JBAAR
Journal of Basic And Applied Research
ISSN 2413-7014

Scientific and Applied Research of ICPS for Agriculture: Mini Review

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Received: 18-5-2016
Revised: 19-6-2016
Published: 23-6-2016

Keywords:
polyizoprenoides, benzimidazoles, quinazolines, aromatic and heterocyclic compounds, plant growth regulators, fungicides, herbicides, agriculture, biological screening.

Abstract: The scientific and applied achievements of Institute of the Chemistry of Plant Substances (ICPS) on the development of products for agriculture for the last years are summarized. Also included different research areas, working to find new promising drugs based on natural, heterocyclic compounds and their synthetic analogues. In this mini review many preparations: plant growth regulators, fungicides, herbicides, which are created in ICPS and recommended for application in agriculture, have been discussed.

Cite this article as: Zakirova, R.P., Elmuradov, B. Zh., Khidyrova, N.K. and Sagdullaev, Sh. Sh. (2016). Scientific and Applied Research of ICPS for Agriculture: Mini Review. Journal of basic and applied Research 2(4): 464-469

INTRODUCTION

Uzbekistan is one of the largest manufacturers of raw cotton in the world. Since the early of 1990 of the country's grain harvest increased from 1 million tones to 7.8 million tones. In recent years, to increase production of vegetables, fruits and other food crops [Karimov, 2014].

Due to the nature of soil and climatic conditions in the Republic to obtain stable products requires not only compliance with the rules of farming, but also the use of new results of biochemical science in the development of new growth regulators and pesticides. The territory of Uzbekistan is located in the arid climate zone, characterized by a pronounced continental, uneven rainfall and seasonal high temperature conditions in summer. A large part of cultivated areas in the country - it is irrigated. Due to the intense land and excess of water use, about 2 million ha (46.7%), they are classified as unfavorable, i.e., having a certain degree of salinity of the soil [Namozov et al., 2004].

To improve the adaptation ability of crops to adverse environmental conditions most environmentally appropriate way is to carry out pre-treatment of seeds with growth stimulants. Promising becomes the use of new, low-toxic compounds based on natural substances and their synthetic analogies. An important indicator of the effectiveness of their use - there are no harmful effects on the environment. For an environmentally friendly and highly efficient new generation pesticides include growth regulators, the active ingredients of them are biologically active plant compounds. These drugs increase the resistance of plants to climate, water, salt, temperature and other stresses, have a stimulating effect on the immune system of plants [Shapoval et al., 2014; Tuterev, 2000].

Aims of the agricultural investigations

Institute of the Chemistry of Plant Substances is one of the leading centers for the study of plant raw materials. The structural organization of the Institute is aimed at a comprehensive study of plant compounds and the introduction into practice.

Currently, the main directions of the Institute in the field of agriculture are:

- Establishment of the structure of the isolated and /or synthesized compounds by physical and chemical methods of research;
- Study of the chemical composition of plants growing in Central Asia;
- Carrying out the synthesis and modification of biologically active substance analogues;
- Biological screening for plant growth regulation, fungicidal, herbicidal activities;
- Toxicological investigations;
- Development and introduction of new technologies for the production of drugs and plant protection products and to organize of their produce on Pilot Manufacturer of the institute.

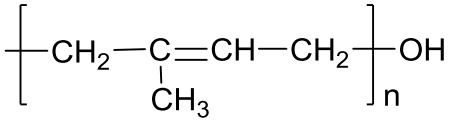
The Institute actively takes part in the creation of the plant protection products. The studies of the biological activity of the isolated and synthesized compounds are held in the phytotoxicology laboratory in the different conditions: laboratory, vegetation, field and industrial environments with purpose subsequent their introduction into agricultural practice of the Republic.

Stimulators and their application

Natural substances are considered as a valuable resource for the creation of plant growth regulators. The advantage of the natural stimulants is a low flow rate, low toxicity, high efficiency, the availability of local raw materials and the absence of phytotoxicity. Investigations on the components of neutral substances of cotton leaves were identified polyizoprenoides: polyprenols, bombiprenones, glicenoprenoles, diols, α-tocopherol, and sterols. On the base of these compounds Pakhtaoy and Uchkun stimulants have been developed. Presowing incrustation of the cotton seeds with Pakhtaoy, produced from polyprenylacetates at a rate of 10 grams per ton of seed leads to increase of cotton yield for 5.4 t / ha [Khidyrova et al., 1993].

Presowing padlock cucumber seeds varieties Uzbek-740 helps to increase harvest of fruits in 1.6-1.8 times or in 63-83% compared to the control variant. It should be noted that at the application of Pakhtaoy preparation a main crop is obtained in the first two collections. The first collection of 3 times exceeds the variants using sodium humate, and as compared to the control is 4.2 times [Rashkes et al., 1995]. Study of the biological activity on potatoes at a rate of 10-100 g/ton of tubers showed that it increases the yield from 34% to 43%.

Biostimulator Uchkun represents the sum of biologically active substances (α-tocopherol, polyisoprenoid alcohols (**1**), phytosterols, and higher aliphatic alcohols, and etc.) at a rate of 5-10 g/ton of seeds increases the yield of many crops (cotton, wheat, cucumber, tomato and etc.) and protects them from adverse conditions (water deficite, saline soils) [Khidyrova et al., 2016]. The results of long-term tests have shown that Uchkun has positive effect on the growth and development of the technical, grain and vegetable and melon crops. He is not inferior to the biological activity of drugs Vitavax, Sodium humat, and others. Using of Uchkun in small doses, making it promising for use in agriculture [Rashkes et al., 1996; Certificate 1B 783, 2015; Shakhidoyatov et al., 2012]:



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By using 1 liter of 1.0% -water emulsion Uchkun preparation to per a ton of cotton seeds, cotton yield increased by 3.6 t/ha compared to control (increasing of the yield is 12.5%) [Umarov et al., 2002]. It is found that specific drug affects the hormonal status of cotton, increasing an action of auxin hormones [Kushaeva et al., 2005]. Its use on tomatoes by steeping the seeds and spraying during the growing season increases the yield up to 62-65 kg/ha (22.8-23.4%). Uchkun has good biological efficiency in the consumption rate of 0.1 l/ha at clasp cucumber seeds and spraying the plants during the growing season. At the same time accelerating the maturation fruiting bodies for 4-5 days, and yield of cucumber increased by 13-15 kg/ha (23.8-33.1%). The Uchkun preparation is recommended by the State Chemical Commission of Uzbekistan for use as a plant growth promoter on cotton, cucumbers and tomatoes [A list of pesticides and agrochemicals, 2013].

In order to expand the application scope of the Uchkun conducted research on the assessment of its effect on wheat. Processing wheat grades Sanzar and Croshka by spraying vegetating plants in the tillering phase contributes to the accumulation of plant biomass; increase the intensity of photosynthesis and increase productivity, as well as a positive effect on the quality of the grain. Biostimulator helps to increase the amount of storage protein and gluten content [Khidyrova et al., 2008; 2016].

From the Uchkun production waste based on the organic acids sum growth stimulator Retkyl has been obtained, which is currently being tested. Conducting field experiments showed that pre-sowing cotton seeds drug accelerates plant growth and development, increases the yield of raw cotton. The yield increase in the field experiments by 3.02 t/ha higher than in the control without treatment, and at the level of the standard version of Vitavax [Kurbanova et al., 2015].

Among the natural substances a great practical interest has high-molecular compounds. The active ingredient of the drug Biovit is glycoprotein complex seeds of Gleditsia triacanthos. Its effect on the cotton and wheat resistance in the flow rate of 50 g/t seeds of the growing plants under water deficit and soil salinity conditions have been studied. Wheat seed treatment contributes to the growth of the test plants and the accumulation of biomass has a positive effect on the performance structure of the crop. Grain yield when using the drug is 47.6 c/ha, exceeding the control benchmark on 9.5 t/ha [Kurbanova et al., 2012; 2013]. In manufacturing experience presowing hydration leads to the increase of the cotton at double watering in Namangan-77 grade to 5.3 t/ha compared to the control, against salinity in C-6524 grade to 3.7 t/ha; the AN Bayaut-2 grade to 4.0 kg/ha [Vlasova, 2012].

The Narpoetan preparation was created from polysaccharide extracts of plants bulbs Narcissus poeticus (fam. Amarylidaceae). The use of stimulant to pickling plants in a rate of 78 g/t seeds promotes better root development, accelerated growth and development that leads to early ripening harvest an average of 5-8 days. Mixed use of Narpoetan + Vitavax 200 FF in a rate: 0.078

kg/ton + 2.5 l/t seeds, shows the best germination and low root prevalence [Kushaeva et al., 2009].

On the basis of lignin have been developed a number of plant growth regulators, such as Roslyn preparation is recommended by the State Chemical Commission of the Republic of Uzbekistan [A list of pesticides and agrochemicals, 2013]. One of the components of the preparation Roslyn is a product of natural material modification of lignin – hydrolysis waste industry. Growth stimulators used for pre-treatment of seeds in the cotton industry at the centralized seed dressing factories. Preparation flow rate is 6 liters of 10% aqueous solution per ton of seed. This yield increase is 2.0-3.0 t/ha. Roslyn is effective for spraying the plants during budding and fruit [Umarov et al., 1993].

Work on finding of new growth regulators in vitro using various bioassays are carried out. It has been found that the compound of a series of 2-alkylthio-5-aryl-1,3,4-oxadiazole has morphogenetic affect growth in tissue culture processes Ajuga turkestanica. When the substance was introduced into culture medium at a concentration of 10.0 mg/l is observed the formation of stem morphogenesis. On the surface there is calluses characteristic green globulinated formation, from which the shoots are formed later. This shows the nature of cytokinin action of the compound and is interest for the development of new and effective drugs for use as a synthetic plant growth regulator and plant cell biotechnology [Zakirova et al., 2015].

Among the synthetic growth regulators of great practical interest is a drug with kinetin-like action - Tetranil (2-tetrahydrofurylpropionitryl). At a rate of 1-1.5.g/ha when wet or pelleting seed cotton enhances the growth processes, reduction of subsidence fruiting bodies and increase yield by 2.1-3.1 t/ha [Umarov et al., 1994, 1995; Kushaeva, 1997].

Processing seeds melons by Roslyn increases germination, accelerates growth and development of tomatoes, cucumbers and potatoes. Spraying crops with aerial parts of the working solution flow rate of 200 mL of 10% in 200 liters of water per hectare, Roslyn stimulate flowering, fruit set; fruiting bodies accelerates ripening for 3-4 days. The viticulture and horticulture drug is used for rooting cuttings and spraying the plants during flowering [Kariev et al., 1996; Kushaeva et al., 1998]. The preparation is developed at the Pilot Manufacturer of the Institute.

Fungicides and their application

The active ingredient of the Dorilin preparation is copolymer of Nitron fiber with nitrolignin by the addition of copper derivatives. Dorilin intended for pre-treatment of cotton seeds in a rate of 6 l/t and is effective against pathogens of cotton root. Perennial field and production tests have shown that the optimal flow rate for the drug of wheat and cotton is 3.0 and 6.0 l/t seed respectively. In applying the drug a decrease susceptibility of wheat and cotton root rotot of plants and increase grain yield by an average of 2.9 t/ha and cotton by 3.1 c/ha compared with controls [Abduazimov et al., 2008].

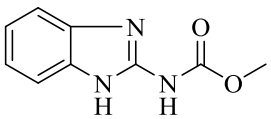
As a result of investigations of lignin derivatives obtained nitrogenous fertilizer organo - mineralized lignin, which is a reaction product of lignin with ammonia. The increase of the cotton crop in the ground when making this fertilizer is 4-6 t/ha. Field trials of the preparation in rice growing and vegetable production also showed its high efficiency [Saipov et al., 1985].

Recently, at the Institute conducted interesting research on the development of effective miticides by using local flora. As a result of tests carried out on the culture of cucumbers grown in greenhouses, selected two active formulations in the processing of which the percentage of mortality of individuals of red spider mite reaches 92% in the standard version with Entomayt percentage of dead animals is 98% [Urakov et al., 2015]. Harvesting cucumbers in greenhouses is carried out during the cultivation of plants. The development of this agent is of great practical interest for the protection of greenhouse plants because at sufficiently high toxicity to insects provides environmentally friendly products. Work in this area continues.

Employees of the Organic synthesis department of the Institute of chemistry of plant substances are carried out investigations on biologically active compounds possessing growth-stimulating, herbicide, fungicide, defoliant activities.

Promising compounds among them were synthesized 2-alkylthio-5-(4-acetyl(chloroacetyl) aminophenyl)-1,3,4-oxadiazoles [Ismailova et al., 2015]. Currently we studied the possibility of using them as preparations with fungicidal activity.

Early by Organic synthesis department team were created a series of highly effective fungicides on the basis of 2-acetylaminobenzimidazoles, 2-acyl (alkoxycarbonyl)-aminoquinazolones-4. Among them is a fungicide Olgin (**2**) - systemic broad-spectrum preparation is highly active against scab, powdery mildew of apple, beet, pumpkin and melons, botrytis and oidium grapes, fruit rot of apple, curl stone [Melnikov, 1980]:



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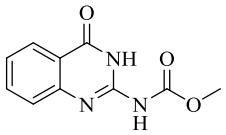
The preparation of the same number is 2-karbmethoxyaminoquinazolone-4 (KMAQ, **3**) - 50% wetting powder effective against wilt of cotton at a rate of 50kg/ha by making plowing under, as well as by 3 times spraying of 5kg/ha

preparation [Shakhidoyatov et al., 1985]. From this series Nikamizolon preparation - 6-nitro-2-karbomethoxyaminoquinazolone-4 (**4**) is cotton seed disinfectant against to bacterial blight and root rotot. [Shakhidoyatov et al., 1985]:



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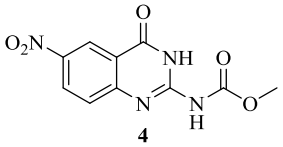

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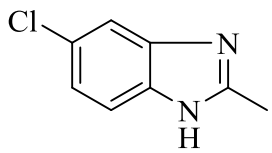
Herbicides and their application

Preparation Rozalin (5-CBI) (**5**) at a dose rate 30g/ha may be used as a plant growth promoter, but in high rates of 4.0 kg/ha and a belt method acts as herbicide in a level of Kotoran, but not phytotoxic contrast [Umarov et al., 1989]:



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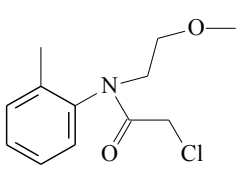
The created in department herbicide Toluin - N-β-methoxyethylchloroacetate-o-toluidine (**6**) was used in agriculture as a 65% strength emulsion concentrate and wettable powder at a rate of 1.3 kg/ha was used by tape or a continuous application to the soil. The drug kills annual weeds of cotton, corn and kenaf, and the yield is increased by 2-3 t/ha, while not phytotoxic [Dustmukhamedov et al., 1979]. Herbicide Ethoxyline - N-β-ethoxyethylchloroacetanilide (**7**) 45% emulsion concentrate is effective in a continuous and belt method in a rate of 1.3-2.2 kg/ha against annual weeds potatoes and corn [Dustmukhamedov et al., 1981]:



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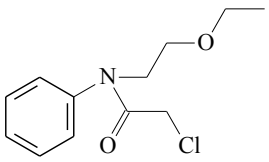

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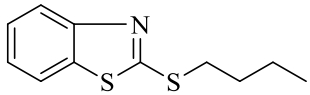
Synthesized defoliant Butylcaptax (**8**) for many years has been used in fine-fiber cotton grades [Yusupov et al., 1985]. These preparations were allowed by the State Chemical Commission of the Republic of Uzbekistan for use in agriculture:



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In the department have been also developed a number of other preparations, having the herbicide, fungicide activities and etc. [Abdullayev et al., 1985; Khamidov et al., 1986; Saprykina et al., 1986; Yusupov et al., 1988].

Currently at the ICPS the fundamental and applied investigations for creation of novel and effective preparations are continued [Levkovich et al., 2016; Khodjaniyazov et al., 2016].

CONCLUSION

The Institute of the Chemistry of Plant Substances of the Academy of Sciences of Uzbekistan aimed at a comprehensive study of plant substances, synthetic compounds, their analogues and derivatives, and the introduction of the obtained results into practice. The study of their biological activity is intensively held by the phytotoxicology laboratory employees in the different - vegetation, field and industrial conditions for subsequent implementation in the agricultural production of the Republic.

Some effective agricultural productions, which are created in the ICPS, were recommended for application in the different field of agriculture.

Search of a new perspective results in phytochemical research are a top priority for professionals, working in the Institute. The Institute is constantly evolving, improving and looking for opportunities to respond to the national economy requests of the Republic.

Further investigations for the creation of novel preparations, as plant growth regulators, fungicides, herbicides will be continued.

REFERENCES

A list of pesticides and agrochemicals permitted for use in agriculture of Uzbekistan. (2013). State Commission of chemicals and plant protection of the Republic of Uzbekistan, Tashkent, p.235.

Abdullaev N.P, Shakhidoyatov Kh.M., Khaydarov M., Umarov A.A. (1986). 3-Benzylidenaminoquinazolone-4 hydrochloride exhibiting herbicidal activity, *Author's certificate* №1235171.

Abduazimov H.A., Abduazimov B.B., Maksimov V.V., Vlasova O.A., Asatova S.S., Kodyakov A.A., Umarov A.A., Azimova Sh.S. (2008). *The patent for the Dorilin*, Patent IAP 03644, 29.04.2008.

Certificate 1B 783 of the State Chemical Commission of Uzbekistan for use preparation Uchkun, *1% - Water soluble emulsion of Uchkun.* 23.01.2015.

Dustmukhamedov T.T., Yusupov M.M., Mirzaev M.S., Rozhkova N.K., Aripov Kh.N., Karimov R.K., Sharipov T.T. (1979). *Author's certificate* USSR 675780. A process for

preparing N-β−alkoxyethylchloroacetanilide, *Discoveries, Inventions*, № 27, p.205.

Dustmukhamedov T.T., Yusupov M.M., Mirzaev M.S., Rozhkova N.K., Aripov Kh.N., Karimov R.K., Shakirov T.T. (1981). A process for preparing N-β−alkoxyethylchloroacetanilide, *Author's certificate* USSR 839221. *Discoveries, Inventions*, № 22, p.296.

Ismailova D.S., Ziyaev A.A., Kurbanova E.R. (2015). Synthesis and fungicidal activity of the 2-alkylthio-5-(4-acetyl(chloroacetyl) aminophenyl)-1,3,4-oxadiazoles. International Congress on Heterocyclic Chemistry «KOST-2015", Moscow, Russia, p.434.

Karimov I.A. (2014). Speech at the opening of the International Conference "On the implementation of the most important reserves Food Program in Uzbekistan". *The newspaper "Jahon"*, №110, 1-2.

Kariev A.U., Abiltarov G.S., Zhakhangirov F.N., Umarov A.A. (1996). Application of Roslin on cotton and other agricultural crops, *Agricultural crops of Uzbekistan*, №6, 8-11.

Khamidov M., Khalikov S.S., Molchanov L.V., Kadyrov Ch.Sh., Ayupova A.T. (1986). 2 Acetylaminobenzimidazole having fungicidal activity against a fungus Verticillium dahlike Keebahn, *Author's certificate* №1240028.

Khidyrova N.K., Borovinskaya N.I., Rashkes A.M., Gazaeva N.N., Shakhidoyatov Kh.M., Churn-environmentally friendly phytoregulators from leaves of cotton. *Abstracts. Regional scientific-practical conference*, Fergana, Uzbekistan, 1993, p.18.

Khidyrova N.K., Mamatkulova N.M., Kurbanova E.R., Ismailova K., Zakirova R.P., Khodjaniyazov Kh.U. (2016). Influence of an Uchkun preparation to some agricultural crops which are grown under unfavorable conditions. *Int. J. Environ. Agric. Res*., Vol.2, №1, 102-108.

Khidyrova N.K., Asatova S., Mamatkulova N.M., Yuldashev S.U., Umarov A.A., Shakhidoyatov Kh.M. (2008). Impact of isoprenoid cotton leaves on the growth and development of wheat, *Agrochemistry*, №2, 33-36.

Khodjaniyazov Kh.U., Mamadrakhimov A.A., Kh.S. Tadjimukhamedov, M.G. Levkovich. (2016). Chemical Transformation of Pyrido[2,3-d]Pyrimidin-4-ones. 2. Selective Reduction of 2,3-Trimethylene-pyrido[2,3-d]Pyrimidin-4-one by Sodium Borohydride. *J. basic appl. Res*. 2(2): 82-85.

Kurbanova E.R., Mustaev F.A., Umarov A.A. (2012). Cold winter wheat treated with a growth factor «Biovit», *16th International Pushchino School-Conference for Young Scientists. Abstracts "Biology*. Science of the XXI century ", Pushchino, Russia, p.470.

Kurbanova E.R., Mustaev F.A., Umarov A.A. (2013). Effect of a new bioregulator «Biovit» on the yield of winter wheat, *Agriculture of Uzbekistan*, №1, 23-25.

Kurbanova E.R., Vlasova O.A., Turaev S.M., Khidyrova N.K., Mamatkulova N.M. (2015). The use of stimulant Retkil in cotton crops, *Agriculture of Uzbekistan*, №11, 32-34.

Kushaeva F.H. (1997). Action of Tetranil on the activity of phytohormones. *Chem. Nat. Compd.*, Special issue, 131-133.

Kushaeva F.H., Majidova B., Umarov A.A. (1998). Use of the Roslyn in floriculture, *Chem. Nat. Compd*., Special issue, 1998, 168-170.

Kushaeva F.H., Umarov A.A., Niyazmetov U., Khidyrova N.K., Mamatkulova N.M., Shakhidoyatov Kh.M. (2005). Biological evaluation of the drug L-2 and its individual components. *Rep. Rus. Acad. Agricul. Sci.*, Moscow, Russia, №2, 13-15.

Kushaeva F.H., Mustaev F.A., Niyazmetov U., Umarov AA., Zhauynbaeva K.S., Malikova M.H., Rakhimov D.A. (2009). Glucomannan of Narcissus poeticus and protective-stimulating activity, *Rep. Rus. Acad. Agric. Sci.*, №6, 28-31.

Levkovich M. G., Elmuradov B. Zh., Shakhidoyatov Kh. M., Abdullaev N. D. (2016). Deuterium Exchange of the α-Methylene Group Protons in the Quinazolones. III. Environment Influence on the Exchange Rate. *J. basic appl. Res.* 2(2): 202-204.

Melnikov N.N. (Editor) (1980). *Fungicides*. Tashkent: FAN, 20-33.

Namozov H.K., Shadraimov K.I., Turdimetov Sh.M. (2004). *The soil valuation*, Tashkent, Uzbekistan, p.199.

Rashkes A.M., Khidyrova N.K., Shakhidoyatov Kh.M., Kiktev M.M. (1996). Secondary Metabolites of cotton leaves and their effects on growth. *First World Congress on Allelopathy*, Cadiz, Spain, p.203.

Rashkes A.M., Kariev A.U., Umarov A.A., Khidyrova N.K., Kiktev M.M., Rashkes Y.V., Shakhidoyatov Kh.M. (1995). The composition and amount of growth-stimulating effect of BM leaves of cotton. *Chem. Nat. Compd*., №4, 614-617.

Saipov Z.K., Khamidov M., Kelginbaev A., Abduazimov H.A. (1985). About the method of producing ammoniated lignin, *Cotton*, №1, 19-21.

Saprykina V.A., Khaydarov M., Ambartsumova R.F., Umarov A.A., Rozhkova N.K. (1986). Herbicide - 2-phenyl-aminobenzoxazole, *Author's certificate* №1287321, 01.10.1986.

Shakhidoyatov Kh.M., Khidyrova N.K., Mamatkulova N.M., Musaeva G.V., Niyazmetov U., Umarov A.A., Karimov R.K., Kiktev M.M. (2012). The process for producing bio-stimulator. *Patent RUz, IAP № 20090160*.

Shakhidoyatov Kh.M., Abdullayev N.D., Davlyatov A., Urunov I.S. (1985). Author's certificate 1135170 USSR. The 2-aminoquinazolone-4, exhibit fungicidal activity against fungal V.dahliae, *Discoveries, Inventions*, №20, p.267.

Shakhidoyatov Kh.M., Yun L.M., Oripov E., Yangibaev S., Kadyrov Ch.Sh., Rasulov U.U., Grigoryants E. (1985). *Author's certificate* 1165029 USSR. 2-Karbmethoxiaminoquinazolone-4, having fungicidal activity in relation to root rot and bacterial blight of cotton, *Discoveries, Inventions,* № 24, p.260.

Stonov L.D. (1973). Defoliants and desiccants, 2nd edition, Moscow: Chemistry, 160 p.

Shapoval O.A., Mozharova I.P., Korshuno A.A. (2014). *Protection and plant quarantine*, №6, 16-20.

Tuterev S.L. (2000). Physiological and biochemical bases of plant stress tolerance in the adaptive control plant. *Plant Protection News*, № 1, 11-34.

Umarov A.A., Tsoi Z.I., Karimov I. (1989). Herbicidal composition of Rozalin on crops of carrots, *Agriculture of Uzbekistan*, №12, 26-28.

Umarov A.A., Kariev A.U., Zhahangirov F., Vidmanova N.V., Dustmukhamedov T.T. (1993). Economical efficiency of Roslin on cotton, *Agriculture of Uzbekistan*, № 5, 11-12.

Umarov A.A., Asatova S.S., Mirmakhmudova S. (1994). Growth regulating activity of Tetranil on vegetable crops, *Uzb. Biol. J.*, № 3, 46-49.

Umarov A.A., Kushaeva F., Avazkhodzhaev M.H., Musayev H.A. (1995). Impact on disease resistance of Tetranil on Uzbek cotton, *Biology Journal*, №4/5, 33-34.

Umarov A.A., Niyazmetov U., Kushaeva F.H., Mamatkulova N.M. (2002). Effect of growth factors on cotton. *Agro XXI century*, Moscow, Russia, № 4, 61-62.

Urakov B.A., Zakirova R.P., Kurbanova E.R., Kuchkarova N.N., Vlasova O.A. (2015). Acaricidal activity of drugs based on the local flora.*11th International Symposium on the Chemistry of Natural Compounds,*Antalya, Turkey. P.133.

Vlasova O.A. (2012). Study of the reaction of varieties under the usual background of growing water scarcity and the processing of their control growth and development of an integrated drug –glicoproteinic complex, Proceedings USRIAC, p. 22.

Yusupov M.M., Abramov A.M., Umarov A.A., Khamidov M., Rahimbaeva O.N. (1985). 2-N-phenylamido-2-hydoxy-N-nitrobenzyl-4,5-dimethyl-1,2,3-dioxaphospholane, having fungicidal activity against cotton wilt, *Author's certificate №1198929*.

Yusupov M.M., Abramov A.M., Khamidov M., Hasanov T.K., Davlyatov A., Aripov Kh.N., Mirzaakhmedov B.K. (1988). Fungicide. *Author's certificate* №1424155.

Zakirova R.P., Ziyaev A.A., Kurbanova E.R., Ismailova D.S. (2015). In vitro inhibitory and growth promoting effect of 2-alkyl-5-aryl-1,3,4-oxadiazoles. *11th International Symposium on the Chemistry of Natural Compounds,* Antalya, Turkey, p.112.