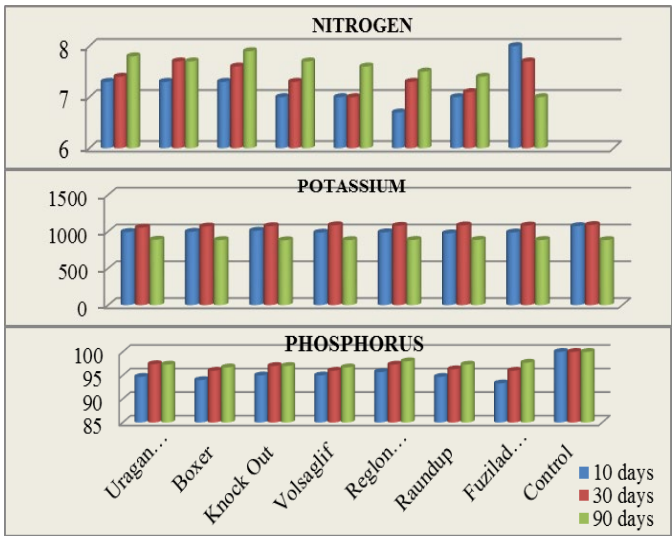


Figure 4. The effect of herbicides applied to vineyards on soil nutrient content

To study the effect of herbicides on beneficial fauna, the evaluation of seven-dotted *Coccinella* and *Chrysoperla carnea* was performed every 10 days after the herbicide application on 25 labeled bushes (100 bushes in each variant) by mowing 25 times through an entomological bag. The research on the effect of various herbicides on the beneficial fauna showed the absence of a significant adverse effect when they are used at the favorable (optimal) doses.

To study the effect of herbicides applied in vineyards on the productivity of grapes, the weighing method was used during the period of technical maturity in different variants and repetitions. Elimination of competition for nutrients in the soil as a result of weeding in the early development period after the application of herbicides in the vineyards during the 2015-2018 vegetation years has led to a higher yield of grapes in all variants compared to the control variant 14,9-10,1 sent/ha intervalinda (figure 5).

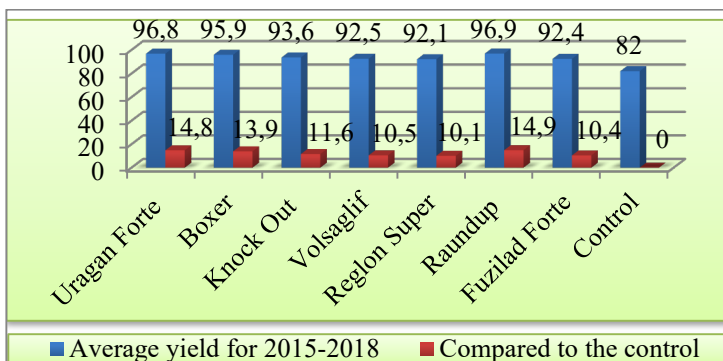


Figure 5. Effect of herbicides used to control the annual and perennial weeds in vineyards on grape yield

The time interval from the application of herbicides to the ripening of the product was more than 70 days. During this period, the herbicides were completely hydrolyzed and no herbicide residue was found in the grape product. Alaq otlarını idarə etmək üçün herbisidlərin istifadəsi təhlükəsiz ekoloji məhsulların tələblərinə cavab verir. BM və TB ETİ-nin «Alaqlarla mübarizə və zəhərlərin qalıq miqdarının öyrənilməsi» laboratoriyasında 2015-2018-ci illərdə tərəfimizdən tətbiq olunan herbisidlərin qalıqları yoxlanılmışdır (table 2).

Table 2 Determination of quantities of herbicide residues used in vineyards (2015 - 2018)

s/s	Experiment variants	Herbicide awareness norm; lt/ha	Amount of herbicide residue in the product mg/kg)
1	Uragan Forte	2,0	Absent
2	Boxer	5,0	Absent
3	Knock Out	3,0	Absent
4	Volsaglif	3,0	Absent
5	Reglon Super	2,0	Absent
6	Raundap	3,0	Absent
7	Fusilad Forte (standard)	2,0	Absent
8	Control	Herbicide free	Absent

Chapter Six. Economic efficiency of herbicides applied against weeds in vineyards. The cost-effectiveness of herbicides is determined

by the chemical treatments and reimbursement of the cost of the chemical treatments. It has been established that the application of herbicides in vineyards infested with annual and perennial weeds is cost-effective and provides additional income.

To calculate the economic efficiency of the application of herbicides against annual and perennial weeds in vineyards, the average productivity established in 2015-2018 was used.

As a result of study, the cost of 1 sentner product was 1,34- 2,73 manat cheaper than control. The net income in the control variant was 2194,0 manats, in the experimental variants 2496,0-2857,0 manats, the profitability was 115,11% in the control, herbicide-free variant, and 123,32-143,71% in the experimental variants. As can be seen from the calculations (taking into account the economic loss), the economic efficiency of the application of herbicides in the case of extreme infestation with annual and perennial weeds was high in all variants. Especially in the 1st, 2nd, 3rd, and 6th variants, the net income and profitability were higher than in the other variants.

Thus, it is necessary to determine the species composition of weeds in vineyards, choose the right herbicides, and chemically control them by following the instructions of their application. Timely performed chemical control increased grape productivity by reducing environmental risk by the end of the vegetation. Profitability increased with increasing efficiency.

Conclusion

1. According to the results of the research, a total of 68 species of weeds were identified in the vineyards of the Republic, of which 28 species were recorded in all viticulture regions. The identified species belong to 21 families, predominantly to Brassicaceae, Cereals, Asteraceae, Fabaceae, Apiales, Saltbushes, Chenopodiaceae, Amaranthaceae, Polygonaceae, Solanales, and Convolvulaceae. On average 33,3% of Azerbaijani vineyards have been infested with weeds (63,2% annuals, 7,3% biennials, and 29,5% perennials).

2. Annual and perennial weeds identified in the vineyards of the Republic spread as follows: 43 in the Goygol region, 46 in the Samukh

region, 51 in the Shamkir region, 47 in the Tovuz region, 41 in the Gazakh region, 46 in the Gabala region, 51 in the Gakh region, 51 in the Jalilabad region, 48 species of weeds in the Salyan region, 60 species in the Ismayilli region and 68 species in the Shamakhi region.

3. Damage threshold in the vineyards of the Republic was 9-10 weeds per 1m², which is considered the proper time to fight against weeds.

4. The biological effectiveness of the applied herbicides against all types of annual and perennial weeds ranged in 82.8-92.1% between the variants. Resistance to them in weeds was not observed. The use of herbicides in the recommended doses did not adversely affect the development of the surface vegetative organs of the grape plant during the growing season, on the contrary, development of the height and diameter of the shoots compared to the control variant has been observed.

5. Weeds were found to have a negative impact on the quality indices of grapes. However, the herbicides applied in early spring allowed the formation of the product, and the sugar content in the berry increased by 0,5-1,2% compared to the control variant. No herbicide residues were found in the grapes in all variants.

6. It was found that the application of various herbicides against weeds in vineyards did not adversely affect the soil microflora, the accumulation of nitrogen, phosphorus, and potassium in the soil, and the beneficial fauna.

7. The application of herbicides in vineyards strongly infested with annual and perennial weeds provided an increase in productivity compared to the control (yield protection). Thus, the increase in productivity by 10,1-14,8 cwt/ha compared to the control variant shows a significant effect of herbicides on weeds.

8. The use of highly effective herbicides such as Uragan Forte, Boxer, Knock Out and Raundap, against complex weeds in vineyards increases the productivity of grapes and provides additional yield, which is very effective both from an environmental and economic point of view.

Reccomendations

1. It is recommended to control weeds in early spring when their height is 10-12 cm and their amount reaches a critical limit, which is 9-10 weeds per 1m². In this case, the application of herbicides is strongly recommended and should be followed.

2. In order to get potential yield and high profitability, it is recommended to use one of the herbicides of Uragan Forte, Boxer, Knock Out, Volsaglif, Reglon Super, Raundup and Fusilad Forte in areas where the annual and perennial weeds are more abundantly present.

The following articles have been published on the topic of dissertation:

1. Hajiyeva, E.A., Agayev A.F. Species indentification of weed species in the vineyards of the Republic, Conference Proceedings, "Innovative Development of Agrarian Science and Education: World Experience and Modern Priorities" of ASAU, Proceedings of the International Scientific and Practical Conference, - Ganja: -2015, Volume III, ADAU publish, -pp.131-133.

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