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Editorial office

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E-mail:

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Section 1. Biology

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*Mamasoliev S. T.,
PhD in biology, Senior teacher,
Andijan State University, Uzbekistan
E-mail: s_mamasoliev@mail.ru*

*Sidikjonov N. M.,
Teacher, Andijan State University, Uzbekistan*

*Mirzaeva S. T.,
Teacher, Andijan State University, Uzbekistan*

ECOLOGY AND FLORA OF KARADARYA VALLEY

Abstract. Information on the current ecological status of the Karadarya Valley, the largest river in the Andijan region, as well as natural plants and their importance is provided.

Keywords: Karadarya, ecology, plants, riparian forest (tugai), soil, species.

In comparison with other regions of our republic, Andijan region is the most rich of water resources. The rivers of the region take water particularly from rainfalls, snow and glacier of many years. The largest river of the region is Koradarya [1; 2].

As a result of taking the water of Koradarya for irrigation through canals, after passing Kuyganyor town, in the period when the plants are mostly irrigated, its water decreases. However, at the confluence with the Naryn River, a large amount of water flows, and this water consists of groundwater flowing into and out of the river [1].

The characteristics of the elements of the Karadarya River are not the same in all parts of it, the complexity of the relief, lithological structure and diversity of hydrological conditions, climate and vegetation have led to the formation of different soil types [2].

In the mountainous part of the Karadarya, the soil types formed three regions: the gray-soil hilly region, the brown mountain-forest region, and the

light-colored brown meadow high mountain region. In the foothills of the Karadarya, on the high slopes of the river, in the foothills of the low mountains, light gray soil is widespread. The soil-forming rocks in these areas are alluvial-proluvial deposits of loess soil and induction cones. Light gray soil is distinguished from clear gray soil by the fact that the top layer of grass is light gray, with a low amount of humus, close to the surface of the carbonate layer [2; 3].

In the foothills of the Karadarya there is a gray soil zone. As the amount of precipitation is also much higher here, the plant species multiply and grow thicker. These in turn affect the process of soil formation and, consequently, the amount of humus in the soil. Hydromorphic soil types such as meadow-gray, swamp-meadow, gray, swamp-gray are also found in the gray-soil hill region. Such gray soil types are located in the old upper reaches of the Karadarya, in the deltas, in the lower parts of the plains at the foot of the mountains. Meadow soils are also found in the lower

reaches of the Karadarya, with humus content up to 2%. Today, this type of soil has been converted into irrigated grassland in many places [2; 5].

The current state of the plants of the Karadarya Valley, the preservation of existing species, the identification of medicinal plants, the uniqueness of the Karadarya plants and various other important aspects are extremely interesting. Plants of the Karadarya Valley are disappearing due to the development of the area as cultural lands by the population. The conservation of existing species in this area is becoming a topical issue. Plants of the Karadarya Valley are disappearing due to the development of the area as cultural lands by the population. The conservation of existing species in this area is becoming a topical issue.

In the mountainous part of the Karadarya, the air temperature is much lower, on the contrary, the amount of precipitation increases, as a result of which specific plants, various shrubs and trees form forests [1; 2].

Karadarya is one of the largest rivers in the Fergana Valley, where the plants that grow there are adapted to grow in the sernam (mesophyte) region of the river basin [1; 2].

Many tugai forests have been formed in the river valley, of which very few remain today. However, the remaining plants in the area raise hopes that the tugai forests will be rehabilitated.

When we say tugai and tugai forest, the local people understand the places near the rivers and the plants that grow there [1, 162; 4, 54]. In many places, tugai forests consist of trees, shrubs, semi-shrubs, and grasses growing together. Occasionally there are liana plants. Tugai forests are found along the rivers of Central Asia, including the desert region of Uzbekistan. But its main area is associated with the middle and lower reaches of rivers. In the mountainous region, such areas form a thin riverbed. On the banks of rivers flowing through mountain ranges and streams, a variety of plants grow in abundance, including trees, bushes, and shrubs. Such as willow,

poplar, birch, spruce, hawthorn, spruce, and occasionally walnuts, apples, jiida grow there. In addition, shrubs such as dog-rose, barberry are also common. In these places, agrostis, rhizome, sagebrush, hemp, sedge, mint, etc., from annual and perennial plants, form grass on the banks of rivers. The tugai in the hilly region cover a much larger area. Because sometimes when water comes and rivers overflow, they expand and water comes out to the shores [1; 4].

Later, the waters recede, and the rivers flow in a narrow stream, forming tugai forests on its banks. In the tugai in this region, shrubs and shrubs (juniper, turangil, willow, chakanda, yulgun) grow more than perennials, such as jiida, white lily, covares. In addition, there are many plants from the family of alfalfa, licorice, various astragalus and wheat [1; 4].

Rocky areas are also found in the upper regions of the tugai, consisting of gray and brown soils. Fertile soils are used for agriculture, to some extent as pastures for livestock.

Due to the proximity of the tugai to the river banks, the vegetation growing there is very diverse.

The following tugai plants can be found on the banks of the Karadarya.

Eliagnus Angistifoliya, *Populus diversifoliya*, *Populus pruinosa*, *Salix songorica*, *Salix Wilhelm jana*, *Fraxinus turkistanica*, *Hippophae rhamnoides*, *Clematis orientalis*, *Holemodendron holidendron*, *Lycium L rufhenicum*, *Tamarix romosissima*, *Tamarix hispida*, *Tamarix Laxa*, *Clycyrihza glabra*, *Capparis spinoza*, *Alhagi sparsifolia*, *Alhagi Kirhizorm*, *Phragmites communis L. Trin*, *Tyrha Laxmanni*, *Imperata cylindrical*, *Trifolium Pratense*, *Equisetum orvense*, *Cennodom Daktelon*, *Mentha oriatica*, *Plantago major L*, *Plantago Lanciolota*, *Apocynum lancifolium Rus*, *Karelinia caspica*, *Aeliropus litoralis*, *Artemisia ferganensis*, *Cichorium intybus*, *Zygophyllum fabogo*, *Asparagus persicus*, *Lepidium latifolium*, *Dadortia orientalis L*, *Saccharum spontaneum*, *Urtica urens*, *Tifa minima*, *Potamogeton natens*, *Potamogeton hodosus poir ex Lam*, *Erianthus ravennae*, *Bithens triopatra*, *Hordeum bulbosum*, *Polygonum gidropiper*, *Oryzoides Avd Koss*, *Juncos gerar-*

dii, *Cyperus orizoides* and many other species are the main constituents of the river valley flora.

At present, most of the land in the valley is being developed and crops of high importance to the farm are being cultivated. Lands in the river basin are being developed even in the old riverbeds and various cultural crops are being planted. Nevertheless, in the Karadarya basin there are many wild species of plants that still grow naturally. If we study the importance of these wild species on the farm, some of them are at a higher level than the cultivated plants. Nevertheless, in the Karadarya basin there are many wild species of plants that still grow naturally. If we study the importance of these wild species on the farm, some of them are at a higher level than the cultivated plants. Unfortunately, the number of some medicinal plant species has greatly decreased. For example, plant species such as *Hippophae rhamnoides*, *Rosados*, *Glycyrhiza glabra* are very rare now [3; 5].

The following is a discussion of the importance of some wild species in the Karadarya basin [1; 3].

Eliagnus Angistifoliya – The fruits are sweet, bitter and edible. As the body is thorny, it is dangerous as a fuel for the locals, it is used as a wall around the garden. It is a quality fuel in remote villages and neighborhoods.

Populus diversifolia – this wood is used as a building material.

Salix songorica, *Salix Wilhelm jana*. The locals transplant them by the roots and use them as living walls and baskets, nacelle, fences.

Hippophae rhamnoides – the fruit of the plant is a very valuable medicine. It is an effective remedy for various internal diseases, diseases of the esophagus, stomach and intestines. The leaves of the sea-buckthorn plant are used in the treatment of various skin diseases.

Holemodendron-holidendron – this thorny shrub grows in groups in the drier parts of the riverbed, on the gravelly hills. From them the locals make barns where cattle cannot pass. It is also used as a broom

to sweep the hay under the cattle and to clean the scattered grain from the straw fields.

Tamarix romosissima – this plant, since ancient times, has been made of whip stalks, sticks, because their stems are stiff. As firewood, fuel is prepared.

Tamarix Laxa – The plant can be propagated as an ornamental plant because of its beauty.

Glycyrhiza glabra – scientists have shown that the sweetness in the root of this plant is several times sweeter than sugar. Sweetheart is a valuable medicinal, fodder plant.

Capparis spinosa– in some places covares is consumed as much as melons. Its buds and fruits and now sprouted twigs can be eaten with vinegar as a spice. Oil can be extracted from the seeds. Locals use covares fruit to treat various ailments, including gum and toothache.

Alhagi sparsifolia– this plant has medicinal properties in addition to being a fodder, wood fuel. Very rich in honey.

Phragmites communis L. Trin– The cane is a good food plant in the spring for cattle. During the summer, the animals eat only its leaves because the stem is woody. High quality silage can be obtained from these plants. The cane is dried and pressed to the roof.

Turha Laxmanni– This plant is used for fodder, mats, chestnuts, rough palaces.

Cennodom Daktelon– This plant is used as fodder for cattle and sheep. Grass is used as a natural rug for playgrounds.

Mentha oriatica L– is an essential oil plant that belongs to the group of meadow plants. This plant is made from young grasses and eaten. Tincture is an effective remedy for nervous disease.

Plantago major L– it is a valuable medicinal plant. In the treatment of liver disease in humans, the juice extracted from this plant “*Rliantaglutciline*” is sold in pharmacies.

Cichorium intybus– is a medicinal plant. The roots and stems are rich in alkali. It is therefore registered as a medicinal plant.

Urtica urens– this plant is rich in vitamin C.

Tifa minima– This plant is well eaten by cattle and sheep. A variety of baskets, buckets, boxes are made.

Bithens triopatra – this plant is a valuable medicinal plant. Children with high temperature, or covered with eruption are bathed in cold boiled water with bur-marigold [4; 6].

Conclusion

The Karadarya River, which flows through the Andijan region of the Fergana Valley, has different geographical structures, different natural zones, different soils across zones.

The soil of the tugai consists of gray and brown soils. Rocky areas are also found in the upper regions.

Specific plant species are distributed in the Karadarya basin. In the upper part, tree shrubs are more common, while in the middle and lower parts, perennial grasses are more common.

The current ecological condition of the Karadarya basin is in poor condition. Existing natural tugai and lakes are being destroyed and turned into cultural crops. The result is the application of various chemical mineral fertilizers to the soil; the use of toxic chemicals against wild plants is disrupting the natural ecosystem of various industrial wastes.

It is necessary to emphasize the importance of Karadarya plants in the economy, the importance of rare medicinal plants such as sea-buckthorn, covares, buckhorn plantain, mint and other plants.

In the continuous study of the flora of the Karadarya basin, in solving problems of nature protection, it is necessary to follow the norms of using the natural plant resources.

References:

1. Arifkhonova M. M. "Growth of the Fergana Valley". – Toshkent. "Fan" 1967.– 294 p.
2. Baratov P. "Natural Geography of Uzbekistan" – Toshkent: "Ukituvchi". 1996.– 440 p.
3. Demyanova E. I. Botanical Resource Science Special Course Study Guide / Perm State University – Perm, 2007.– 172 p.
4. Ikromov M. I., Normurodov H. N., Yuldashev A. S. Botany "Morphology and anatomy of plants".– Toshkent: "Uzbekistan", 2002.– 336 p.
5. Sedov V. V. Floodplain vegetation of the Zaravshan valley and ways of its reconstruction.– Nukus Uz. State University named after Alisher Navoi, 1959.– 165 p.
6. Pratorov U. P., Shamsuvalieva L., Sulaymonov E., Axunov H., Ibodov K., Mahmudov V. Botany (Morphology, Anatomy, Systematics, Geobotany).– Toshkent: "Talim nashriyoti", 2010.– 288 p.

Section 2. Study of art

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*Gurchenko A. I.,
Associate Professor, at the Belarusian State University
of Culture and Arts, Candidate of Art History, Republic of Belarus, Minsk
E-mail: alesia_gr@mail.ru*

CHARACTERISTICS OF THE PERIOD OF ORIGIN AND FORMATION OF FOLKLORISM AS A METHOD IN BELARUSIAN THEATRICAL ART

Abstract. This article analyzes the specific features of folklorism at the stage of origin and formation of this method in theatrical art of Belarus (from 1850s to 1950s). The idea of the authors' approaches to the use of folklore manifestation methods is defined, which predetermined the ways of further development of folklorism up to the early 1990s.

Keywords: folklore; folklorism, theatrical art.

As the most unique and rich layer of national culture, folklore has a potential for artistic creation, which is realized in the process of its embodiment in the art. Folklorism as a method of embodiment of the Belarusian traditional folk art has been actively used in all forms of art for many centuries. This approach to comprehension of our ancestral heritage is also prominent in theatrical arts. In this context, the aim of this article is to reveal the specific features of folklore traditions embodiment in the theatrical art at the stage of origin and formation of folklorism as a method.

The first rare examples of Belarusian folklore traditions embodiment date back to the second half of the XIX century. For example, in the play "Sjaljanka", which was staged in 1852 by Vincent Dunin-Marcinkievič himself, in addition to proverbs and sayings, organically intertwined in the fabric of the literary source, as close to the authentic material, the Belarusian folk songs "Jak pajšoŭ ŭ naš kaval", "Ja cyacerku zlaviŭ, uh ja", "Hadzi, dzeŭka-čarnabreŭka"

and Mjajelica dance with chastushkas were staged. Researchers give other examples as well. For example, in the 1870s, some performances featured Belarusian folk songs, while some Russian-language productions used traditional folk proverbs and sayings of the Belarusians, which was extremely risky in the face of severe oppression and censorship by the tsarist authorities, but demonstrated the civic stance of the authors and performers [1, 138].

After the revolution of 1905–1907, the tendency to turn to folklorism as a method became even more stable, which was caused by the emergence of another wave of national and cultural revival, one of the symbols of which was the Belarusian parties, dating back to traditional folk games with songs and dances. These evenings of the Belarusian culture were built on the principle of synthesis of stage action and, along with the dramatic productions, which became dominant over time, included blocks of folk songs and dances. So, at a party, which was organized by the *Nasha Niva* newspaper in Vilno in February 1910,

choir led by L. Rogovsky performed interpretations of the Belarusian traditional folk songs “Čamu ž mne ne peć”, “Oh, ty dub”, “Pryljaceli gusi”, “Dyj kudy ž ty, dub zjaleny”, and I. Buinitsky’s dance group performed “Ljavonicha”, “Mjajacelica”, “Jurka” and “Verabej”. However, the researchers emphasize that if at the first parties folk songs and dances in relation to the performance were an independent section of the program, over time they merged with the dramatic action [1, 142–150]. In these projects, in addition to the song and dance, the embodiment of folklore traditions was reflected in the design of the stage and in the interpretation of stage outfits in the Belarusian authentic structures of the regions from which those folklore pieces have originated. It is noteworthy that often the spectators themselves came to the evenings of Belarusian culture in authentic costumes. Therefore, the interest in Belarusian oral folk art stimulated the emergence of groups that adhere to the principle of the most accurate reflection of the original folklore source in the process of its stage embodiment. It should be noted that the form and content of the stage action borrowed from the Belarusian parties was taken as a basis for the performances of the troupe of I. Buynitsky, the mobile troupe of V. Golubok, the First Association of Belarusian Drama and Comedy and other groups.

In the 1920s, the folklore traditions of the Belarusians formed the basis of many plays of Jeüscihniej Mirovič on the stage of the Belarusian State Theatre (“Na Kupalle”, “Vjaselle”, “Mašeka”, “Kastuś Kalinoŭski”, “Kaval-vajavoda”, etc.). It is noteworthy that for some plays fielded ethnographic expeditions to find the necessary material at the preparatory stage. For instance, in the course of work on the play “Na Kupalle” (1921) traditional folk costumes and household items were brought from Slutskiy district, and for the play “Mašeka” (1923) the necessary authentic material was found in Mogilev region [1, 211–212]. Mirovič’s productions widely represented the arrangements of Belarusian folk melodies, folklore elements enriched the scenography, and according to the director’s con-

cept, episodes with the stage embodiment of Belarusian traditional folk rituals (the plays “Na Kupalle” and “Vjaselle”) were introduced. It is noteworthy that the Belarusian State Theater, along with the dramatic company, included a choir, orchestra and ballet, which in addition to participation in the performances had its own concert repertoire. For example, the ballet company under the direction of Konstantin Andreevich Aleksyutovich in 1927 on the stage of the Bolshoi Theater in Moscow presented to the audience stage versions of the Belarusian traditional folk dances “Ljavonicha”, “Kryžačok”, “Taŭkačyki” and “Jurachka”. It should be noted that at the initial stages of K. Aleksyutovich’s work in the Belarusian State Theater (later — the First Belarusian State Theater), the dance folklore in the performances of the theater and solo programs of the ballet company was embodied as close as possible to the authentic original source, but gradually the choreographer began to focus on the artistic development of folklore [2, 98]. In this regard, we should note that the trend of active transition from the minimal stage adaptation of folklore material to its artistic processing in the work of art was clearly expressed in the period of formation of folklorism as a method.

Addressing folklore was typical for the productions of other Belarusian theaters. For instance, based on Belarusian folk songs, riddles, fairy tales and legends, in 1939 on the stage of the Youth Theatre Mirovič staged the play “Cudo ŭnaya dudka”. As an example, we will also give the performances “Večar belaruskich vadevilyaŭ” (The Second Belarusian State Theatre, directed by P. Molchanov, 1936), “Salavey” (The First Belarusian State Theatre, directed by L. Rachlenko and L. Rakhlenko). Litvinov, 1937), “Ščasce paeta” (Janka Kupala National Theatre, directed by I. Sudakov and P. Sushko, 1952), “Raskidanae gnjazdo” (Yakub Kolos Belarusian State Theatre, directed by A. Skibnevsky, 1951), etc.

Speaking about the expression of folklore traditions on the Belarusian stage, one cannot help mentioning the performances-brands “Nescerka”

and “Paŭlinka”. These performances are still present in the theaters where their premieres took place. For example, in 1941 on the stage of the Second Belarusian State Theater (now the Yakub Kolas National Academic Drama Theatre) director N. Loiter based on the authentic traditions of Belarusians created the play “Nescerka”. In this play, folklorism as a method emerged in of Belarusian folk songs arrangements and dances into play (“Ljaceli gusańki ceraz sad”, “Ljavonicha”, etc.), stylization of folklore elements at the scenography level (imitations of a wedding towel on the frontal stage curtain, cross embroidery on the back background curtain, etc.), motifs of the school theater intermedia, stage embodiment of the traditional Belarusian wedding (Vyaselle) and a scene of a harlequin (skomorokh) with a bear. Folklorism as a method closer to the Belarusian authentic traditions was represented in the play “Paulinka” staged in 1944 on the stage of the First Belarusian State Theatre (present name — Janka Kupała National Theatre). The musical design of the play is based on the arrangements of Belarusian folk songs and dances (“Pajshoŭ mily lužkam”, “Aj, u baru, baru”, “Čamu ž mne ne peć”, “Ljavonicha”, etc.). In the scenography the appeal to folklore is expressed even before the beginning of the stage performance — the thin and transparent sheer curtain depicts stylized Belarusian ornament. All the action takes place among the decorations of the interior of the village house, which is decorated with towels and curtains with embroidery. Close to the canons of traditional folk culture are the stage outfits of the acting characters in the play. In addition, in one of the scenes of the play, typical household speeches can be heard. For example, Alzhbeta Krynitskaya, despaired and outraged by her husband’s behavior, rants in a typical manner of that time (this heroine’s acting technique is more than a decade old, yet it is still used by contemporary performers).

During the period of formalization of folklorism as an independent phenomenon of landmark

was the staging of the first national ballet “Salavej” (1939, composer M. Kroshner, ballet master A. Yermolayev) on the stage of the National Opera and Ballet Theatre, choreography of which was a mixture of folklore and academic language of dance. As a result of subtle stylization and infusing the traditional form with new content, a language permeated with the intonations of folk dance was created, which combined the ethnic originality and synthesis of the academic dance language [1, 578]. In the following national ballets (“Knyazvozera” (1949, composer V. Zolotorev, ballet master K. Muller), “Padstaŭnaya njavesta” (1958, composer G. Wagner, ballet master K. Muller), etc.) the authors repeatedly used and developed artistic techniques found by A. Yermolayev in the ballet “Salavej”. Thus, in the production of “Knyazvozera”, folklore traditions are embodied in the plot based on traditional folk legends of Polesie, in the introduction of motives of the Kupala rite, in the stage embodiment of traditional folk dances of the Belarusians, etc. As Y. Churko notes, from the point of view of using folklorism as a method, the director’s work on embodiment of round dance genre is of interest [2]. Mermaids’ scene uniquely combined elements of traditional folk round dance and classical ballet waltz, resulting in the first mass dance “on the toes” on the professional stage with the Belarusian national image. Later, in another version of the ballet, K. Muller has also successfully implemented the stage embodiment of the Belarusian folk dance “Juračka”, synthesizing it with elements of virtuoso toe dancing.

Therefore, it is obvious that at the stage of origin and formation of folklorism there was a gradual transition from the method according to which the folklore material was represented as close as possible to the authentic material, to the method based on its essential artistic treatment, which determined the ways of development of this phenomenon in the direction of academicization of Belarusian folklorism up to the early 1990 s.

References:

1. Беларусы. – Т. 13. Тэатральнае мастацтва / Р. Б. Смольскі [і інш.]; навук. рэд. А. І. Лакотка; рэдкал.: В. М. Ярмалінская [і інш.]; Нац. акад. навук Беларусі, Ін-т мастацтвазнаўства, этнаграфіі і фальклору імя К. Крапівы. – Мінск: Беларус. навука, 2012. – 758 с.
2. Чурко Ю. М. Стварэнне першага нацыянальнага спектакля ў беларускім балетным тэатры / Ю. М. Чурко // Весткі Акадэміі навук БССР. Серыя грамацкіх навук. 1963. – № 2. – С. 96–105.

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*Sokolova Alla Viktorovna,
PhD, (Candidate of Pedagogical Sciences),
Senior Lecturer of Department of Department of Cultural,
The Odessa National A. V. Nezhdanova Academy of Music, Ukraine
E-mail: asmoonlux@gmail.com*

THE SACRED DANCE IN THE COURT THEATER OF THE BYZANTINE EMPIRE

Abstract. The article discusses the origins of the rise and fall of the Byzantine theater, the aesthetic principles of ancient Greek pantomime in the culture of early medieval Byzantium. The sacred and spiritual meaning of dance, which was the core of Byzantine musical theatrical performances, is revealed.

Keywords: Byzantine Empire, court theater, pantomime, mask, sacral dance, mime actress, the spiritual and secular meaning of the court theater.

Exploring the origins of the rise and fall of the Byzantine theater is a difficult task. On the one hand, the Byzantines carefully preserved the legacy of their predecessors: the revelations of the holy fathers and classical “Hellenic” literature. Indirectly, this testifies to the existence of archives and libraries in Byzantium. On the other hand, the number of archival documents, one way or another, covering the theme of the court secular theater in any form, is a small part, and the surviving texts provide scant information.

According to the famous sinologist, Professor Wolfram Eberhard, the theater originated in sacred dance, mimetic (imitative) and agonal (adversarial) functions are associated with dance. This trend can be traced in the theatrical traditions of many cultures and ethnic groups: India, China, Japan, Indonesia, Turkey and Iran [1]. Many scientists and philosophers viewed dance as a meaningful ritual action, prayer in motion, a sacred ritual, a theatrical performance that permeates the whole world.

The desire to unite with God through dance was present in primitive culture, in the pagan mythology of Egypt, Greece, ancient Rome and India. Paganism and the Sacred Dance are at the same time a sacrificial ceremony, prayer, a connection with the past,

that the imperial palace was an ideal environment for dancing at the most refined level. The Christian tradition borrowed the tradition of sacred dance from the Jewish people, for whom dance was an important part of religious life.

Many historians consider the church’s limiting influence on dance, but archival research indicates that the Church actually created the conditions for social and religious dance to flourish.

We should especially note the special attitude to dance as an integral part of the court theater art of Byzantium.

At the end of the 1st century BC, the Roman theater associated with the staging of traditional classical drama (tragedy, comedy) enters a phase of decay and is associated with licentiousness, vulgarity and wasting time. A negative view of the theater is dominated by many scholars and writers, a prominent representative of whom is the ancient Greek writer, historian and “last Hellene” Zosimus [2]. In the 4th century, the influential John Chrysostom Archbishop of Constantinople attributed such features to the theater as immorality and cynicism. According to the Church Fathers, song, music, play posed a danger to a peaceful family life [3].

Both the Western and subsequently the Eastern Roman Empire, represented by the clergy and the Church Fathers, tried to ban the theater, condemning it for its pagan roots. However, soon the Eastern Orthodox Church, having signed in the actual inability to ban entertainment, tried to take the initiative into her own hands, to cleanse and spiritualize the vicious essence of theatrical art and dance. So, dances, which received the approval of the church, were group processions or round dances in which men, separated from women, performed solemn and befitting movements of the moment. It looked like a Christian rethinking of pre-Christian holidays and symbols. The Roman scientist Varro Reatinsky saw the meaning of dance in Christianity in the following: “The meaning of dancing at religious festivals is that, according to our ancestors, no part of the body should remain aloof from religious sensations” [4, 175].

Both critics and defenders of theatrical art left to posterity valuable information about the theater. There are several classical sources that historians rely on when discussing the origins of theatrical performances and dances. These include Lucian with his treatise “On the Dances” [5] and the historian Titus Livy with the large-scale work “History of Rome from the Founding of the City” [6]. The historian Titus Livy believed that theatrical performances first appeared in Rome around 400 BC: “Since neither human understanding nor divine help softened the merciless pestilence, superstition prevailed in souls, and then, as they say, in search of ways to appease the wrath of heaven, stage games were instituted – an unprecedented business for the military people, because until then the only spectacle was running in the circus” [6, 323].

The author of the book “Sexual Life in Ancient Rome” Otto Kiefer wrote: “... the Romans, by their very nature, had no artistic origin. They did not understand the true essence of dance, this aimless activity, and the Greeks, with their innate artistic flair, indulged in dancing as complete artists” [4, 166].

However, after the end of the first Punic War in Rome, dances are rapidly gaining popularity.

The ancient Roman writer and philosopher Ambrose Theodosius Macrobius notes: “In the era of the highest morality, between the two Punic wars, free-born citizens, even the sons of senators, went to dance schools and learned to dance and shake tambourines. I am ashamed to admit that even the matrons saw nothing indecent in dancing. On the contrary, the most respected were interested in them, although they did not strive to become experienced dancers” [7, 14]. Publius Cornelius Scipio, Roman military commander and politician, who once went to such a school and saw more than fifty young men and women there. Among them was a twelve-year-old boy, the son of a candidate for magistracy: the boy performed “a dance with tambourines, which even a shameless slave cannot adequately perform” [8, 36].

The ancient Roman historian Ammianus Marcellinus, a Syrian Greek by origin, noted in the middle of the 4th century: “... even a few houses, formerly famous for their serious attention to science, are immersed in the fun of shameful idleness, and songs and loud ringing of strings are heard in them. Instead of a philosopher, they invite a singer, and instead of a rhetorician – masters of amusing affairs. Libraries are locked forever like tombs, and hydraulic organs, huge lyres the size of a cart, flutes and all sorts of bulky instruments of acting equipment are being erected ... women “slide their feet on the stage in a variety of figures, depicting countless scenes that are composed in theatrical plays” [4, 169].

It should be noted that in Rome in the III century, the pyrrhic dance became extremely popular. The ancient Roman writer of the 2nd century AD Apuleius, the author of novels written in Latin, wrote: “Young men and women, shining with the first color of youth, beautiful in appearance, in smart costumes, with beautiful gestures, moved back and forth, performing the Greek pyrrhic dance: in beautiful round dances they intertwined in a full circle, then converged in a winding ribbon, then joined in a square, then scattered in

groups apart. But then the sound of the trumpet rang out and put an end to these complex combinations of convergence and divergence. The main curtain came down, the screens were folded, and the stage opens before the eyes of the audience” [4, 49]. Thus, the pyrrhic dance embodied the main action of the pantomime, in its manner and style of performance, very reminiscent of modern ballet.

The author of the novel, Otto Kiefer, believed that in the Roman Empire, prior to its division into Western and Eastern, theatrical performances were conventionally divided into three groups: atellans, mimes and pantomimes proper. The Atellans (*fabulae Atelannae*) were a South Italian farce, crude and obscene in content. Mimes (*mimos* in Greek means imitation) supplanted Attelan, but differed little from them and staged scenes replete with obscenity, intrigue and erotic elements. Actors took part in short scenes with masks or without masks, depending on the storyline, women participated in the performances. The dance formed the core of the performance and was unlike any previously known. The actor accompanied the monologues with beautiful and smooth movements of the hands and body, and the dancer, who was on the same stage, complemented the action with a dance comic set to music or choral accompaniment [4].

However, after a while, the actors’ long and often meaningless monologues ceased to be practiced, and the actors’ remarks sounded less and less frequently. Dancers begin to dominate the stage, expressing their feelings in the element of movement. This is how pantomime was born. The word “pantomime” is also Greek, however, according to the ancient Greek writer Lucian of Samosata, it was widely used by Italians. The origins of pantomime undoubtedly lead to pagan religious rituals. Researcher E. T. Kirby is convinced that masquerade plays, pantomimes and other dress-up performances are a fusion of shamanic substratum and primitive folk customs [9, 285].

Greek pantomime was represented by a “dancer” or “tragic dance actor”. The Greek performer

sought to express his commitment to Greek traditions through dance and music. Pantomime, as a form that took shape in Rome, is difficult to separate from other theatrical performances precisely because of the wide variety of forms of dance. These include cult dances, sometimes associated with the Greek god Dionysus, military dances, dance genres – round dance, sacred religious dances. However, there are a number of distinctive moments of pantomime, which include the actor’s attire (a cloak and a silky tunic that reached the ankles), the accompaniment of an orchestra, which included pipes, flutes, trumpets, cymbals, chorus, as well as masks that completely or partially covered face. The wooden ratchet (*scabellum*) attached to the musician’s leg was of particular importance. The time allotted for the performance was calculated in hours, since the dancers had to change their clothes several times. Mimes wore masks, and solo performances of dancers with masks only became fashionable after the 5th century, at a time when the Western Roman Empire fell. The most popular form of pantomime is performed by the Roman dancer Piladus of Cilicia, who is credited with leading the way in solo pantomime performances. The famous Roman dancer Batill of Alexandria entertained the audience with other subjects: to the endless applause of the audience, he easily transformed into a goat-footed satire [10].

Many Roman and Greek philosophers such as Ludwig Friedlander in his work, “Roman Life and Manners Under the Early Empire” [11] rhetorician Libanius in his speeches, the ancient historian Zosimus considered pantomimes as a sign of immorality in society.

In Byzantium, which in every possible way emphasized its succession to Western Rome, pantomimes became widespread and were popular in different parts of the empire. The pantomimes of the East and the West are related not only by the phenomenon of division into comedy and tragic, but also by plots, which were mostly borrowed from ancient Greek myths [12].

The defining criterion of pantomime in Byzantium was entertainment. In pantomimes, jumps, imitation of wrestling, prolonged freezing and even somersaults were implied. And yet, a distinctive feature of pantomimes is their “accuracy” in imitating the depicted character. In this action, the dancer’s hands were of paramount importance, the hands were supposed to “speak” and “enchant”. The mask completely (sometimes partially) covered the face, and its image was supposed to help reveal the character of the character. A feature of Byzantine masks in late pantomimes are masks with long strands of natural hair [12].

Dramatic dance formed the basis of tragic pantomime and was extremely popular in Byzantium in the early Middle Ages. The researcher J. Jory noted that if a contemporary, during the early Middle Ages, was invited to a Byzantine theatrical event, it is more likely that such a performance would be called a pantomime [13, 57–66].

It is generally accepted that the pantomime, set on a mythological plot, and performed through the prism of dance, was performed to the accompaniment of a choir, and a dancer’s obligatory attribute was a mask, which he could change several times during the performance, if the plot required it.

The Church openly opposed pantomime as a kind of theatrical art. The church associated theatrical art with the pre-Christian idea of the world and man, considered the theater a relic of the pagan world and fought resolutely against it.

In 425, the Church succeeded in banning dancing and performances on Sundays and major Christian holidays. [15, 39–45]. In 692, the Quinisext Council, held during the reign of Justinian II and characterized by extreme conservatism, in fact banned theater, festivals and all such events and decided to treat theater as a form of paganism. However, there are good reasons to believe that the ban did not achieve its goal. In Byzantium they loved holidays and entertainment. Weddings, fairs, theatrical performances, acrobatic horseback riding, as well as dancers, magi-

cians, jugglers and acrobats are becoming a hallmark of Byzantine culture. The Church failed to finally convince even faithful Christians to abandon the theater and from participating in “bacchanal” carnivals and processions. In general, the hostile attitude of the church, which viewed entertainment from the perspective of pagan traditions, had a negative impact on the evolution of the Byzantine theater [15].

The pantomime broadcast the traditions of the Roman theater, multiplied by the cultural traditions of Byzantium itself. The performances consisted of short monologues or dialogues on themes taken from mythological plots, everyday life or sacred texts, that is, the pantomime was clothed in verbal form and, in fact, resembled a musical theatrical performance, where plasticity and movement were taken as the basis. Monologues and dialogues, in one form or another praising the virtues of the emperor, were accompanied by the sound of instrumental music, dancing and singing. It is significant that several times pantomimes were staged in St. Sophia Cathedral at solemn ceremonies [12].

Pantomime remained quite popular until the 6th-7th centuries. Since the 7th century, pantomime has lost its well-recognizable shape. The theater of pantomime, in the form in which the ancient Greeks and Romans knew it, actually died in Byzantium in the process of a long, complex and multifactorial transformation.

Byzantine diplomacy played a significant role in the development of a secular spiritual theater within the imperial palace. Byzantine diplomacy was so effective that many historians tend to view the successful diplomatic activity of emperors and other Byzantine officials as a key element that explains the empire’s millennia-long existence. The Imperial Palace, with its imposing architecture, was a public monument designed to thrill the viewer into the might of the state and its august ruler, while at the same time allowing the mere mortal to feel pride at the mere sight of the imperial palace. The Byzantine Palace was a huge theatrical stage, awe-inspiring and admirable for those

who crossed its threshold. Until the 12th century, the Grand Palace served as the imperial residence and was a privileged place to receive foreign delegations sent to Byzantium to solve complex political issues. The Book of Ceremonies, which codifies the protocol used in the palace in the mid-10th century, informs historians of a certain official standard for receiving emissaries [17]. This standard was largely developed from magnificent techniques involving large-scale theatrical performances. Receptions were given, in particular, on the occasion of the arrival of representatives of the Cordoba Caliphate, as well as a delegation led by Princess Olga of Kiev. Thus, the theater was both opium and a form of propaganda. It can be argued that with the decline of the pantomime genre, theater in Byzantium did not die. He moved to the hippodrome, to the imperial palace, to aristocratic literary clubs, where poems, dialogues, and performed plays were accompanied by music, songs and dances.

During the heyday of the Empire, court culture was reduced to carefully orchestrated secular-spiritual performances prescribed for special occasions. It was important for the Emperor to show that “power can be exercised in divine harmony and order”, and “the empire thus reflects the movement of the Universe in the form in which it was created by the Creator,” according to the records of Constantine Porphyrogenitus in the Ceremonial Book [18] special clothing for different social groups, for example, at a dinner given in honor of an emperor or empress, various groups of officials performed ceremonial dances, one group wearing “blue and white, short sleeved clothing with gold ribbons and ankle rings. In their hands they held what is called phengia”, the second group actually performed the same actions, but in “clothes of green and red colors with gold stripes. “These colors were the hallmarks of the old aristocratic groups. Having danced three times, everyone stands at the foot of the emperor’s table. Then the singers sing: “Lord, strenghten the Empire forever”, and the people sing three times: “Lord, strenghten the Empire forever” [19, 227].

In the story of Constantine Porphyrogenitus, the celebration dedicated to the name days of the emperor or empress resembles a ballet with an oratorio rather than an ordinary dinner. Some researchers believe that the dignitaries of the court dances were more like a restrained “stylized walk”. However, enamel plaques on the Byzantine Holy Crown of Hungary, circa 1050, depict female dancers with their arms raised above their heads and their legs abruptly pulled back, swinging long strips of cloth over their heads [20].

Physician Sharaf al-Zamān Ṭāhir al-Marwazī, author of *The Nature of Animals*, wrote: “In the morning the king comes in [to the imperial box overlooking the Hippodrome] with his intimates and servants, all of them dressed in red. He sits on an eminence overlooking the place and there appears his wife called dizbuna (Greek despoina, mistress) with her servants and intimates, all of them dressed in green and she sits in a place opposite the king. Then arrive the entertainers and players of string instruments and begin their performance” [21,170].

John Ash, author of *The Byzantine Journey*, notes: “The refectory was decorated with mosaics and frescoes, stucco, ceramic vessels and carpets ... The Roman custom of reclining on a bed was forgotten in the 10th century, and guests, whose number could reach forty, sat around a round or a rectangular table inlaid with marble, gold, silver and ivory” [19, 286]. Such feasts often served as a breeding ground for gossip and intrigue, against which the Byzantine moralists sharply rebelled, and they also turned out to be an arena for serious conversations about literature, philosophy and theology as well as a place for presenting new literary and musical compositions. Thus, musical theatrical performances, as well as gatherings of the noble men of Byzantium, became the prototype not only of the Parisian salons of the 18th century, but also of the court mask in England in the first half of the 17th century.

Refined theatrical performances become an integral part of imperial ceremonies. It is interesting to note that Emperor Michael III the Drunkard person-

ally took part in theatrical performances. The use of sharp satire directed against the Church gave a special piquancy to this story [14]. Ultimately, the Church establishes a special relationship with the theater, both direct, aimed at creating a religious drama, and indirect, where the liturgy was based on the principles of theatricality, and the secular theater existed within the boundaries of the imperial possessions and private homes of aristocrats. Representatives of the church are forced to turn a blind eye to the theatrical and musical performances that took place in the imperial palace. The content of the plays, as in the pantomimes, was associated with mythological plots, less often with events from the lives of emperors. Women were allowed to take part in theatrical performances.

In the Eastern Orthodox Church, the group dance (Xopos) was encouraged by the church fathers. The theologian of the Eastern Orthodox Church Gregory Nazianzen strongly advised to perform triumphal round dances in honor of God. Basil the Great and Bishop John of Constantinople blessed the parishioners to perform round dances (Xopos). Eusebius of Caesarea described an act in which true Christians performed a dance in honor of God. "Everything was filled with light, and it was with smiling faces, sparkling eyes that they looked at each other, barely lowering their eyes, with dancing choruses, hymns in cities and villages, they honored God, the sovereign king" [22, 620].

The Byzantine historian and writer Eustathius of Thessalonica mentioned a dance that began in a circle and ended with a meeting of dancers, when the dancers did not dance in a circle, they raised their arms high or waved them left and right. They held a scarf in their hands, and their long sleeves accentuated the beauty of their movements; often, the dancers performed a song at the same time or improvised on the move, sometimes repeating the words in unison. At the end, the audience could join the general dance, which symbolized unity. Professional singers and musicians themselves composed poems, which they recited between dances [23]. Byzantine

dances were performed at banquets for the emperor and his guests. The circle served as the basis for the compositional construction of dances. The estate-hierarchical position of the aristocratic nobility influenced the arrangement of the dancers. Gothic dances were also performed in the Imperial Palace and were an example of exotic dance along with traditional Byzantine dance elements. Dances in secular places also included sexually obscene dances such as cordax and were performed until the 15th century. Much of the information about Byzantine dancing comes from the admonitions of the church fathers who openly opposed dancing. However, the rhetorician Libanios, the scientist, Byzantine monk Michael Psellos, the writer and historian Niketas Choniates, on the contrary, came out in their defense, which is confirmed by published speeches. Examples of dances in sacred places (churches) are the weeping dances (moirologia), which were eventually allowed to be danced using circular movements in the narthex of the church, or, for example, the Isaiah dance, associated with the Byzantine marriage ceremony and performed in the church. The founder of Byzantine ethnography, Phaidon Kukules, in the voluminous work "Byzantinon bios kai politismos" also mentions dancing in the church or in the narthex of churches. On Easter, women gravely led round dances in the narthex of churches; on Christmas, parishioners danced in masks in the immediate vicinity of the church [25, 425, 493].

Thus, the dance carries a sacred and spiritual meaning and does not lose it after the fall of Byzantium, strengthening in Europe and England in the court culture of the Renaissance.

Conclusions

Pantomime, as a form of theatrical art, which has an ancient Greek origin, was an important element of the cultural life of the Roman Empire. Subsequently, the traditions of pantomime were continued in the culture of early medieval Byzantium. Ultimately, the aesthetic principles of pantomime played a decisive role in the emergence of court secular-spiritual musi-

cal theatrical performances, which are a distinctive feature of the culture of the Byzantine Empire.

Pantomime was rediscovered during the Renaissance in many countries of Western Europe, as well as England, mainly through the treatise of the ancient Greek writer Lucian of Samosata "On Dances", which became an extremely popular ancient Greek writer in the 16th–17th centuries. The founders of the ballet and dance concept in the 16th–17th centuries were deliberately inspired by the example of ancient Greek pantomime.

In the Middle Ages, the secular-spiritual court theater of Byzantium broadcasts the aesthetics of the salon theater, where the discussion of philosophical, theological and political issues, the presentation of new musical or literary works becomes a component

of the court theater. Theatrical culture of Byzantium demonstrates the spiritual and secular principle. The secular principle manifests itself in solving political issues during musical and theatrical performances and at banquets that completed the performances.

The spirituality of the Byzantine court theater was especially fully revealed in the religious sphere, in attracting pagans to the side of Christians, in the reading of odes and panegyrics as part of theatrical culture, which exalted the emperor claiming to be a spiritual leader, in emphasizing his divine status, as well as in the sacred meaning of the Byzantine dance.

Unlike the West, Byzantium never faced the problem of a deep cultural break with its past. This influenced the process of formation, prosperity and decline of the theatrical art.

References:

1. Eberhard W. *Conquerors and Rulers: Social Forces in Medieval China*. – Leiden: E. J. Brill Publisher. 1952.– 197 p. (in English).
2. Cameron A. The date of Zosimus' *New History*. *Journal: Philologus*.– Vol. 113. – Issue 1–2. 1969.– P. 106–110. (in English).
3. Svyatitel' Ioann Zlatoust. *Izbrannyye besedy o povsednevnykh voprosakh khristianskoy zhizni* [Selected Discourses on the Everyday Issues of Christian Life].– Moskva: Otchiy dom. 1999.– 640 s. (in Russian).
4. Kiefer Otto. *Sexual Life in Ancient Rome*. Whitefish: Kessinger Pub Co. 1952.– 424 p. (in English).
5. Lukian. *O plyaske* / *Perevod N. P. Baranova* (About dance / Translation by N. P. Baranova).– Tom 2.– Leningrad: Aleteyya. 1935.– 92 p. (in Russian).
6. Tit Liviy. *Istoriya Rima ot osnovaniya goroda* (History of Rome from the founding of the city) / *Perevod N. A. Pozdnyakovoy*,– Tom II.– Moskva: Nauka. 1989.– 71 p. (in Russian).
7. Macrobius Ambrosius Theodosius. *Saturnalia* / Editor J. Willis. Leipzig: Teubner Verlag. 1970.– 14 p. (in English).
8. Pliny. *Natural History: Scullard, Howard Hayes. Scipio Africanus in the Second Punic War / Book VII Chapter 47*. Cambridge: Cambridge University Press. 1930.– 36 p. (in English).
9. Kirby E. T. The Origin of the Mummery Play / *Journal of American Folklore*,– Vol. 84.– No. 333. 1971.– 285 p. (in English).
10. William J. Slater *Roman Theater and Society*. Ann Arbor: University of Michigan Press. 1996.– 200 p. (in English).
11. Fridlender L. *Kartiny iz bytovoy istorii Rima v epokhu ot Avgusta do kontsa dinastii Antoninov* (Pictures from the everyday history of Rome in the era from August to the end of the Antonine dynasty). *Chast' I*. Sankt-Peterburg: Brokgauz-Yefron. 1914.– P. 583–589. (in Russian).
12. Hall Ed. & Wyles R. *New Directions in Ancient Pantomime*. Oxford: Oxford University Press. 2009.– 504 p. (in English).

13. Moffatt Ann. Maistor: Classical, Byzantine and Renaissance Studies for Robert Browning. 2017.– P. 57–66. (in English).
14. Horsfall N. The Culture of the Roman Plebs. London: Bristol Classical Press. 2003.– P. 7–126. (in English).
15. Richard C. Beacham. The Roman Theatre and its Audience. USA, Cambridge: Harvard University Press. 1996.– 282 p. (in English).
16. Hilsdale C.J. Byzantine Art and Diplomacy in an Age of Decline. Cambridge: Cambridge University Press. 2014.– 412 p. (in English).
17. Porphyrogenetos Constantine. The Book of Ceremonies (Byzantina Australiensia) / Editors: A. Moffatt & Tall M. – Vol. 18. – Leiden: Brill. 2017.– 864 p.
18. Ash J. A Byzantine Journey. – London: Random House, 1995.– 330 p. (in English).
19. Harris J. The Lost World of Byzantium. – London: Yale University Press. 2015.– 298 p. (in English).
20. Herrin J. Byzantium: The Surprising Life of a Medieval Empire. New Jersey: Princeton University Press. 2009.– 416 p. (in English).
21. Pamphilus Eusebius. Church History, Life of Constantine, Oration in Praise of Constantine.– New York: Grand Rapids, MI: Christian Classics Ethereal Library. 1890.– 1015 p. (in English).
22. Eustathii. Archiepiscopi Thessalonicensis commentarii ad Homeri Iliadem pertinentes,– Vol. 1–4. Leyden: Marchinus van der Valk. 1971.– P. 154–156. (in Latin).
23. Phaidon Kukules. Θεσσαλονίκης Εἰρησταθίου τάλαογραφικά (Thessaloniki 5th folklore).– Vol. 2. Athens: Fordham University Press. 1950.– P. 435, 493. (in Greek).

Section 3. Information Technology

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*Hrybkov Serhii Vitaliiovich,
PhD, Associate Professor, Department of Information Systems
National University of Food Technologies, Kiev, Ukraine*

E-mail: sergio_nuft@i.ua

*Seidykh Olga Leonidovna,
National University of Food Technologies,
Senior lecturer, Department of Informatics, Kiev, Ukraine*

E-mail: olgased@ukr.net

HYBRID ALGORITHM BASED ON FISH SCHOOL SEARCH AND GREY WOLF OPTIMIZER ALGORITHMS FOR FOOD ENTERPRISE MANAGEMENT

Abstract. The article proposes a hybrid method on the basis of optimization algorithms inspired by nature for solving problems of food enterprise production process management in conditions of uncertainty and risk. This hybrid algorithm is based on FSS (Fish School Search) and GWO (Grey Wolf Optimizer) algorithms. The advantages of algorithm hybridization are the formation of alternative solutions to the production management task of finding the desired global optimum within a reasonable time with avoiding local optimums.

Keywords: enterprise management, hybrid algorithm.

Introduction

Food industry enterprises are of strategic importance to many countries. Their functioning depends on the demand of the end user, seasonal fluctuations of prices for energy resources, raw materials and auxiliary supplies. Constant food market competition is based on the flow of goods from internal and external producers. All of the above requires the operational management of all parts of the enterprise in conditions of uncertainty and risk, which cannot be achieved using standard management methods that lead to the waste of time and cannot ensure real-time management.

The main task of management is to ensure the manufacture of products in full and range to meet the needs of customers for a given time. Such task belongs to the class of multiobjective NP-hard combinatorial tasks [1; 2].

In the article [2], the authors proposed a mathematical model of the task of planning contract execution and a modified method of an ant colony for its implementation. But the disadvantage of the proposed approach is the orientation on the execution of service contracts.

The authors of the articles [3] proposed a hybrid planning algorithm based on particle swarm

optimization and ant colony optimization algorithm. The proposed algorithm does not take into account economic and social impacts in finding the optimal plan.

In [4], a critical analysis of common factors that hinder the planning of various production processes based on optimization methods has been performed and approaches to their elimination have been proposed. But the article does not take into account the specific characteristics of food industry enterprises.

The task of production management using hybrid algorithms of the inspired by nature remains relevant despite the fact that solutions using classical, heuristic and evolutionary methods have been considered by various scientists.

Objects and research methods

The authors offer a new modified method based on a hybrid of FSS and GWO algorithms. As a mathematical model, the authors have taken the models given in [1; 2]. Depending on the general situation and trends of the whole enterprise, a task can include a certain set or all partial criteria [1].

The authors have conducted a number of practical research on the effectiveness of the proposed method on the statistical data presented by enterprises of the food industry of Ukraine, namely, pasta, meat processing and dairy production.

Results and its discussion

Let us examine the general application of the proposed algorithm in detail.

Upon receipt of an order, the conditions of its execution, workload of production facilities, equipment condition, schedule of planned repair and maintenance works, availability and schedule of resources delivery, possibility of their postponement or transfer, priority of each order execution, determine the possibility of full or partial reconfiguration of the plan are analyzed [1].

Then the orders are classified into groups using decision tree algorithm. The choice of this algorithm is justified by its ability to represent objects in the form of a hierarchy based on classification param-

eters, where each element corresponds to a single decision tree node [5; 6]. By the example of sausage products manufacturing all orders are divided into boiled and smoked products, then by the equipment involved and the type of packaging.

The main operators of FSS algorithm are: the feeding and the movement operators (movement of agents). The feeding operator determines how the agent weight gain is accomplished at each iteration. FSS algorithm distinguishes three types of movement: *individual*, *collective-instinct* and *collective volition*.

In case of individual movement, an agent moves randomly with the same probability in any direction at a given speed or at a given distance. To be applied to the task in question, the transition distance acts as an execution order. Individual movement includes more than one iteration and is aimed at finding the optimal solution.

Collective-instinct movement is carried out after all possible individual movements of all agents. At each step, each agent takes into account the movement of the entire group, that is, choose the sequence of tasks in which we get the most benefit.

Collective volition movement is carried out after instinctive movement. This type of movement consists in shifting all agents in the direction of the current center of gravity of the population, if the total weight of the school as a result of individual and collective-instinct movement increased, and in the opposite direction – if this weight has decreased. Otherwise, the population expands from the same center of gravity, increasing its diversification properties.

The authors apply GWO algorithm for collective volition movement, which copies their hunting process in nature. According to our task, the pack is hunting for the victim, which corresponds to the optimal operational plan of execution of orders. Each wolf pack corresponds to an alternative operational plan at each iteration. After each iteration for each wolf is calculated value of its alternative operating plan using the target function. According to the value of evaluation of each wolf in the pack they are divided into four types:

alpha – the wolf leader, the evaluation of which is the optimal solution by specific criteria or evaluation function; Beta and delta – the wolves driving the victim, whose evaluation is ranked second and third place among the best; Omega – all others [9–11]. The first three types of wolves are fixed in the next iterations until new alternatives are found that will be better than the current one or a given number of iterations will be exhausted. The alpha, beta and delta wolves influence the formation of omega wolves [11]. The first iteration use the best options obtained by collective volition movement as alpha, beta and delta. Using GWO algorithm, we get variants of order execution plans.

The work stops when the specified number of iterations is exhausted or when the optimal solution is repeated during the specified number of iterations.

The authors have compared the proposed hybrid algorithm with various algorithms inspired by nature, using statistical data from the Ukrainian food industry, namely pasta, dairy processing plants and enterprises producing sausage and meat products.

According to the results of comparisons, the proposed hybrid algorithm is significantly better in time expenditure, because all the algorithms are limited

by the number of iterations, and the resulting plan of order execution will be more optimal with an increase in the number of input data. If we use each algorithm and its modifications separately, the search time increases as the task size increases.

For example, in comparison with GWO algorithm, the algorithm in question finds a better solution with the selected input data of 200 or more orders 40% faster.

Conclusion

The article proposes a hybrid algorithm based on the FSS and GWO algorithms to solve the multi-objective problem of food enterprise management, specifically, the formation of a plan of manufacturing products on order. Application of the proposed algorithm allows you to form new plans and to re-configure existing ones in a short time.

The proposed hybrid algorithm will be included in the decision support system for food industry enterprises, which will increase profits by reducing the cost of manufacturing products, the optimal use of production facilities, warehouses for storage of finished products and raw materials, as well as other parameters.

References:

1. Hrybkov S., Kharkianen O., Ovcharuk V., Ovcharuk I. (2020) Development of information technology for planning order fulfillment at a food enterprise // *Eastern-European Journal of Enterprise Technologies*, – Vol. 1/3. (103) – P. 62–73. DOI: <https://doi.org/10.15587/1729-4061.2020.195455>
2. Hrybkov S. V., Lytvynov V. A., Oliinyk H. V. Web-oriented decision support system for planning agreements execution // *Eastern-European Journal of Enterprise Technologies*, – Vol. 3/2.(99). 2018.– P. 13–24. Doi: <https://doi.org/10.15587/1729-4061.2018.132604>.
3. Senthilkumar K. M., Raja K. A Hybrid Algorithm Based on PSO and ACO Approach for Solving Combinatorial Fuzzy Unrelated Parallel Machine Scheduling Problem // *European Journal of Scientific Research*. 2011.– P. 87–104.
4. Georgiadis G. P., Elekidis A. P., Georgiadis M. C. Optimization-Based Scheduling for the Process Industries: From Theory to Real-Life Industrial Applications. *Processes*. 7. 438. 2019.– P. 1–35. Doi: <https://doi.org/10.3390/pr7070438>.
5. Barker K., Wilson K. Decision trees with single and multiple interval-valued objectives. *Decis Anal*. 9(4). 2012.– P. 348–358. Doi: 10.1287/deca.1120.0253.
6. Kamiński B., Jakubczyk M., Szufel P. “A framework for sensitivity analysis of decision trees” // *Central European Journal of Operations Research*. 26 (1). 2017.– P. 135–159. Doi:10.1007/s10100-017-0479-6.

7. Filho C.J.A.B., de Lima Neto F.B., Lins A.J.C.C., Nascimento A.I.S. and Lima M.P. “A novel search algorithm based on fish school behavior”, *Systems, Man and Cybernetics, SMC. IEEE International Conference on*, 2008.– P. 2646–2651.
8. de Lima Neto, Fernando Buarque and Marcelo Gomes Pereira de Lacerda. “Multimodal Fish School Search Algorithms Based on Local Information for School Splitting”. *BRICS Congress on Computational Intelligence and 11th Brazilian Congress on Computational Intelligence. IEEE*, 2013.
9. Yudong Zhang, Saeed Balochian, Praveen Agarwal, Vishal Bhatnagar, Orwa Jaber Housheya. *Artificial Intelligence and Its Applications // Mathematical Problems in Engineering. Article ID840491*, 2014.– P. 1–10. Doi: <http://dx.doi.org/10.1155/2014/840491>
10. Mirjalili S., Lewis A. *Grey Wolf Optimizer // Advances in Engineering Software.– Vol. 69. 2014.– P. 46–61.*
11. Madadi A., Motlagh M. *Optimal Control of DC motor using Grey Wolf Optimizer Algorithm // Technical Journal of Engineering and Applied Science.– Vol. 4(4). 2014.– P. 373–379.*

Section 4. Medical science

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Venger Andrii,
PhD (biology), associate professor,
Odessa national medical university, Ukraine
E-mail: venger87@ukr.net

Venger Olga,
PhD (biology), junior scientific researcher,
Plant breeding and genetics Institute – National
center of seed and cultivar investigation, Ukraine

Vasina Yuliia,
student, Odessa national medical university, Ukraine

Zhuravlov Ivan,
lecturer, The state institution South Ukrainian National
Pedagogical University named after K. D. Ushynsky, Ukraine

Kholodnitskiy Igor,
lecturer, The state institution South Ukrainian National
Pedagogical University named after K. D. Ushynsky, Ukraine

Liubov Bahrii,
lecturer, The state institution South Ukrainian National
Pedagogical University named after K. D. Ushynsky, Ukraine

POLYMORPHISM OF AMB A I ENCODING GENE OF AMBROSIA ARTEMISIIFOLIA

Abstract. Diagnostics of polymorphism of Amb a I encoding gene of *Ambrosia artemisiifolia* was conducted. Polymorphism of Amb a I encoding gene of Ukrainian and world collection samples of *A. artemisiifolia* was researched.

Keywords: *Ambrosia artemisiifolia*, Amb a I, allergen, polymorphism. Ukrainian samples.

Allergens released by *Ambrosia* from the *Asteraceae* family are an important factor of allergy. Amb a I is the major allergen of *Ambrosia*. This protein belongs to the pectate lyase family. Amb a I is an acidic non-glycosylated 38-kDa protein consisting of

a 26-kDa α -chain and an associated 12-kDa β -chain [3, 27].

A. artemisiifolia is an invasive weed from North America, which has currently inhabited many regions in Asia and Europe, especially in Ukraine. The

weed has recently become spreading as a neophyte in Europe, while climate change may also have affected the growth of the plant and additionally may also influence pollen allergenicity [4, 176]. In Ukraine, the number of diseases caused by this allergen has recently increased [1, 350].

The gene for Amb a I had recently been cloned, and it was shown that Amb a I makes a group of proteins with three polymorphic isoform members [2].

Polymorphism of Amb a I encoding gene of Ukrainian samples of *A. artemisiifolia* is still unknown. The aim of current scientific work was to create primers for polymorphic regions of Amb a I encoding gene and to detect polymorphism of that gene in Ukrainian and world collection samples.

Material and methods

Polymorphism of Amb a I encoding gene of *A. artemisiifolia* was researched by polymerase chain reaction (PCR) *in silico* and *in vitro*. Primers and time-temperature environment for PCR were conducted by VectorNTI10 program.

124 nucleotide sequences of Amb a I encoding gene from National Centre of Biotechnology Information and 43 DNA samples of Ukrainian *A. artemisiifolia* were analysed by PCR *in silico* with Fast-PCR program [5].

Polymorphism of Amb a I encoding gene in DNA, extracted from 43 samples Ukrainian *A. artemisiifolia* was analysed by PCR *in vitro*. Sizes of products of PCR were detected by gel-electrophoresis.

Results

By VectorNTI10 program for analysis of polymorphism of Amb a I encoding gene of *A. artemisiifolia* there were conducted following primers (5'→3'): AMB1F GTCTACACGGTCACCAGCAA and AMB1R AGGGGCCAAGAATCTGTTCC. Condition of PCR: 2 min at 94 °C for first denaturation; 35 basic cycles of 0,5 min at 94 °C, 1 min at 54 °C, 1,5 min at 72 °C; and 10 min at 72 °C for final elongation.

Results of PCR are present in (table 1).

Table 1. – Products of PCR-analysis *in silico* and *in vitro*

Type of PCR	Products of PCR, base pairs		
	690.690	690.700	700.700
	Number of samples		
<i>in silico</i>	88	36	
<i>in vitro</i>	27	12	4

Discussion

The most popular combination of products of amplification *in silico* and *in vitro* is 690.690 base pairs (bp). Combination 690.700 bp was also obtained after both providing types of PCR and combination 700.700 bp was produced only in reaction with DNA of Ukrainian samples of *A. artemisiifolia*. Unique combination of amplicons can be correlated with unique germplasm presence in Ukrainian population of *A. artemisiifolia*.

Conclusion

In result of the accomplished research the primers and conditions of PCR for detection of polymorphism of Amb a I encoding gene of *A. artemisiifolia* were conducted. Polymorphism of *Amb a I* encoding gene with nucleotide sequences from NCBI and DNA of Ukrainian samples of *A. artemisiifolia* was researched. Unique combination of alleles in Ukrainian population of *A. artemisiifolia* was described.

References:

1. Chen M., Xu J. D., Devis, J., Shi K., Ren I., Searle D., Zhang. Origin and Functional Prediction of Pollen Allergens in Plants. *Plant Physiol.* 172(1). 2016.– P. 341–357.
2. Chruszcz M., Kapingidza A. B., Dolamore C., Kowal K. A robust method for the estimation and visualization of IgE cross-reactivity likelihood between allergens belonging to the same protein family. *PLoS One.* 13(11). 2018. e0208276.
3. Hiller K. M., Lubahn B. C., Klapper D. G. Cloning and expression of ragweed allergen amb a 6. *Scandinavian Journal of Immunology*, 48. 1998.– P. 26–36.
4. Kelish A. L., Zhao F., Heller W., Durner J., Winkler J. B., Behrendt H., Traidl-Hoffmann C., Horres R., Pfeifer M., Frank U. Ragweed (*Ambrosia artemisiifolia*) pollen allergenicity: SuperSAGE transcriptomic analysis upon elevated CO₂ and drought stress. *BMC Plant Biology*, 14. 2014.– 176 p. Published online.
5. URL: <http://www.ncbi.nlm.nih.gov>

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*Lisukha Liubov Mykhailivna,
Junior researcher, Ph.D., The department of clinical physiology
of connective tissues O. O. Bogomoletz Institute of Physiology,
National Academy of Sciences of Ukraine
E-mail: lyubovlisukha@gmail.com*

EFFICACY OF L-TRYPTOPHANE TREATMENT IN CHILDREN WITH TIC HYPERKINESIS

Abstract. The efficacy of the neuroadaptogen containing L-tryptophan 50 mg in children aged from 6 to 12 years with tic hyperkinesis was investigated. The obtained results indicate that the examined subjects were characterized by a symptom complex of psychoneurotic and somatovegetative disorders. Taking the syrup helped reduce the appearance of tics.

Keywords: tics; children; tic hyperkinesis; central nervous system; autonomic nervous system; L-tryptophan; children's questionnaire of neuroses.

Introduction. It is known that tics significantly worsen the children's health [1–4]. The prevalence of the disease in the pediatric population varies from 4 to 25%, according to the data of various authors [1, 4]. Most often this pathology is manifested in children before the age of 12 years. Taking into account that the etiology and pathogenesis of hyperkinesis are insufficiently studied this disease is difficult to treat. Currently, there is no consensus on the causes which lead to this pathology. A genetic predisposition with an autosomal dominant type of inheritance (including tics in families) is considered one of the causes for disease by most scientists [1, 4–6]. Boys get sick 3 times more often than girls, which is possible in cases of incomplete and sex-dependent gene penetration. Some authors [7] point to the infectious and immune mechanisms, others [8–11] consider the kinurein hypothesis.

The effectiveness of the dopaminergic system may be affected by disorders of intrauterine development due to hypoxia, infections, birth trauma. In the pathogenesis, there are not only functional and organic changes of the central nervous system (CNS), but also complex chains of imbalance in the cortex, subcortex with the cerebellum, spinal cord,

peripheral nervous system [1, 12]. Based on clinical criteria, the following types of tics are distinguished: F95 – transient; F95.1 – chronic motor or vocal; F95.2 – combined vocal and multiple motor (de la Tourette syndrome) [5]. Treatment of tic hyperkinesis remains an urgent problem now [13; 14].

Aim. To determine the effect of neuroadaptogen (containing L-tryptophan 50 mg) in children with tics aged from 6 to 12 years.

Patients and methods. There were examined 30 children (20 boys and 10 girls) aged from 6 to 12 years, which were divided into two groups: main group (I) consisted of 20 children with tics (mean age 7.88 ± 0.55 yrs.); control group (II) – 10 almost healthy children (mean age 8.10 ± 0.67 yrs.). Patients receive medical care at the Children's Clinical Hospital № 4 in Solomyanskyi district of Kyiv. Criteria for inclusion in the study for the control group were: 1) age from 6 to 12 years; 2) the average values of physical and sexual development at the time of the study; 3) absence of acute diseases during the last two months before the examination; 4) children who did not in general use drugs with psychoactive and anticonvulsant and nootropic effects. Criteria for the main group were: 1) age from 6

to 12 years; 2) the presence of clinical manifestations of tic hyperkinetic disorders; 3) absence of acute diseases during the last 2 weeks; 4) children who did not take drugs with psychoactive, anticonvulsant, and nootropic effects for last 6 months. Exclusion criteria: 1) non-compliance with inclusion criteria; 2) false answers by the scale of the VII children's questionnaire of neuroses (CQN) [15].

Clinical and neurological examinations were carried out including the medical history; complaints; study of neurological status according to the scheme [16]. CQN (Sedneva, Zbarskin, Burtseva) was used to assess the adaptation and clinical profile of the neurotic condition [15]. A following score scale of neurotic disorders was used for testing: I – depression; II – asthenia; III – behavioral disorders; IV – autonomic disorders; V – sleep disorders; VI – anxiety; VII – lies. After converting the primary data using the coefficients, the results were compared with the classifier: 16–20 points – a high level of risk of a certain clinical symptom complex; 12–15 points – average or uptrend; up to 11 points – low level. Patients were additionally examined by laboratory (clinical analysis with blood formula) and functional methods (electrocardiogram (ECG), electroencephalogram (EEG)). In addition the patients were examined by a cardioreumatologist, ophthalmologist, otolaryngologist, and if necessary by a psychologist. The medical history of the child's development was analyzed. Neuroadaptogen in syrup containing L-tryptophan 50 mg (Silenta syrup) was used for treatment.

The study meets all modern requirements of moral and ethical norms. Programs of Microsoft Excel and Origin Pro 7.5 were used to analyze the results. The significance of disagreements for samples with normal distribution was evaluated by Student's t test. Differences in the results were considered statistically significant if $P < 0.05$.

Results. There were 3 of the 20 children in the main group (I) who had false answers by the VII CQN scale and they were excluded from the examination. The average age of patients (group I) was

7.88 ± 0.55 years: boys – 1.9 ± 0.18 ; girls – 1.7 ± 0.17 . In the control group (II) the average age was 8.10 ± 0.67 : boys – 1.6 ± 0.17 ; girls – 1.4 ± 0.15 . Analysis of the anamnestic data of the examined patients (group I) revealed the factors which contributed to the change in CNS reactivity, and could affect the monoaminergic system of the brain: 7 out of 17(41%) were premature infants with gestational age from 35 to 38 weeks; 2 of 17(12%) had perinatal lesions of the CNS. At the time of examination, 10 of 17(59%) patients in group I had frequent blinking of the eyelids, 5 of 17(29%) – twitching of facial muscles, 2 of 17(12%) – obsessive neck movements, 1 out of 17 – upper shoulder girdle, 3 out of 17(18%) – “sniffing”, 4 out of 17(23%) – “snoring”. Based on clinical data, and neurological status tic hyperkineses of facial mimic muscles was registered in 11 of 17(65%) children and combined tic (hyperkineses of the muscles of the face, head, neck, shoulder girdle) – in 6 of 17(35%). Chronic motor tic hyperkineses were noted in 4 out of 17 patients.

Complaints from the CNS and ANS were as follows: emotional lability in 7 out of 17(41%); sleep disorders in 2 of 17(12%); hyperactivity in 2 (17%); fatigue in 5 out of 17(32%) patients. Studying the neurological status in patients according to the scheme [16], microsymptoms such as installation nystagmus in the removal of the eyeballs were registered in 3 of 17(18%), eyelid tremor – in 7 of 17(41%), local hyperhidrosis of the palms and soles – in 4 of 17(23%), increased tendon reflexes in the lower extremities – in 3 of 17(18%). White dermographism of the skin (anterior outer abdominal wall) was revealed in 8 out of 17(47%), pink ones – in 9 out of 17(53%) patients.

CQN allows to detect subclinical prenosological phenomena which form borderline neuropsychiatric, psychosomatic and somatoform autonomic disorders. The manifestation of neurotic disorders in the CNS, the presence of various symptom complexes and the possibility of simulation and aggravation by the patient (by the VII scale of neuropsychiatric

disorders) were revealed in this study. A high risk of sleep disturbance (> 16 points by the V scale) was found in 1 of 17 patients (group I) of our studies. The average level of symptom complexes (group I) (> 12 points) was registered by the following scales: III – behavioral disorders in 4 of 17 (23%); IV – autonomic disorders in 3 out of 17 (18%); V – sleep disorders in 6 of 17 (35%); VI – anxiety in 2 of 17 (12%) patients. In the examined subjects (group II) the average level of risk was demonstrated in 1 out of 10 patients by the IIIrd scale and in 1 out of 10 by the IVth scale. That is, according to the CQN analysis, borderline psychoneurotic syndromes and somatophomic autonomic dysfunctions were formed in the vast majority of patients. The course of tics was manifested by emotional lability, excitability, and by tension in some children when trying to control the situation. All this reduces the quality of life.

The functional state of the cardiovascular system, which was assessed by ECG recording, showed that 2 out of 17 persons had repolarization disorders, 5 out of 17 (29%) – sinus tachycardia (1 out of 10 in controls), which may be the result of extracardiac influences (strengthening of cardiac sympathetic innervation or weakening of vagal innervations against psychoemotional excitement). The study of brain bioelectrical activity according to the EEG record showed that the presence of non-epileptic activity, lowering the threshold of convulsive readiness, which indirectly indicates instability of the cerebral cortex (rhythm disorganization, dominant theta-delta activity) was a characteristic feature in 7 of 17 (41%) examined persons. Convulsive readiness was detected in 2 of 17 patients, during a hyperventilation test.

Silenta syrup (containing L-tryptophan 50 mg) was used by us. The drug was administered in a dose of 10 ml 2 times a day for 21 days. The clinical and neurological status and manifestations of neurotic disorders were assessed after the course of treatment. Positive changes were registered in the vast majority of patients: tic hyperkinesias were almost invisible

in 8 of 17 (47%); an improvement was noted in 5 out of 17 (29%). The condition remained unchanged in 4 out of 17 (23%) persons. The best response to treatment was observed in patients with tics which were manifested by twitching of facial mimic muscles (one muscle group), and a mild course was registered in them. Children have reduced complaints of emotional lability, sleep disturbances, fatigue, and improved well-being. According to the results of CQN, the total number of points by the scales was significantly decreased by 21.35 conventional units (from 43.29 ± 2.45 to 21.94 ± 2.79). Individual analysis of the scales showed that the risk of developing autonomic disorders, sleep, anxiety decreased to a low level after treatment. The functional state of the cardiovascular (according to the EEG) system also was within the physiological norm after treatment. According to the EEG, the instability of the cerebral cortex remained in 2 of 17 patients.

Thus, the obtained results indicate that the condition of children aged from 6 to 12 years with tic hyperkinesias, was characterized by a symptom complex of psychoneurotic and somatovegetative disorders according to the used tests. The use of syrup containing L-tryptophan, magnesium and herbs has a positive effect on the CNS and improves well-being of patients.

Conclusions

1. The clinical manifestation of tics may be accompanied by an imbalance of ANS, which indicates a decrease in the adaptive capacity of the body in children aged from 6 to 12 years.

2. The use of a neuroadaptogen which contains L-tryptophan helps to restore the activity of the CNS in the form of reducing the symptoms of tics and improving general well-being of children.

3. Silenta syrup can be recommended for the comprehensive treatment of children with tic hyperkinesias.

References:

1. Chutko L. G. Tics in children. – Moscow: Media sphere, 2008. – 10 p.
2. Zalyalova Z. A., Bogdanov E. I., Munasipova S. E. Tic hyperkinesia: current views. *Neurological Bulletin*. 2010. – 4LII (3). – P. 77–84.
3. Delyagin V. M. Tics in children. *Breast cancer “Mother and Child”*. 2013. 14. – P. 784–790.
4. Jankovic J. Clinic of tics. *Adv. Neurol.* 2001. – 85. – P. 15–29.
5. American Psychiatric Association. *Diagnostic and statistical manual of mental disorders 4th ed.* Washington (DS): American Psychiatric Association, 1994.
6. Kurlan R. *Handbook of Tourette’s Syndrome and Related Tic and Behavioral Disorders (Neurological Disease and Therapy)*. 2005. – P. 325–329.
7. Murphy T., Storch E., Turner A. et al. Material history of autoimmune disease in children presenting with tics and / or obsessive-compulsive disorder. *J Neuroimmunol.* 2010. – 229(1–2). – P. 5–13.
8. Uzbekov M. G. The hyperkinetic syndrome as a manifestation of disturbances in the brain monoaminergic systems development. *Social Psychiatry*. 2006. – P. 31–43.
9. Oades R. D. Differential measures of “sustained attention” in children with attention-deficit / hyperactivity or tic disorders: relations to monoamine metabolism. *Psychiatry Res.* 2000. – 93. – P. 165–178.
10. Gainetdinov R. R., Wetsel W. S., Jones S. R. et al. Role of serotonin in the paradoxical calming effect of psychostimulants on hyperactivity. *Sciences* 1999. – 283. – P. 397–401.
11. Askenazy F., Caci H., Myquel M. et al. Relationship between impulsivity and platelet serotonin content in adolescents. *Psychiatry Res.* 2000. – 94. – P. 19–28.
12. Fedoseyev I. F., Poponnikova T. V., Veremeev A. B. The metabolic state of neurotransmitters in tic hyperkinesia in children. *Mother and child in Kuzbass*. 2012. – 2. – P. 53–56.
13. Asimova N. M., Achilova K. T. Tic hyperkinesia in children and their comorbidity. *Vestnik Kazan NMU*. 2016. – 2. – P. 178–182.
14. Fedoseeva I. F., Poponnikova T. V., Veremeeva A. V. The condition of metabolism of neurotransmitters in children with tic disorders. *Mother and child in Kuzbass*. 2012. – 2(49). – P. 53–56.
15. Sednev B. P. *Diagnosis of neurotic disorders in children of primary and secondary school age. Children’s Neurosis Questionnaire (DON). Application for rationalization.* – Donetsk: DOLKO. 1994. – No. 48.
16. Petrukhin A. S. *Pediatric neurology: in 2 vol.* – Moscow: GEO-TAR-Media; 2012. – 815 p.

Section 5. Psychology

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*Moskvin Victor A.,
Dr. Psych., professor of psychology department,
Russian University of Physical Education, Sport,
Youth and Tourism Moscow, Russia
E-mail: 1700018v@mail.ru*

*Moskvina Nina V.,
Ph.D., associate professor of psychology department,
Russian University of Physical Education,
Sport, Youth and Tourism Moscow, Russia*

INDIVIDUAL FEATURES OF AGGRESSIVENESS OF YOUNG BOXERS, TAKING INTO ACCOUNT GENDER DIFFERENCES

Abstract. The problem of aggressiveness and gender differences in 40 sportsmen-boxers (20 men and 20 women 20–28 years old) has been investigated. We used the methods of S. Bem “Masculinity-Femininity”, the Bass-Darki questionnaire to study the level of aggressiveness, the Spielberger anxiety scale. For statistic processing, the nonparametric Kruskal-Wallis H-test was used. It was found that there are gender differences in the manifestations of boxers’ aggressiveness. Confirmed by putting forward a hypothesis.

Keywords: sport, boxing, sports psychology, masculinity, femininity, aggression, anxiety.

Introduction. The subjective approach in sports psychology is extremely relevant today and requires an in-depth approach to an athlete, taking into account the problem of differential differences [1–5]. An individual approach is especially relevant in the study of joint activities in the triad “athlete – coach – psychologist”. Today in sports psychology, the features of gender differences are still insufficiently developed. This also applies to such a sport as boxing. The relevance of the study, for example, the problem of aggression in boxing, is associated with the fact that there are stereotypical views in society about the potential aggressiveness of boxers. Usually, the phenomenon of aggressiveness is studied without

taking into account the gender factor. And it, as a rule, is more attributed to the male quality (it was also studied, to a greater extent, on male samples). The gender aspect of aggressiveness in sports psychology has recently become the subject of rigorous scientific research. At the moment, the gender specificity of sports, and in particular boxing, is an extremely poorly studied area [6].

Objective. The purpose of this work was to try to investigate gender characteristics in the manifestations of aggressiveness in young sportsmen-boxers.

The hypothesis under study. There are differences in the manifestations of aggressiveness

among young sportsmen-boxers, due to individual gender characteristics.

Experimental part. The following methods of psychodiagnostic research were used: “Masculinity-Femininity” by S. Bem, “Questionnaire of the level of aggressiveness” by Bass-Dark and the Spielberger anxiety scale. A nonparametric method, the Kruskal-Wallis H-test, was used as a statistical method for processing.

The experimental research took place on the basis of the professional martial arts club “GOR MMA” (Moscow). It was attended by 40 athletes-boxers (20 men and 20 women aged 20–28).

Research results. Based on the analysis of studies of gender characteristics in sports pedagogy and psychology [1–5], the results of the diagnosis of “masculinity-femininity” (obtained by processing the data of S. Boehm’s methodology “Masculinity-femininity”) were analyzed. The work allows us to conclude that in the group of subjects 46% show such a quality as “androgyny”. Moreover, men are more characteristic of “masculinity” (60%) than “androgyny” (40%), and women in the sample studied equally show both “androgyny” (53%) and “femininity” (47%).

The data of the Bass-Dark questionnaire (for the study of the level of aggression) showed that in the surveyed sample the indicators of physical aggression, negativism and verbal aggression in men were higher than in women. Female boxers had a higher indicator of indirect aggression, resentment, suspicion, and guilt. Most of the subjects in the sample are characterized by a high level of hostility, but an average indicator of aggressiveness. For “masculine” athletes, physical aggression is most pronounced, for “androgynous” athletes – verbal aggression, for “feminine” athletes – indirect aggression.

The “androgynous” and “feminine” subjects were more hostile than the “masculine” ones. According to the general indicator of aggressiveness, the majority of “masculine” boxers showed an average level of

aggressiveness, while among the “androgynous” and “feminine” boxers, a low level prevails.

The data obtained by the Spielberger method show that the majority of subjects in the study sample have medium and low levels of situational and personal anxiety. It should be noted that a high level of personal anxiety is more manifested in “feminine” subjects than in “androgynous” and “masculine” athletes-boxers.

In “masculine” athletes, physical aggression is most pronounced, in “androgynous” athletes – verbal aggression, in “feminine” ones – indirect. It can be assumed that the “masculine” personality type, due to an active lifestyle, constantly exposes its body to loads of varying degrees of intensity, which allows this personality type to adapt to sensual bodily manifestations of the emotional level, as a natural reflection of their emotional background. Also (according to a similar principle) aggression is manifested in a “feminine” personality, a greater load, which is rarely physically exposed. When faced with problems, such a person finds a way out by trusting intuition and calculation, which allows her to both identify aggression (directed at her) and respond to this aggression.

Most of the “masculine” subjects show a high level on the “hostility” scale, while it can also be noted that a slightly smaller number of “masculine” subjects have a low and medium level on this scale. The majority of “androgynous” and “feminine” subjects also had a high level on the “hostility” scale. This fact suggests that “feminine” and “androgynous” boxers are more hostile. The results can be attributed to the fact that hostility is associated with emotionality, which is characteristic of the “feminine” type and is allowed for the “androgynous” type, but is not characteristic of the “masculine” type.

According to the general indicator of “aggressiveness”, the majority of “masculine” boxers were diagnosed with an average level of aggressiveness, while “androgynous” and “feminine” boxers had a low level of “aggressiveness”. This is due to the fact that for these individuals, external aggressive behavior is unacceptable.

It should also be noted that in this sample all “androgynous” personality types are represented by women. They show their need to express aggression through boxing, but they do not realize aggressiveness in the outside world. Regardless of their gender identity, they rarely experience emotions of tension, anxiety, nervousness, etc.

This is due to the fact that this group is engaged in boxing, which allows women-boxers to show self-confidence, teaches them to discipline, self-control, meaningfulness of their actions. At the same time, the subjects are able to control the environment well, as a result of which, they feel more secure, and this trait is formed in them regardless of gender identity.

Personal anxiety in the studied sample was formed at the average level, regardless of gender characteristics. A high level is more developed in “androgynous” and “feminine” subjects than in “masculine” ones.

Conclusions. The data confirmed the hypothesis that there are gender differences in the manifestation of aggressiveness among boxers. Physical aggression in “androgynous” boxers is lower than in “masculine”, but higher than in “feminine”. Indirect aggression in “androgynous” athletes is lower than in “feminine” ones, but higher than in “masculine” athletes. Resentment among “androgynous” athletes is higher than among “masculine” ones, but lower than among “feminine” ones. “Androgynous” athletes are more

suspicious than other athletes. The hostility among “androgynous” athletes is lower than among “feminine” athletes, but higher than among “masculine” ones.

Aggressiveness among “androgynous” athletes is significantly lower than among “masculine” ones, but higher than among “feminine” ones. Personal anxiety among “androgynous” boxers is lower than among “feminine” ones, but higher than among “masculine” athletes. The data obtained are of interest not only for sports psychology, but also for the development of the theory and methodology of modern boxing [6].

It is urgent to conduct further research in this direction of athletes (including boxers), taking into account the signs of individual manifestations of the peculiarities of functional asymmetry [7–9]. The study of the individual characteristics of the regulatory processes of athletes, taking into account the signs of interhemispheric asymmetry, convincingly proves the existence of differences and the prospects of such studies [4; 9].

The data obtained can be used in differential and sports psychology – both in the course of corrective work and in the implementation of differential diagnostic work.

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References:

1. Ilin E. P. Differential psychophysiology of a man and a woman. SPb.: – Piter, 2003.– 544 p. (in Rus.).
2. Ilin E. P. Psihologiya sporta. SPb.: – Piter, 2009.– 352 p. (in Rus.).
3. Psihologiya fizicheskoi kulturi / Pod obschei red. B. P. Yakovleva _ G. D. Babushkina. Moscow: Izd. “Sport”, 2016.– 898 p. (in Rus.).
4. Moskvina V.A., Moskvina N. V. Mejpolutsharnie asimmetrii i individualnie razlichiya cheloveka.– Moscow: Smisl, 2011.– 367 p. (in Rus.).
5. Yurov I. A. Psihofiziologicheskie svoistva sportsmenov.– Moscow: RUSAINS, 2018.– 184 p. (in Rus.).
6. Koncev K. N. Teoriya i metodika boksa. Akcentirovannii i tochnie udari: uchebnoe posobie dlya vuzov / K. N. Koncev, O. V. Menshikov, A. I. Garakyan, Z. M. Husyainov. 2-e izd.– Moscow: Yurait, 2020.– 174ps. (in Rus.).
7. Sakano N. Latent left-handedness. Its relation to hemispheric and psychological functions.– Jena: Gustav Fischer Verlag, 1982.– 122 p.

8. Moskvin V.A., Moskvina N. V. Asymmetry and individual characteristics of strong-willed regulation teenage athletes // *Austrian Journal of Humanities and Social Sciences*, 2016.– No 5–6.– P. 22–24. Doi: 10.20534/AJH-16–5.6–22–24.
9. Moskvin V., Moskvina N., Nurgaleev V., Lukyanchikova Zh., Nepopalov V., Romanina E., Sopov V. *Interhemispheric Asymmetries and Individual Features of Regulatory Functions in Sport Psychology* // *Sports, Health and Exercise Medicine* / Ed. by Samuel Honório.– London, Intech Open, 2020. ISBN: 978–1–83880–400–8. DOI: 10.5772 / intechopen.87066.

Section 6. Agricultural sciences

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*Ahire L. M.,
Assistant Chief Technical Officer,
ICAR-National Academy of Agricultural Research
Management Rajendranagar, Hyderabad-500030, India
E-mail: laxman.ahire1967@gmail.com*

*Hudedamani Umesh,
Scientist
ICAR-National Academy of Agricultural Research
Management Rajendranagar, Hyderabad-500030, India*

*Basith M. A.,
Chief Technical Officer
ICAR-National Academy of Agricultural Research
Management Rajendranagar, Hyderabad-500030, India*

*Venkatesan P.,
Principal Scientist,
ICAR-National Academy of Agricultural Research
Management Rajendranagar, Hyderabad-500030, India*

*Balakrishnan M.,
Principal Scientist,
ICAR-National Academy of Agricultural Research
Management Rajendranagar, Hyderabad-500030, India*

MANAGEMENT OF FIELD AND HORTICULTURAL CROPS UNDER CHANGING CLIMATIC SCENARIO

Abstract. Low productivity in food grains, vegetable and fruit crops worldwide is the major cause of climate change. Increasing temperatures limits the water availability, flooding and salinity hamper the sustainable horticultural production. Changing climatic scenario leads to the crop failure, reduced production, poor quality produce and more incidences in pests and diseases makes food grain, vegetable and fruit production makes unprofitable. Droughts and soil salinity are major factors makes temperature worsening in horticultural production. Therefore, need arises to use appropriate climate resilient technologies and approaches to ward off various new insect pests, diseases and hitherto

unheard stresses and increase the productivity to feed the global population without compromising on the quality of the produce. A holistic climate resilient technologies consisting of mulching with crop residue management which helps in soil moisture conservation. Proper drainage due to heavy rains can be avoided by adoption of raised beds in vegetable crops. New genotypes tolerant to high temperature, droughts, salinity and conventional and non-conventional breeding techniques are essentially required to meet these challenges.

Keywords: Climate change, Climate resilient technologies, Field crops, Horticultural crops, Adaptation.

Introduction

Ensuring food security to Indian population in changing climatic scenario is the major concern and challenge to scientific community. At present crop simulation models are used to study the impact of climate change on agricultural production and food security. Simulation models help farmers to take appropriate decisions in farm management practices and alternative options to choose a particular farming system. Due to technological advances in India, the use of computer based simulation models by farmers, agri-professionals and policy makers is expected to increase and it is also witnessed in the past decade some work has been done on simulation models to understand the nature and change in production of various crops due to climate change. The current article focused on the impact of climate change on various field and horticultural crops and ways to mitigate these challenges through climate resilient technologies to boost higher food grain and horticultural production. Climate change is hampering agricultural growth and it was reported by Intergovernmental Panel on Climate Change (IPCC) that climate change is affecting the crop production in many regions of the world and the negative effects are more prominent in developing countries. Climate change has led to increase in carbon dioxide (CO₂) in atmosphere. Present day the concentration of carbon dioxide in earth's atmosphere is around 412 ppm and which has seen 47 percent increase from pre-industrial era. It is expected double by the end of this century (IPCC [5]).

Apart from the effect on the carbon dioxide, climate change has effect on multitude of factors

leading to erratic rainfall, higher average temperatures and water stress might which in turn have major implications for crop production in the tropical regions. Climate change is expected to increase the extreme weather conditions like increase in heat waves, cyclones which adversely affect agricultural activities leading to substantial reduction in agriculture production. It was reported by many researchers in India, that there is increased trend in surface temperature during the last century (Hingane et al., [8]; Srivastava et al., [20]; Rupa Kumar et al., [12]; De and Mukhopadhyay, [6]; Pant et al., [12]; Singh and Sontakke, 2002; Singh et al., [17]). Climate change is the alarming situation for agricultural production and food systems. Therefore, it is a time to support the farming community with technological approaches to transform the agricultural systems to support global food security to reduce poverty. (Sonja et al. [21]). To bring out the changes at global level, all the stakeholders at all levels need to work to mitigate the food security and climate change challenges. Farmers need to face the climate change challenges by intelligently adapting climate smart technologies for sustainable crop yields. Several advanced technologies and approaches have been developed by the scientific fraternity to increase agricultural production under varying climatic conditions and these should be adopted to obtain optimum production in changing climatic scenario. Efficient use of existing resources, use-and-re-use, safeguard of environment, societal safeguard, sustainability and long term development goals have the prime importance under these conditions. Participatory approach and on-site

demonstrations coupled with location specific technologies help farmers accept the present situations of climatic changes. The horticultural production systems suffer due to climate change affecting various issues like price fluctuations in fruits and vegetable crops. Also the declining fruit and vegetable production due to short growing period, will hamper the growth and development due to terminal heat stress and less availability of water. Variability in rainfall and less number of rainy days affects the rain-fed agriculture (Venkateswarlu and Shanker [22]). Climate-smart horticulture interventions which are highly location specific and knowledge based need to be employed to face the competitiveness in sustainable manner for improving horticultural production in the challenged environment (Malhotra and Srivastava [11], Malhotra [13]).

In India, there are two major crop growing seasons as far as climate is concern. The '*kharif*' crop growing season starts with June and goes up to September coincides with south-west monsoon. In *kharif* season crops like rice, maize, sugarcane, cotton, jute, groundnut, soybean and Bajra are grown based on the crop duration and harvested during the autumn (October–November) or winter (December–February) months. The southwest monsoon plays important role in *kharif* production which accounts for more than 50% (food-grain) and 65% of the oilseeds production in India. Monsoon rainfall variability affects large-scale droughts and floods in India, hampers food grain production (Parthasarathy and Pant [16]; Parthasarathy et al., 1992; Selvaraju, 2003; Kumar et al., [4]) in India and also on the economy (Gadgil et al., 1999 a; Kumar and Parikh [18]). After the summer monsoon, winter or '*rabi*' crop-growing season starts and continues up to early summer. Rainfall at the end of monsoon provides stored soil moisture and also helps for irrigation water for *rabi* crops. Therefore, summer monsoon is very important for both *kharif* and *rabi* seasons in India. Significant work on climate resilient practices in food-grain and horticultural crops

is done by Indian Council of Agricultural Research (ICAR) under National Innovations on Climate Resilient Agriculture (NICRA) network project which was started in the year 2011. The other organizations such as Consultative Group on International Agricultural Research (CGIAR) also started a program on Climate Change, Agriculture and Food Security (CAAFS) organization promoting adaptable resilient technologies in several countries including India. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) has developed several climate-smart technologies. In spite, of having climate change challenges India stands second in vegetable and fruit production after China in the world and supports 17 per cent of the population with a land share of 2.4 per cent. Still we are facing the problem of food security. According to the UN report Right to Food, around 1 billion people sleep without food, and children suffer from malnutrition. Considering these facts, this chapter focuses on production challenges in food-grain, vegetables and fruits and ways to mitigate them with the adaptation appropriate climate resilient technologies.

1. Climate resilient technologies for Food grains

The adaptation strategies to overcome the adverse climate impacts includes the breeding of new varieties tolerant various kind of stresses such as moisture and heat, change in cultural practices of various crops, efficient water use practices, technologies of conservation agriculture, improved IPM practices, crop based insurance and use of traditional knowledge in practice among the farming community. There are several climate resilient technologies scientifically proved and tested by the National Innovations in Climate Resilient Agriculture (NICRA) are available for the farmers for adaptation.

1.1 Climate stresses tolerant varieties

NICRA screened large number of germplasm in rice and identified Nerica L44 and N22 cultivars which are resistant to heat and other stresses. These cultivars can serve as pre-breeding genetic resources

for breeding elite varieties. The use of improved genotypes will help in mitigating intermittent drought as well to save water in irrigated rice cultivation. NICRA screened two wild cultivars of tomato namely *L. peruvianum* and *L. pimpinellifolium* which are tolerance to temperature stress. The cultivars which are under cultivations viz., Pusa Sadabahar and TH-348 and two hybrids viz., DTH-9 and DTH 10 are also found tolerance to heat stress.

1.2 Water conservation

The several steps have been taken up by for water availability, renovation of water harvesting bodies and desilting and deepening of open wells through stakeholders' participation. Other water saving technologies are network of underground irrigation lines as drip, sprinkler, popup irrigation and use of rain-gun irrigation systems. Most advanced water saving technique is laser aid land levelling and efficient use of need based irrigation. Drip irrigation system also introduced for rice cultivation which helps in reduced GHGs emission and saves water.

1.3 Farm pond-rain water harvesting technology

It is an option to harvest rainwater to be used for irrigating the standing crops during water stress or to overcome with the terminal drought and pre sowing irrigation in rainfed areas. Farm ponds are helpful to recharge old open well, bore wells and injection wells for recharging ground water are taken up for enhancing farm level water storage.

1.4 Conservation agriculture technologies

Conservation agriculture helps in efficient use of resources provides economic benefits and minimizes unresponsive climatic stresses. Conservation agriculture is one of the soil and water conservation method adopted throughout the world. Conservation agriculture is a farming system in which soil is covered with various plant species for protection of soil and avoids soil tillage which helps to cultivate various plant species for improvement of soil conditions with reduced degradation and efficient use of water and nutrients. These conservation agriculture technologies or practices include direct sowing or

no tillage or minimum tillage, incorporation of plant residues in soil, cultivation of cover crops for annual or perennial crops. According to FAO to integrate farm income and soil health through CA (Conservation Agriculture) technologies must be focused on the concept of resource-saving agricultural production which includes achieve acceptable profits, high sustained production levels and conserve the environment. The conservation agriculture practices are applicable to all crops including food grains, horticulture and plantation crops. These technologies are more popular in maize, soyabean, rice and wheat.

1.5 Zero-tillage practice

Zero tillage practice helps farmers subject to farmers have to sow wheat immediate after harvesting of rice to void the threat of terminal heat. The zero tillage practice of rice-wheat system of north-west India can also be diversified in wheat and after harvesting of wheat crop summer mungbean and direct seeded rice can be practiced to enhance the income of farmer and also helpful to reduce the Green House Gases (GHGs) emission.

1.6 Improved nutrient management practices

In case of delayed monsoon, late sowing of direct seeded rice affects the yield reduction which can be compensated by timely application of Nitrogen to get higher yields and in case of delay in transplanting of rice due to delay in south-west monsoon can be compensated by using neem oil coated urea.

1.7 Integrated farming system:

Integration crop production along with livestock, backyard poultry, agro-forestry, fish culture etc., helps farmers to raise their income and livelihood.

2. Climate resilient technologies for horticultural crops (Vegetables)

2.1 Selection of location specific crop and cultivar

Crops suitable for rain-fed cultivation of vegetables are cowpea, drumstick, brinjal, cluster bean, okra, dolichos bean, lima bean, chilli. Among them vegetable crops, legume vegetables are most suitable for contingency crop-planning in the event of delay in monsoon. Selection of cultivars with good root

system and ability to recoup during the stress and short duration.

2.2 Production of seedlings using improved method

Use of Protray grown seedling using cocopeat instead of using soil under shadenet cover. Bio-fertilizer or bio-pesticides can be used for uniform disease free seedlings at nursery. These seedlings will establish quickly and has less damaged root system during transplanting and sustain better during biotic and abiotic stresses specially in water stress.

2.3 Crop residues to enhance soil organic matter

Incorporation of plant residues in soil and application of farm yard manure helps to improve the status of soil organic matter, soil structure, water holding capacity of constant efforts must be made to improve the soil organic carbon. Incorporation of crop residues and farmyard manure to soil improves the organic matter status, improves soil structure and soil moisture storage capacity. Organic matter in soil can be improved by opting alley cropping system, incorporation of green manure crops in the soil, crop rotation and agroforestry. For cultivation of vegetable crops proper organic matter needs to be maintained in the soil for faster growth of vegetable crops as the crops as short duration.

2.4 Foliar application micro nutrients

Timely application during water stress and drought of K and Ca is helpful for better growth and enhancement of yield in vegetables crops is essential. Due to foliar application the nutrients will be quickly absorb in plants which helps in overall development of the crop.

2.5 Water Resource Conservation

2.5.1 Micro irrigation

Drip irrigation system in vegetables is better than the traditional irrigation method for better quality of produce and also saves water around 30–50 per cent based on the crop season also helps to irrigate more area with the available water. Drip irrigation also helps in efficient use of fertilizers, weed control and saves manpower. The efficient use of water can be

achieved by using drip irrigation as the water drops will drop in the root zone area only. Drip irrigation have its own advantages such as faster growth and development of plants with higher yields in fruit crops. Drip irrigation easily adopted in chilli, brinjal, cauliflower and okra with paired row planting which is in practice by using one drip lateral in two crop rows. A considerable saving in water, increased growth, development and yields of fruits and vegetables and control of weeds, saving in labour under drip irrigation are the added advantages. Drip irrigation can be adopted in fruit crops and also to all vegetable crops including closed spaced crops like onions and beans. The saving in water is to the tune of 30–50% depending on the crop and season. Generally inline drip laterals having emitting point spaced at 30 cm distance and emitting at the rate of 2LPH is selected for vegetable crops. In crops like chilli, brinjal, cauliflower and okra paired row planting is practiced and one drip lateral is used for two crop rows.

2.5.2 Sprinkler irrigation system

The cost of laying of micro sprinkler irrigation system is less than the drip irrigation system, this method can be used in almost all fruit and vegetable crops depending on the availability of water and soil structure. It helps in summer to reduce the micro climate temperature and increases humidity which helps to vigorous growth to boost the higher production. By using micro sprinklers 20–30 percent water can be save.

2.5.3 Water saving method under limited water resources

Alternate furrow irrigation method is more popular. This type of method can be easily adopted even by making wide spread furrows in various crops such as capsicum, tomato, okra and cauliflower by irrigating alternate-furrows which helps to save 35–40 per cent of water.

2.5.4 Moisture conservation and soil conservation techniques

Tillage, mulching, zero tillage, contour cultivation, contour strip cropping, multi-cropping systems,

the practices for *in-situ* soil moisture conservation. The mechanical method for soil and moisture conservation are contour bench terracing, bunding, graded bunding, vertical mulching etc. to be adopted in drylands. The other practise to stop the runoff water is harvesting of rain water and recycling. The areas with rainfall around 500–800 mm are suitable for rain water harvesting. In farm ponds 10–50% of the runoff water can be collected and it will be used for life saving irrigation during water stress conditions in various crops.

2.5.5 Mulching in Vegetable Production

In this method soil is covered with plant residues or with plastic sheets which helps for water conservation and also helps to control weeds. Mulching is used in all fruit crops and vegetable crops by using crop residues as well as by using organic matter. Very recently plastic mulches are commonly used due to its advantages in efficient moisture conservation, weed control and ant to maintain soil structure. In vegetable crops a 30-micron thick polyethylene with width of 1 to 2 m is used. Raised bed system is used for laying the mulching sheets.

2.6 Wind breaks, hedges and intercropping

Tall growing trees to be planted along with the border of field to avoid the strong winds and adverse effect such as dry spell and high temperature. In orchards vegetable crops can be grown as intercrop during summer.

2.7 Protected cultivation of vegetables

Vegetable production can be taken under protected condition in peri-urban areas where climate is not favourable round the year that to in open fields. Under protective cultivation biotic and abiotic constraints will be avoided. Commonly suitable material protective structure are green houses, plastic or net house, tunnels, polyhouses etc. Simple structure as rain-shelter covered with polyethylene sheet also helps in producing crops by avoiding the excessive rainfall. The production is adversely affected in the vegetable crops *viz.*, tomato, onion and melons due to heavy rainfall and difficult to man-

age fungal foliar diseases and also difficult to manage due to improper aeration in soil, poor drainage facility and flower drop in crops. Net houses and shade nets are the better options to cope up with the heat waves of summer. It helps to reduce the high temperature and creates the microclimate and improves the humidity. By using shade net or net house the production can be enhanced in tomato, French beans and capsicum.

2.8 Management of leaf miner and mites during high temperature stress

By spraying neem soap 4 grams / liter or triazophos at the rate 1.5 ml / l of water leaf miners can be controlled and to manage mites, Abanectin 0.5 ml/l and to control Aphids may be observed in case of beans. Neem soap (1.0%) or kernel extract (4.00%) are also useful in control of leaf minor and mites.

3. Climate resilient technologies for horticultural crops (orchards)

3.1 Abiotic stress tolerance varieties

Inclusion of varieties tolerance to abiotic stress in orchards *viz.*, Pomogrante (Ruby hybrid), Annona (Arka Sahana hybrid), Fig selection (Deanna and Excel) are the drought tolerant cultivars to be included in the cropping system. Dogris (Vitis champine) also promising cultivar for crop growth, yield and also suitable for seeded and seedless grapes with drought tolerant and sustains in saline soil.

3.2 Water management in orchard

Application of water in root zone area in water is very important for proper growth to boost higher yields it helps to save water, timely irrigation and quantity of water plays an important role. Shifting from traditional method of irrigation with channels can be replaced with drip irrigation or micro spray for effective and efficient use of water.

3.3 High-density planting in orchards

In lighter soils row spacing 10 m. and line spacing 5 m. is good to accommodate more number of trees to get the higher yields and it is possible with the recent technologies of high density planting. Same thing is applicable in heavy clay soils row spacing

may be 10 m. and line spacing is 8 m. subject to selection of less vigorous varieties in case of mango.

3.4 Agri-horti-silviculture and canopy management

Cultivation of legume-based pastures and leguminous crops are beneficial for orchards to add more fertilizers or fertilizers can be avoided to cut down the cost of cultivation and helpful for the farmers to get an extra income from the same land. Managing tree canopy helps to harvest good quality fruits.

3.5 Soil organic matter

Application of organic matter in various forms in orchard such as animal manures, wood chips mulches, deep rooting ground covers, leguminous pastures helps to maintain good soil structure and drainage. Enhances water holding capacity, good root health, nutrient cycling and good organic carbon levels.

3.6 Integrated pests and disease management

Use of suitable planting methods such as crop rotation in orchard crops between rows, planting of resistant plant varieties, use of pest-free rootstock. These methods are very useful and in terms of cost

reduction and lower risk to human health as well as environment.

4. Conclusions

The ever-increasing global population has put burden on the agricultural production system. The ways to increase the productivity of these crops using various means needs to be explored as there is less scope for area expansion. Climate change has further put burden on the crops as it is expected to increase the various biotic and abiotic stresses on crops making crop production systems suffer further. We need to use appropriate climate resilient technologies and approaches to ward off various new insect pests, diseases and hitherto unheard stresses and increase the productivity to feed the global population without compromising on the quality of the produce. A holistic climate resilient technologies consisting of conventional and modern approaches including climate resilient varieties, water conservation strategies and biomolecules for the management of emerging pests needs to be employed to get the optimum yields under changing climate.

References:

1. Abewoy D. Review on Impacts of Climate Change on Vegetable Production and its Management Practices. *Adv Crop Sci Tech* 6: 2018.– 330 p. Doi:10.4172/2329-8863.1000330.
2. Jeetendra Prakash Aryal, Meera Bhatia Mehrotra, Jat M.L. and Harminder Singh Sidhu. Impacts of laser land leveling in rice-wheat systems of the north-western indo-gangetic plains of India. 2015. DOI 10.1007/s12571-015-0460-y.
3. Venkateswarlu B., Sikka A. K. Climate Resilient Crop Varieties for Sustainable. Food Production under Aberrant Weather Conditions. National Innovations on Climate Resilient Agriculture. NICRA/2015/ Bulletin – No. 4. 2015.
4. Sudhakar B., Prabhu Kumar N., Singh S., Gogoi A. K., Singh A. K., Singh Y. V. and Mishra A. Smart Practices and Technologies for Climate Resilient Agriculture. 2014.
5. Bernstein L., Bosch P., Canziani O., Chen Z., Christ R., & Riahi K. (2008). IPCC, 2007: Climate Change 2007: Synthesis Report. – Geneva: IPCC. ISBN2–9169–122–4.
6. De U. S. and Mukhopadhyay R. K. “Severe heat wave over the Indian subcontinent in 1998, in perspective of global climate”, *Current Science* – 75, 12. 1998.– P. 1308–1311.
7. Harish Chandra Prasad Singh, Nadipynayakanahally Krishnamurthy Srinivasa Rao and Kodthalu Seetharamaiah Shivashankara (2013). *Climate-Resilient Horticulture: Adaptation and Mitigation Strategies*. ISBN978–81–322–0974–4 (eBook).

8. Hingane L. S., Rupa Kumar K. and Ramana Murthy Bh. V. "Long-term trends of surface air temperature in India", *J. Climatol.* – 5. 1985.– P. 521–528.
9. IPCC Summary for Policymakers Climate Change 2014. Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects (eds Field, C. B. et al.) (Cambridge Univ. Press, 2014).
10. Jignasa Rajatiya D. K. Varu Preeti Gohil, Meera Solanki, Farheen Halepotara, Maheswari M., Sarkar B., Vanaja M., Srinivasa Rao M., Srinivasa Rao Ch., Mulji Gohil, Pooja Mishra and Rutu Solanki. Climate Change: Impact, Mitigation and Adaptation in Fruit Crops. *International Journal of Pure & Applied Bioscience.*– Vol. 6 (1). 2018.– P. 1161–1169.
11. Malhotra S. K. and Srivastava A. K. Climate smart horticulture for addressing food, nutritional security and climate challenges. (In) *Shodh Chintan- Scientific articles*, by Srivastava A. K et al. ASM Foundation, – New Delhi, 2014.– P. 83–97.
12. Pant G. B., Rupa Kumar and Borgaonkar K. H. P. Climate and its long-term variability over the western Himalaya during the past two centuries. *The Himalayan Environment* (Eds. S. K. Dash and J. Bahadur), New Age International (P) Limited, Publishers, – New Delhi, 1999.– P. 172–184.
13. Malhotra S. K. Mission approach for development of protected cultivation. *New Age Protected Cultivation* – 1(1). 2015.– P. 29–32.
14. Prabhakar Adhikaria, Hailu Arayab, Gerald Arunac, Arun Balamattid, Soumik Banerjee, Baskaran P., Barahg B. C., Debaraj Beherah, Tareke Berhei, Parag Boruahj, Shiva Dharg, Sue Edwardsk, Mark Fulfordl, Biksham Gujjam, Harouna Ibrahimn, Humayun Kabiro, Amir Kassamp, Ram B. Khadkaq, Komar Y. S., Natarajanm U. S., Rena Perezs, Debashish Sent, Asif Sharifu, Gurpreet Singhv, Erika.
15. Stygerw Amod K. Thakurx Anoop Tiwariy, Norman Uphoffz and Anil Vermaa. *International Journal of Agricultural Sustainability.* 2018.– Vol. 16.– No. 1.– P. 1–28.
16. Prasad Y. G., Maheswari M., Dixit S., Srinivasarao Ch., Sikka A. K., Venkateswarlu Rupakumar K., K. Krishna Kumar and G. B. Pant: 1994. 'Diurnal asymmetry of surface temperature trends over India', *Geophy. Res. Let.* – 21. 677–680
17. Singh N. and Sontakke N. A. "On climatic fluctuations and environmental changes of the Indo-Gangetic plains, India", *Climatic Change* – 52, 2002.– P. 287–313.
18. Singh R. S., Narain P. and Sharma K. D. "Climate changes in Luni river basin of arid western Rajasthan (India)", *Vayu Mandal* – 31(1–4). 2001.– P. 103–106.
19. Spaldon S., Samnotra R. K. and Chopra S. Climate resilient technologies to meet the challenges in vegetable production. *International Journal of Current Research and Academic Review.*– Vol. 3(2). 2015.– P. 28–47.
20. Srivastava H. N., Dewan B. N., Dikshit S. K., Rao G. S. P., Singh S. S. and Rao R. "Decadal trends in Climate over India", *Mausam* – 43. 1992.– P. 7–20.
21. Sonja J. Vermeulena B., Andrew J. Challinora C., Philip K. Thorntona D., Bruce M. Campbella E., Nishadi Eriyagamaa F., Joost M. Vervoorta G., James Kinyangia D., Andy Jarvisa E., Peter Läderacha E., Julian Ramirez-Villegasa C. E., Kathryn J. Nicklinc Ed Hawkinsh, and Daniel R. Smithc. Addressing uncertainty in adaptation planning for agriculture. *Proc. Natl Acad. Sci. USA* 110, 2013. – P. 8357–8362.
22. Venkateswarlu B. and Shanker A. K. Dryland agriculture: bringing resilience to crop production under changing climate. (In) *Crop Stress and its Management: Perspectives and Strategies.* Springer, Netherlands, 2012.– P. 19–44.

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*Baratova Mohidil Rakhimovna,
Teacher, Ph D. (Chemistry). Deputy Professor,
Andijan branch of Tashkent state Agrarian University, Uzbekistan
E-mail: mbaratova1975@gmail.com*

*Xidirova Nazira Kudratovna,
Deputy professor, Ph D. (Agriculture sciences). Deputy Professor,
Institute of chemical substance of the plants. Tashkent city Uzbekistan*

EFFICIENCY OF THE TECHNOLOGY OF GROWING ECOLOGICALLY POOR PUMPKIN WITH USING BIO STIMULATORS

Abstract. An improving of the technology of product growing is basic factor for increasing product volume in order to ameliorate of ensuring world people with food staffs. Using of bio stimulator in the conditions of grey pasture soil as a untraditional organic fertilizer had justified yourself from point of view economic efficiency. In the conditions of poster soil using bio stimulator as a untraditional fertilizer allows to increase a volume of humus in the structure earth.

Keywords: pumpkin, bio-stimulator, productivity, economic efficiency, seed-growing, humus, organic fertilizer.

Topicality of the problem. Improving of the technology of product growing is basic factor for increasing product volume in order to ameliorate of ensuring world people with food staffs. A pumpkin fruit has very important significance for satisfying population demand for food staff and industry within row material, so increasing its' productivity is one of the urgent problems in developing countries. It is scientifically justified that a pumpkin should be eaten by man during year systematically that is in constant volume. But, in order to achieve this goal available cultivated land should be used rationally and productivity has to increase intensively [10, 212–216].

Cultivating sorts' of the pumpkin had origination from America continent. If a pumpkin with big fruit originated from South America, but hard bark pumpkin from Northern America and Muscat pumpkin appeared in Central America and Southern Mexico. Results of the archaeological digs in America continent herald us that cultivated sorts of the pumpkin were known to humankind in the 3

century BC. A pumpkin got Europe and Asia from America and it was wide spread in many countries of these continents. A pumpkin was sown in Portugal, Spain and France first of all. Pumpkins were brought to England in the beginning of XVIII century, but in the south part of Russia it begun to sow from XIX century. This culture was very wide spread in Kazakhstan and Central Asia region at that time [5, 10–13].

A reason of necessity of growing pumpkin in huge volume is linked its' consumption and treatment peculiarities. That is pumpkin tree is a keeper of health of human. A carbon water, oils and carbohydrates are additional food for man's health. A pumpkin structure has more than 50 useful biological active materials. Besides, pumpkin is reach for mineral salts' units, carbon waters, different oils, acrobatically acid, retinolium, thiamine, hepatoflavin, nicotine acid and vitamins. If C vitamin is missing in the human body it may cause such diseases zinc and anemia, if a vitamin is missing a body growth is slowdown and

eye vision may get turbid. Vitamin B1 and Vitamin B2 enter ferments which are participating in the exchange of oils and carbohydrates. In order to ensure an organism with vitamins A, B1 and B2 2–3,5 milligram necessarily to eat vitamin C 50–120 mg and PP 15–25 mg during a day.

Growing ecologic poor product with using bio-simulators is advanced in such countries as France, Ukraine, Russia and Netherlands. For instance, in Sol province of Netherland organized growing poor potato without chemical drugs and fertilizers. That is, a potato is feeding with only organic fertilizers and fighting against diseases and insects are conduct by using technical methods. 1 kg of this potato sell on the world market 8 euro per kg nevertheless consumers' potato grown with using mineral fertilizers sells on the world market 2 or 3 euro per kg.

However, it is worthy to underline that while significant steps had done in the world for growing ecological poor product, cultivating food products without using chemical drugs and by using bio stimulators is one of the very urgent tasks. First of all, this method ecological poor and secondly, very economical from point of view of production expenses. It means that conducting new scientific studies in this field is very actual problem of the society and science in Uzbekistan.

Uzbekistan is a developing country and reforms in agriculture sphere intended onto improving food supply of the population. 2007 year vegetables were sown on 159,8 hectare land, and received yield 4669,9 ton total crop, but in 2010 year a total volume of the crop was 6346,4 ton and per person product had been increased till 192 kg. This indicator was equal to 145 thousand ton in 2018 year. Vegetables and melon growing are one of the significant branches of the agriculture sphere in Uzbekistan, because on the available 3.5 mln arable land 213 hectare or 4,9 percent uses for growing vegetables melon growing and potato. Local experts underline that every person who lives in Central Asia region should eat 63,9 kg potato, 113 kg vegetables and 98 kg melon grow-

ing products per year. In order to satisfy claims of the health care organizations, 5–5,5 mln ton vegetables, 1,5 consumable potato, and 2,3–2,4 mln ton melon growing products should be cultivated for full satisfaction a demand of the Uzbekistans' population.

Plant feeding is very significant for pumpkin growing especially for pumpkin's seed. Increasing productivity with additional feeding is very important and this information is obvious for many people [7, 7–8] in the book "Vegetables and melon growing products seeds" pointed out to main key situations of the pumpkin's growing agriculture technics and very useful recommendations. They had gave very large recommendations about sowing chart: they outlined pumpkin sowing chart as $(330 \times 70) \times 100/2$. In this chart it is possible receiving 6600 seedlings per hectare. It was underlined that in this chart it is possible to receive 25–30 ton harvest from each hectare from pumpkin sorts Spanish-73 and Palov Kadu [7, 8–12]. Three type of pumpkin growing in Uzbekistan: maxima, mascata and pepo. Spanish-73 is belongs to pumpkin with big fruit, "Palov Kadu" and "Qashqar" to mascat, and Kabachka and Patisson to hard bark sort.

It was conducted field experiment in Andijan region of Uzbekistan with an aim for increasing pumpkin productivity by applying bio stimulators technology, to select prospective sorts of pumpkin, to work out seed growing agriculture technology, developing recommendation to farm facilities for cultivation selected sorts on the fields. The next tasks were done during two years:

- to sow on the 0.5 hectare field of Andijan experimental scientific station the pumpkin Spanish-73 sort, 0.5 hectare of the experimental field of "Naynavo oqshomi" farm pumpkin sort "Palov Kadu – 268";
- to learn an effect of the bio stimulators of "Verva", "Uchqun", "Super uchqun", "Gossiprin" on pumpkin productivity and augment seeds;
- conducting phenologic observations in each variance;
- conducting bio metric measurements (length of the plant and its lateral leaves, number of the twigs);

- valuing of the seed fruits coming of morphological signs (height, width, diameter, color, cobweb, width of womb, epidermis thickness;
- defining productivity (fruit and seed);
- estimating economic efficiency.

A methods of research: methods of the conducting field experiments, methods of conducting field researches on vegetables, melon growing and statistical data observations.

Places of field experiment, soil and climate conditions. Experiments conducted on the 0.5 hectare of experimental fields of the Andijan scientific experimental station of growing potato vegetables and melon growing, and Andijan region “Shaxrixon” district “Naynavo” farm field in the 2018–2019 years. A weather of experimental fields seems similar because of they situated in one region and looks like identical with other farms specialized in growing vegetables on the plain lands of Uzbekistan. A temperature of the places very variable, rainy, annual volume of precipitations is 200–225 mm. Relative humidity of the weather’s in summer season is averaged 35–40%. Winter season is cold and dew drop. The most cold month is January (–15, –18 grade). The most hot month is July. (+35, +44 grade).

Results of the field experiment. A). Preparing seeds to sow and growing them. Before sowing seeds were observed and defected ones had been separated by hand and planned to use 5 kg/he seed. Pumpkin’s sort Spanish-73 and Palov Kadu-268 were processed with bio stimulators of Verva, Uchqun, Super Uchqun and Gossiprin and then sown directly into earth. Sowing process was organized in this way: one day before sowing seeds had put into Verva, Uchqun, Super Uchqun and Gossiprin bio stimulators tinc-

ture in the proportion 200 ml/kg for infusion and then drying. Because of Uchqun and Super uchqun bio stimulators has liquid shape, Gossiprin one is powdery and Verva resinous, first of all they were weighted, then prepared tincture. As soon as seeds had grew out from earth they were processed within pitchblende fodder prepared with using 2 liter plant oil, 2 kg Chlorophos chemical preparation and 40 kg oilcake per hectare against such insects as rootworm, shortwire maggot and calfhead and etc. By means this method it was possible to save all seedlings:

1. For the 0,5 ga field spent 2,5 kg seed of pumpkin sort of Spanish-73.

2. For the 0,5 ga field spent 2,5 kg seed of pumpkin sort Palov Kadu 268.

3. For ensuring seeds growing up on time and smooth a soil humidity had been kept on the level 85–90%.

4. Using pitchblende fodder for saving seedlings from harmful insects gave positive results.

A field of increasing pumpkins’ seeds. Seeds of the pumpkin were sown on the experimental fields on 10th April of 2018 year after processing with bio stimulators. Accordance of seed-growing methods, an isolated zone had been created in the size 1000 meter around experimental field. All agro technic tasks were carrying out strictly of claims of method of seed-growing.

Results of the phenological observation of field experiment. A time of grow out of seeds: seeds processed with bio stimulators were sown on 10th April of 2019 accordance of field design and satisfactorily watered. On the day of sowing a grade of air was observed +20 +22 °C and soil grade by +18 +20 °C. As a result seeds grow out in the next time vary.

Table 1.– Andijan scientific experimental station field

Sort name	Years	Time of sowing	1-v	2-v	3-v	4-v	5-v
Spanish-73	2018	20.04	29.04	28.04	26.04	25.04	27.04
Spanish-73	2019	10.04	16.04	16.04	15.04	14.04	16.04

As it seeing above illustrated variables of table, day of grows out have some differences among variances on the Andijan scientific experimental station field. In first variance difference consists 6 days, in second vari-

ance 6 days, in third variance 5 days, in fourth variance 4 days and in fifth variance 6 days. But, in 2018 year in 1 variance 8.8 days, in 2 variance 8 days, in 3 variance 6.2 days, in 4 variance 5.2 days and in 5 variance 7.4 days.

Table 2. – Andijan branch of TSAU field

Sort name	Years	Time sow	1-v	2-v	3-v	4-v	5-v
Spanish-73	2018	20.04	29.04	28.04	26.04	25.04	27.04
Spanish-73	2019	10.04	16.04	16.04	15.04	14.04	16.04

As seen in the table above, grow-out of seed on the field of Andijan branch of TSAU in 2019 year in all variances had some differences: 1 day in 1 variance, 2 day in 2 variance, 5 day in 3 variance, 4 day

in 4 variance, and 6 day in 5 variance. But, in 2018 year these variances had next differences: 1 variance 8.8 days, 2 variance 8 days, 3 variance 6.2 days, 4 variance 5.2 days, and in 5 variance 7.4 days.

Table 3. – “Naynavo oqshomi” farm filed

Sort name	Years	Time of sow	1-v	2-v	3-v	4-v	5-v
Palov Kadu- 268	2018	20.04	29.04	28.04	26.04	25.04	29.04
Palov Kadu –268	2019	10.04	17.04	16.04	16.04	15.04	16.04

Grow-out of seed on the field of “Naynavo oqshomi” farm filed in 2019 year in all variances had some differences: 7 day in 1 variance, 6 day in 2 variance, 6 day in 3 variance, 5 day in 4 variance, and 6 day in 5 variance. But, in 2018 year these variances had next differences: in 1-variance 9 days, in 2-variance 8 days, in 3 variance 6.4 days, in 4 variance 5.2 days, and in 5 variance 7.8 days. Thus, during 2018 and 2019 years was observed that in the 3 and 4 variances seed grow out time was shortest than in other variances. A seed grow out in shortest time have the next positive sides: firstly – a time of plant growing shortening (fruit got ripe quickly), second-

ly – a level of decay and getting harmful from ground thrust decreased comparing with control variance in spring season of year.

Agro technique actions (fertilize, watering, chop) carry out had been organized coming of the recommendations of the textbook “Seed-growing of vegetables and melon growing” of R. A. Rakhimov, A. S. Khakimov and A. A. Toshmammedov. [3]. Although in all variances agriculture technology tasks were carry out similarly depends on the bio stimulators feed quantity it was observed differences in the phases of plant growing and evovement.

A time of budding phase

Table 4. – Andijan scientific experimental station field (Spanish-73 sort)

Years	1-v	2-v	3-v	4-v	5-v
2018	10.06	07.06	06.06	04.06	08.06
2019	24.05	22.05	21.05	19.05	23.05

If to compare phase of plants budding of 2019 and 2018 years, a time gap between grow out and total budding consisted 42 days in 1 variance, 40 days in 2 variance, 41 days in 3 variance, 40 days in 4 vari-

ance and 42 days in 5 variance in 2018 year. In 2019 these variables were: 38 days in 1 variance, 36 days in 2 variance, 36 days in 3 variance, 35 days in 4 variance and 37 days in 5 variance.

Table 5. – “Naynavo oqshomi” farm (Palov Kadu –268 sort):

Years	1-v	2-v	3-v	4-v	5-v
2018	08.06	07.06	04.06	03.06	06.06
2019	26.05	25.05	23.05	21.05	26.05

Comparing budding phase results in 2018 year had the next values from time grow out and total budding 40 days in 1-variance, 40 days in 2-variance, 39 days in 3-variance, 39 days in 4-variance, 38 days in 5-variance. In 2019 these variables were: 39 days in 1 variance, 39 days in 2 variance, 37 days in 3 variance, 36 days in 4 variance and 40 days in 5 variance. Shortening time of grow brought about to early flourishing of plants.

If to compare a phase of flourishing plant by sowing variances of 2018 year, there are next time disparities 1-variance 51 day, 2-variance 49 day, 3-variance 49 day, 4-variance 48 day and in variance 51 days but in 2019 year the next variables observed: 1-variance 49 day, 2-variance 45 day, 3-variance 43 day, 4-variance 43 day and 5-variance 46 days accordingly.

If to compare a phase of flourishing plant by sowing variances of 2018 year, there are next time disparities 1-variance 51 day, 2-variance 49 day, 3-variance 49 day, 4-variance 48 day and in variance 51 days and in 2019 year the next variables observed: 1-variance 49 day, 2-variance 45 day, 3-variance 43 day, 4-variance 43 day and 5-variance 46 days accordingly.

Flourishing phase of plants on the field “Naynavo” farm in 2018 year has the next time disparities by variances: 1-variance 51 day, 2-variance 50 day, 3-variance 51 day, 4-variance 51 day, 5-variance 48 days. In 2019 year these variables has next values: 1-variance 48 day, 2-variance 47 day, 3-variance 45 day, 4-variance 45 day, 5-variance 49 days. Besides, flourishing phase in 3 and 4 variances were early and when were used bio stimulators “Uchqun” and “Super uchqun” time of flourishing shortened. It allowed to enter the plants into phase of procreate earlier.

According of the above illustrated table data, in 3 and 4 variances length of leafs and and latter twigs number has similar values all experimental field

of “Andijan scientific – experiment station”, and “Naynavo oqshomi” farm. This results’ allowed grow up qualitative and big fruits besides growing additional fruits on the latter twigs. As it seen above table calculated variables about phase of procreate on the all experimental fields in 3 and 4 variances began little bit early. If period of flourishing and procreating may match with beginning of hot days of summer season it is possible to observe falling of flowers and fruit elements. Accordance of the received results of from experiments in that variances when seeds were processed with bio stimulators “Uchqun” and “Super uchqun” phase of flourishing and procreating begins early. It allows to crease productivity and to improve quality of fruit. Pumpkin growth agro technics were carry out accordance of the methodical guide of the scientific research institute of vegetables, melon grown and potato studies.

Economic efficiency. Coming of the results about increasing productivity that a number of 6600 plant unit per hectare it was registered the next variables values:

Andijan scientific experimental station field. Spanish-73 sort

1-variance: control one, and total expenses not exceeded from indicated criterion indicated in the methodical guide. This was recognized as a zero expense. Productivity consisted 25,9 ton per hectare.

2-variance: 200 gram Gossiprin bio stimulator purchased for 20000 Uzbek soum and after processing seeds 5 kg were sown per 1 hectare. Exceeded expense was 20000 Uzbek soum for purchase bio stimulator Gossiprin. Yielded additional crop was equal to 2300 kg pumpkin in the 2 variance. Taking into count that fact that market price for 1 kg pumpkin was 1000 Uzbek soum per kg, total profit consisted 2.3 million Uzbek soum. But, additional

net profit consisted 2.280 million Uzbek soum that is “2300000–20000 =2280000”.

3-variance: 200 gram Uchqun bio stimulator purchased for 20000 Uzbek soum and after processing 5 kg seeds were sown per 1 hectare. Exceeded expense was 20000 Uzbek soum. Yielded additional crop was equal to 4300 kg in 3 variance. If to take into count that fact market price of 1 kg pumpkin was 1000 Uzbek soum, total profit consisted 4.3 million Uzbek soum. Additional net profit was equal to 4.280 million Uzbek soum that is “4300000–20000 = 4280000”.

4-variance: 200 gram bio stimulator “Super-uchqun” purchased for 20000 Uzbek soum and after processing 5 kg seeds were sown per 1 hectare. Ex-

ceeded expense was 20000 Uzbek soum. Yielded additional crop in the 4 variance was equal to 6100 kg and if take into count market price 1000 Uzbek soum for 1 kg pumpkin, total profit consisted 6.1 million Uzbek soum. But, additional net profit was equal to 6100000–20000=6080000 Uzbek soum.

5-variance: 200 gram bio stimulator Verva purchased for 10000 Uzbek soum and after processing 5 kg seeds were sown per 1 kg. Exceeded expense was 10000 Uzbek soum. Yielded additional crop in the 5 variance was equal to 900 kg. Taking into count market price 1000 Uzbek soum per kg, total profit consisted 900000 Uzbek soum. Additional net profit was equal to 900000–10000=890000.

Table 6. – “Naynavo oqshomi” farm field. Palov Kadu –268 sort:

Variances	Number fruits per plants		Weigh of fruit(kg)		Productivity (c/he)	
	2018	2019	2018	2019	2018	2019
1	1.2	1.3	2.7	2.72	213	233
2	1.6	1.3	2.22	2.74	234	235
3	1.8	1.4	2.33	2.8	277	258
4	1.7	1.5	2.73	3.0	306	29.7
5	1.5	1.4	2.46	2.6	243	240

1 variance: control one, and total expenses not exceeded from indicated criterion indicated in the methodical guide. This was recognized as a zero expense. Productivity consisted 23,3 ton per hectare.

2-variance: 200 gram Gossiprin bio stimulator purchased for 20000 Uzbek soum and after processing seeds 5 kg were sown per 1 hectare. Exceeded expense was 20000 Uzbek soum for purchased bio stimulator Gossiprin. Yielded additional crop was equal to 200 kg pumpkin in the 2 variance. Taking into count that fact that market price for 1 kg pumpkin was 1000 Uzbek soum per kg, total profit consisted 200000 Uzbek soum. But, additional net profit consisted 198000 million Uzbek soum that is “2000000–20000 =198000”.

3-variance: 200 gram Uchqun bio stimulator purchased for 20000 Uzbek soum and after processing 5 kg seeds were sown per 1 hectare. Exceeded expense was 20000 Uzbek soum. Yielded additional crop was

equal to 2500 kg in 3 variance. If to take into count that fact market price of 1 kg pumpkin was 1000 Uzbek soum, total profit consisted 2.5 million Uzbek soum. Additional net profit was equal to 2.5 million Uzbek soum that is “2500000–20000 =2480000”.

4-variance: 200 gram bio stimulator “Super-uchqun” purchased for 20000 Uzbek soum and after processing 5 kg seeds were sown per 1 hectare. Exceeded expense was 20000 Uzbek soum. Yielded additional crop in the 4 variance was equal to 6400 kg and if take into count market price 1000 Uzbek soum for 1 kg pumpkin, total profit consisted 6.4 million Uzbek soum. But, additional net profit was equal to 6400000–20000=6380000 Uzbek soum.

5-variance: 200 gram bio stimulator Verva purchased for 10000 Uzbek soum and after processing 5 kg seeds were sown per 1 kg. Exceeded expense was 10000 Uzbek soum. Yielded additional crop in the 5 variance was equal to 700 kg. Taking into count

market price 1000 Uzbek soum per kg, total profit consisted 700000 Uzbek soum. Additional net profit was equal to $700000 - 10000 = 690000$.

Conclusion

1. Using of bio stimulator in the conditions of grey pasture soil as a untraditional organic fertilizer had justified yourself from point of view economic efficiency. Coming of above mentioned facts recommend to farm heads to use bio stimulator as the best organic fertilize for increasing pumpkin plants productivity.

2. In the conditions of poster soil using bio stimulator as a untraditional fertilizer allows to increase a volume of humus in the structure earth. Though humus had splatted during period of plant growing in the variances of experiment with comparing control was observed exceeded volume on 0,06–0,05%.

3. During the period of growing mobile food elements in the field of experiment not changed. (in the beginning growing period, in the period of flourishing and in the end of harvesting).

4. Because of increased level of feeding elements in the variances 3 and 4 they affected on pumpkin's growth and evelvement positively. As a result it was observed high rates of height, crop elements and collected harvest on the field of experiment.

5. Coming of the results, Spanish-73 sort in the variances 3 and 4 productivity were high comparing with control one. In the control variance yielded per hectare 25,2 ton fruit, 136 of its seed of fruit, in the 2 variance 27,5 ton fruit and 157 kg seed, in the 3 variance 29.5 ton fruit and 175 kg seed, in the 4 variance 31.3 ton fruit and 209 kg seed, in the variance 26,1 ton fruit and 149 seed. A main result is that it was created gene pool of qualitative seed.

6. Using bio stimulators for growing pumpkin justify themselves as a organic fertilizer from economic point of view. As showed in results of economic efficiency, in the 2 variance received 180000, in the 3-variance 2480000, 4-variance 6380000 and in the 5-variance 690000 Uzbek soum profit earned.

References:

1. Baratova M., Xidirova N., Qosimova S. H., Environmentally friendly method of cultivation of sport pumpkin Spanish-73, XIII International Symposium on the Chemistry of Natural compounds, Shanghai, Chine, October 16–19, 2019.– 73 p.
2. Berdiev E. T., Ahmedov E. T. Natural curative plants, Tashkent “UzbR AC”, 2018.– 188 p.
3. Baratova M., Xidirova N., Qosimova S. H. A study of influence of bio stimulators on local sorts of pumpkin, Ecologic questions of saving, recreation and protecting of “Soth Orol sea” biodiversity, International scientific practical conference, Nukus, 2018.– P. 79–81p.
4. Abdulov I., Usmonxodjaev G., Baratova M. Study if usefull features of pumpkin and improving of growing. Republican scientific and practical conference “Current situation of genetics in Uzbekistan, problems and prosperity”,– Tashkent, 2018.
5. Baratova M. R., Sariboeva N. N., Baratova M. E., Improving growing of local sorts of pumpkin and evelvement of seed-growing, International scientific journal “Put nauki”,– Volgograd, 2018.– No. 4.– P. 10–13.
6. Akhmedov E. T., Berdiev E. T. Technology of growing curative plants, Tashkent, “UzbR.AC”, 2017.– 156 p.
7. Khakimov R. A., Mavlanov M. F. A Cataloge of local sorts of potato vegetables and melon growing.– Tashkent. 2016.– 85 p.
8. Tuxtaev B. Y. and others. A guide on organizing of the plantations of curative and feed plants, preparing row material,– Tashkent, 2015.– 144 p.
9. State reestr of the plants recommended for growing on the territory of republic of Uzbekistan,– Tashkent, 2014.
10. Ahmedov O., Ergashev A., Abzalov A., Yuilciev M. Technology of growing medicine plants and ecology,– Tashkent, 2009.– 216 p.

Section 7. Physics

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Rasulov Voxob Rustamovich,
associate professor, of Fergana State University

Rasulov Rustam Yavkachovich,
professor, of Fergana State University

E-mail: r_rasulov51@mail.ru

Axmedov Bahodir Bahroovich,
doctoral student of Fergana State University.

Muminov Islombek Arabboyevich,
doctoral student, of Fergana State University

Polvonov Baxtiyor Zaylobidinovich,
associate professor, of Ferghana Polytechnic Institute

LINEAR-CIRCULAR DICHROISM OF ONE-PHOTON ABSORPTION OF LIGHT IN NARROW-ZONE SEMICONDUCTORS. CONTRIBUTION OF THE EFFECT OF COHERENT SATURATION

Abstract. The matrix elements of optical transitions, the spectral and temperature dependences of the one-photon absorption coefficient of polarized radiation were calculated, and the linear-circular dichroism in narrow-gap semiconductors was investigated taking into account the effect of coherent saturation.

Keywords: narrow-gap semiconductor, absorption of polarized light, linear-circular dichroism, coherent saturation.

The nonlinear in intensity of both one- and multiphoton absorption of polarized radiation in semiconductors with a complex valence band was researched in [1–9], where direct intersubband optical transitions were taken into account and it was believed that the nonlinearity in the dependence of the one-photon absorption coefficient on the intensity arises due to the effect of coherent saturation of absorption, which is due to a photo-induced change in the nonequilibrium distribution functions of holes.

However, the contribution of the effect of coherent saturation of absorption of polarized radiation [3; 4] to single-photon linear-circular dichroism caused by direct between optical band transitions in narrow-gap semiconductors, where the Kane model [10] can be used, remains open, to which this work is devoted. Therefore, we will consider this contribution in the region of light intensity, where perturbation theory is applicable. As indicated in [9], in order to take this contribution into account, it is necessary to make a substitution under the sum sign in the expression for

the probability of optical transitions from state $|\vec{k}\rangle$ to $|\vec{k}'\rangle$: instead of the nonequilibrium distribution function of current carriers $f_l(E_l(\vec{k})) - f_l(E_l(\vec{k}'))$, it is necessary to replace by $(f_{l\vec{k}}^{(0)} - f_{l\vec{k}'}^{(0)}) \times (f_{l\vec{k}}^{(0)} - f_{l\vec{k}'}^{(0)}) \left[1 + 4T_{l\vec{k}} T_{l\vec{k}'} \hbar^{-2} |M_{l\vec{k}, l\vec{k}'}|^2 \right]^{-1/2}$, where $T_{l\vec{k}}$ and

$$K^{(1)}(\omega, T) = \frac{2\pi}{\hbar} \frac{\hbar\omega}{I} \sum_{l, l', \vec{k}} (f_{l\vec{k}} - f_{l'\vec{k}}) |M_{l\vec{k}, l'\vec{k}}|^2 \delta(E_{l\vec{k}} - E_{l'\vec{k}} - \hbar\omega), \quad (1)$$

where $I = \frac{n_\omega \omega^2 A_0^2}{2\pi c}$ is the light intensity, $E_{l\vec{k}}$ is the energy spectrum of current carriers in the subband l , n_ω is the refractive index of light at the frequency ω . The rest of the values are generally known.

Next, we will consider single-photon absorption of light and its linear-circular dichroism in narrow-gap semiconductors. In a spherically symmetric approximation in the energy spectrum of current carriers, one-photon nonlinear radiation absorption in semiconductors with a degenerate band structure was researched in [2], where it was shown that the absorption coefficient of light decreases with increasing intensity.

Further calculations will be performed in the two-band approximation (Kane's model) [10; 11], where the energy spectrum of current carriers is spherically symmetric and the effective masses of heavy and light holes are determined by the relations (see formula (14.5) in [11])

$$(m_0/m_1) = -1 (m_0/m_1) = 4P_{CV}^2 / (3m_0 E_g). \quad (2)$$

As we can see, the two-band approximation incorrectly conveys the curvature of the heavy-hole

$$K_0^{(1)} = \frac{4\pi^2 e^2}{c\omega m_0^2 n_\omega} \sum_{s, l, m; \vec{k}} |\vec{e} \vec{p}_{cs, V_l m}(\vec{k})|^2 \delta(E_{c\vec{k}} - E_{V_l \vec{k}} - \hbar\omega) = \frac{4\pi^2 e^2}{c\omega n_\omega m_0^2} P_{cv}^2 \frac{1}{12} \left[6 \left(|\vec{e}_+|^2 + |\vec{e}_-|^2 \right) \rho_{c, \vartheta_1}^{(0)}(\omega) + \left(|\vec{e}_+|^2 + |\vec{e}_-|^2 \right) + 24 |\vec{e}_z|^2 \rho_{c, \vartheta_2}^{(0)}(\omega) \right], \quad (5)$$

where the reduced density of states (excluding spin degeneracy)

$$\rho_{c, \vartheta_2}^{(0)}(\omega) = \sum_{\vec{k}} \delta(E_c(\vec{k}) - E_{\vartheta_1}(\vec{k}) - \hbar\omega) = \frac{1}{2} \pi^{-2} \hbar^{-2} \mu_1 k_l^{(0)}, \quad (6)$$

μ_1 is reduced effective mass: $\mu_1 = (m_c^{-1} + m_l^{-1})^{-1}$ in the *InSb* $\mu_1 = m^*$, $\mu_2 = m^* / 2$; $k_l^{(0)} = \left[2\mu_1 (\hbar\omega - E_g) / \hbar^2 \right]^{1/2}$,

$T_{l\vec{k}}$ are the times of exit of current carriers from the saturation region in the bands with numbers l and l' , $f_{l\vec{k}}^{(0)}$, $(f_{l\vec{k}}^{(0)})$ is the equilibrium electron distribution function, $M_{l\vec{k}, l'\vec{k}}$ is a composite matrix element of the optical transition between the states $|\vec{k}\rangle$ and $|\vec{k}'\rangle$. Following [3], the one-photon absorption coefficient can be written in the form

branch (the correct curvature will be obtained only if the distant zones are taken into account). According to [11], in this approximation $(m_0/m_c^*) = 1 - (3E_g + 2\Delta_{SO})2m_0B / (\hbar^2(\Delta_{SO} + E_g))$, (3)

Note here that the Luttinger-Kohn parameters (see, for example, [11]) are related to the Kane parameter by the relations

$$D = -\hbar^2 P_{CV}^2 / (\sqrt{3}m_0^2 E_g), \\ A - B = \hbar^2 / (2m_0), \\ A + \frac{B}{2} = \frac{\hbar^2}{2m_0} - \frac{\hbar^2 P_{CV}^2}{2m_0^2 E_g}, \quad (4)$$

where the Kane parameters are determined by the relation $-iP_{CV} \delta_{\alpha\beta} = \int dx dy dz S(\vec{r}) \hat{P}_\alpha X_\beta(\vec{r})$, $X_\beta(\vec{r})$ is one of the basis functions defined according to (13.18) [11], where spin-orbit mixing with other bands is not taken into account.

The spectral dependence of the light absorption coefficient in narrow-gap semiconductors for direct between-band optical transitions, neglecting the non-parabolicity in the energy spectrum of current carriers, according to the formula:

index (0) indicates the neglect of non-parabolicity (and $\vec{k} \cdot \vec{p}$ mixing). It was assumed here that the final states of the current carriers are empty, and the initial states are completely occupied. Since $|\vec{e}_\pm|^2 = 2/3$ and $|\vec{e}_z|^2 = 1/3$ then

$$K_0^{(1)} = \frac{e^2}{cn_\omega} \frac{4\pi^2 4\pi}{(2\pi)^3} \frac{P_{cv}^2}{\omega m_0^2} \frac{2}{3} \sum_{l=1,2} \mu_l k_l^{(0)} \hbar^{-2} = \frac{e^2}{cn_\omega \hbar} \frac{E_g}{\hbar \omega} k_1^{(0)} \left(1 + \frac{1}{\sqrt{2}}\right) \quad (7)$$

(since in *InSb* $k_2^{(0)}/k_1^{(0)} = 1/\sqrt{2}$).

Note that taking into account non-parabolicity in the energy spectrum will lead to the following relation

$$K_0^{(1)} = \frac{4\pi^2 e^2}{c\omega n_\omega m_0^2} P_{cv}^2 \left\{ \frac{2}{3} a_c^2(k_1) \rho_{c,\vartheta_1}(\omega) + \left[\frac{2}{9} + \frac{4}{9} \left(\frac{E_g}{\eta(k_2)} \right)^2 \right] \rho_{c,\vartheta_2}(\omega) \right\}. \quad (8)$$

Here k_1 and k_2 they satisfy the law of conservation of energy:

$$\frac{1}{2} [E_g + \eta(k_1)] = \hbar\omega, \quad \eta(k_2) = \hbar\omega, \quad (9)$$

where $\eta^2(k_1) = (2\hbar\omega - E_g)^2$, $\eta^2(k_2) = (\hbar\omega)^2$,
 $E_g^2 + 2E_g \frac{\hbar^2 k_1^2}{2m^*} = (2\hbar\omega - E_g)^2$, $E_g^2 + 2E_g \frac{\hbar^2 k_2^2}{m^*} = (\hbar\omega)^2$,
 $k_1 = \left[m^* \hbar\omega \cdot 2 \cdot (\hbar\omega - E_g) / (\hbar^2 E_g) \right]^{1/2} = k_1^{(0)} \sqrt{\frac{\hbar\omega}{E_g}}$,

$$a_c^2(k_1) = \frac{\eta(k_1) + E_g}{2\eta(k_1)} = \frac{\hbar\omega}{\eta(k_1)},$$

$$k_2 = \left[m^* \left((\hbar\omega)^2 - E_g \right) / (2\hbar^2 E_g) \right]^{1/2} = k_2^{(0)} \sqrt{\frac{\hbar\omega + E_g}{2E_g}}.$$

For the reduced density of states, taking into account non-parabolicity, we have
 $\rho_{c,\vartheta_1}(\omega) = \frac{4\pi}{(2\pi)^3} k_1 \left/ \left(2 \frac{d}{dk^2} (E_c(\vec{k}) - E_{\vartheta_2}(\vec{k})) \right) \right.$, therefore,

$$\rho_{c,\vartheta_1}(\omega) = \rho_{c,\vartheta_1}^{(0)}(\omega) \frac{k_1}{k_1^{(0)}} \frac{\eta(k_1)}{E_g}, \quad \rho_{c,\vartheta_2}(\omega) = \rho_{c,\vartheta_2}^{(0)}(\omega) \frac{k_2}{k_2^{(0)}} \frac{\hbar\omega}{E_g} \quad (10)$$

So,

$$K^{(1)} = \frac{e^2}{\hbar c n_\omega} \frac{E_g}{\hbar\omega} k_1^{(0)} \left[\left(\frac{\hbar\omega}{E_g} \right)^{3/2} + \frac{1}{2\sqrt{2}} \left(\frac{1}{3} + \frac{2}{3} \left(\frac{E_g}{\hbar\omega} \right)^2 \right) \cdot \frac{\hbar\omega}{E_g} \cdot \left(\frac{\hbar\omega + E_g}{2E_g} \right)^{1/2} \right]. \quad (11)$$

It can be seen from (11) that $K^{(1)}(\xi)$ increases with increasing of frequency of light, where $\xi = E_g / \hbar\omega$. In particular, as the frequency of light doubles, $K^{(1)}(\xi)$ it triples.

Note that the contribution of the coherent saturation effect to the light absorption coefficient, which is taken into account, is determined by the expression

$$K^{(1)}(\omega, T) = \frac{4\pi}{\hbar} \hbar\omega \frac{1}{I} \sum_{k;s=\pm 1/2, m=\pm 1/2, \pm 3/2} (f_{hh} - f_c) \delta(E_{hh} - E_c + \hbar\omega) \left\langle \frac{|M_{C,s;V,m}^{(1)}(\vec{k})|^2}{\sqrt{1 + 4 \frac{\alpha_\omega}{\hbar^2 \omega^2} |M_{C,s;V,m}^{(1)}(\vec{k})|^2}} \right\rangle, \quad (12)$$

where $f_{hh}(f_c)$ is the distribution function of holes (electrons), $E_{hh}(E_c)$ is the energy spectrum of holes (electrons), the sign $\langle \dots \rangle$ means averaging over the solid angles of the wave vector of current carriers,

and other quantities are well known. For example, for an optical transition $|V, \pm 3/2\rangle \rightarrow |C, \pm 1/2\rangle$, the quantity $K^{(1)}(\omega, T)$ is determined by the relation

$$\frac{16e^2}{3c\omega \hbar^2 n_\omega} \mu_{c,L}^{(+)} \cdot k_{c,L}^{(\omega)} \cdot P^2 \cdot F(\beta, 1, \omega) \cdot \mathfrak{I}(\omega) \cdot \left[f_{hh}(E_{hh} k_{c,L}^{(\omega)}) - f_c(E_c k_{c,L}^{(\omega)}) \right] \quad (13)$$

where

$$F(\beta, 1, \omega) = [1 - \exp(1\beta\hbar\omega)] \exp\left[\beta(\mu - E_{hh}(k_{c,L=hh}^{(\omega)}))\right],$$

$$\zeta_\omega = 4 \frac{\alpha_\omega}{\hbar^2 \omega^2} \left(\frac{eA_0}{c\hbar}\right)^2 P^2, \quad k_{c,L}^2 = \frac{2\mu_{c,L}^{(\omega)}}{\hbar^2} (\hbar\omega - E_g),$$

$$\frac{1}{\mu_{c,L}^{(+)}} = \left(\frac{1}{m_c} + \frac{1}{m_L}\right), \quad \beta^{-1} = k_B T, \quad \mathfrak{I}(\omega) = \left\langle \frac{|e'_\pm|^2}{\sqrt{1 + \zeta_\omega |e'_\pm|^2}} \right\rangle.$$

It is seen from (13) that the linear-circular dichroism of the light absorption coefficient depends on the value $\mathfrak{I}(\omega)$. In particular, disregarding the contribution of the effect of coherent saturation (i.e., at $\zeta_\omega = 0$) $K^{(1)}(\omega, T)$ to both for linearly and circularly polarized light $\mathfrak{I}(\zeta_\omega = 0) = \frac{4}{3}$, i.e. in this case, there is no linear-circular dichroism of the light ab-

$$\mathfrak{I}_{lin} = \zeta_\omega^{-5/2} \left\{ \zeta_\omega^{3/2} + \zeta_\omega^2 \cdot \arcsin\left(\frac{\zeta_\omega}{1 + \zeta_\omega}\right)^{1/2} - \zeta_\omega \cdot \arcsin\left(\frac{\zeta_\omega}{1 + \zeta_\omega}\right)^{1/2} \right\}, \quad (16)$$

for circularly polarized light

$$\mathfrak{I}_{circ} = \frac{2(\zeta_\omega^{3/2} \sqrt{\zeta_\omega + 1} - \zeta_\omega \arcsin \sqrt{\zeta_\omega})}{\zeta_\omega^{5/2}}. \quad (17)$$

From (16) and (17) it can be seen that with increasing light intensity, it grows $\zeta_\omega \gg 1$, and within the limits of high intensity, that is, it does not depend on the intensity and equal to $\oplus 1.1$. This means that in the region of high intensities, the linear-circular dichroism has saturation.

sorption coefficient. And for $\zeta_\omega \neq 0$ we have: for linearly polarized light

$$\mathfrak{I}_{lin} = \int_{-1}^{+1} d\mu \frac{1 - \mu^2}{\sqrt{1 + \zeta_\omega (1 - \mu^2)}}; \quad (14)$$

for elliptically polarized light

$$\mathfrak{I}_{circ} = \int_{-1}^{+1} d\mu' \frac{\frac{1}{2}(1 + \mu'^2) \mp P_{circ} \mu'}{\sqrt{1 + \zeta_\omega \left[\frac{1}{2}(1 + \mu'^2) \mp P_{circ} \mu'\right]}}, \quad (15)$$

where P_{circ} is the degree of circular polarization of light, the sign " \pm " corresponds to the σ_\pm polarizations, $\mu' = \cos\phi'$, $\mu = \cos\phi$, where $\phi(\phi')$ the angles between vectors $\vec{e}(\vec{q})$ and \vec{k} , \vec{q} is the wave vector of the photon. In case $P_{circ} = 1$ we have that: for linearly polarized light

Thus, one-photon linear-circular dichroism in narrow-gap semiconductors arises only when the effect of coherent saturation is taken into account. Following [9], it is possible to calculate the multi-photon linear – circular dichroism caused by interband optical transitions, to which a separate work will be devoted.

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References:

1. Ivchenko E. L. Two-photon light absorption and optical orientation of free carriers // Solid state physics 1972.– V. 14.– 3489 p. (in Russian).
2. Rasulov R. Ya. Polarization optical and photovoltaic effects in semiconductors with linear and nonlinear absorption of light. Dissertation of the degree of doctor of physical and mathematical sciences. St. Petersburg. 1993.– 306 p.
3. Ganichev S. D., Ivchenko E. L., Rasulov R. Ya., Yaroshetskiy I. D., Averbukh B. Ya. Linear-circular dichroism of the drag current in the case of nonlinear intersubband absorption of light in p-Ge // Solid state physics (in Russian). 1993.– T. 35.– P. 198–207.
4. Parshin D. A., Shabaev A. R. Theory of nonlinear absorption of infrared radiation in semiconductors with degenerate bands // ZhETF (in Russian). 1987.– V. 92.– No. 4.– P. 1471–1484.
5. Rasulov R. Ya. The drag effect upon three-photon absorption of light in Ge-type semiconductors // Semiconductors. 1988.– Vol. 22.– No. 11.– P. 2077–2080. (in Russian).

6. Rasulov R. Ya., Khoshimov G. Kh., Kholitdinov Kh. Linear-circular dichroism of nonlinear light absorption in n-GaP // *Semiconductors*. 1996.– Vo. 30.– No. 2.– P. 274–272. (in Russian).
7. Rasulov R. Ya. Linear-circular dichroism in multiphoton interband absorption in semiconductors // *Solid State Physics*, 1993.– Vol. 35.– No. 6.– P. 12674–1677.
8. Rasulov V. R., Rasulov R. Ya., Eshboltaev I. Linearly and circular dichroism in a semiconductor with a complex valence band with allowance for four-photon absorption of light // *Physics of the Solid State*. Springer, 2017.– Vol. 59.– No. 3.– P. 463–468.
9. Rasulov V. R., Rasulov R. Ya., Eshboltaev I. Linear-Circular Dichroism of Four-Photon Absorption of Light in Semiconductors with a Complex Valence Band // *Russian Physics Journal*.– Springer, 2015.– Vol. 58.– No. 12.– P. 1681–1686.
10. Bir G. L., Pikus G. E. *Symmetry and deformation effects in semiconductors*.– M.: Science. 1973.– 672 p.
11. Ivchenko E. L., Rasulov R. Ya. *Symmetry and real band structure of semiconductors*.– Tashkent. Fan. 1989.– 126 p.

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Rasulov Voxob Rustamovich,
associate professor, of Fergana State University

Rasulov Rustam Yavkachovich,
professor, of Fergana State University

E-mail: r_rasulov51@mail.ru

Axmedov Bahodir Bahroovich,
doctoral student, of Fergana State University

Muminov Islombek Arabboyevich,
doctoral student, of Fergana State University

Nematov Xusnitdin,
undergraduate, of Fergana State University

TWO-PHOTONE LINEAR-CIRCULAR DICHROISM IN NARROW-ZONE SEMICONDUCTORS

Abstract. The matrix elements of two-photon direct optical transitions between the valence and conduction bands in narrow-gap semiconductors in the three-band Kane model were calculated. All types of optical transitions were analyzed, which differ from the initial states of current carriers, leading to linear-circular dichroism in narrow-gap semiconductors with taking into account the effect of coherent saturation in two-photon optical transitions.

Keywords: narrow-gap semiconductor, two-photon absorption of polarized light, linear-circular dichroism, coherent saturation.

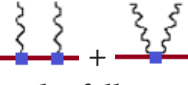
The absorption nonlinear in intensity of polarized radiation in semiconductors with a complex valence band was researched in [1–10], where direct intersubband optical transitions were taken into account and it was assumed that the nonlinearity in the dependence of the one-photon absorption coefficient on intensity arises due to the effect of coherent saturation of absorption, which is caused by a photoinduced change nonequilibrium hole distribution functions.

However, the question of two-photon absorption of light caused by direct between optical band transitions in narrow-gap semiconductors in the three-band approximation in the Kane model [9; 10] with taking into account the contribution of the effect of coherent absorption saturation depending on the de-

gree of radiation polarization, where the Kane model can be used, remained open, what this work is about.

As indicated in [2], in order to take this contribution into account, it is necessary to make a substitution under the sum sign in the expression for the probability of optical transitions from state $|\vec{l}\vec{k}\rangle$ to $|\vec{l}'\vec{k}\rangle$ state: instead of the nonequilibrium distribution function of current carriers $f_l(E_l(\vec{k})) - f_{l'}(E_{l'}(\vec{k}))$, it is necessary to replace by $(f_{l'\vec{k}}^{(0)} - f_{l\vec{k}}^{(0)}) \left[1 + 4T_{l\vec{k}}T_{l'\vec{k}}\hbar^{-2} |M_{l'\vec{k},l\vec{k}}|^2 \right]^{-1/2}$, where $T_{l\vec{k}}$ and $T_{l'\vec{k}}$ are the time of the exit of current carriers from the saturation region into the zones with numbers l and l' , $f_{l'\vec{k}}^{(0)}$, $(f_{l\vec{k}}^{(0)})$, $f_{2\vec{k}}^{(0)}$, $(f_{1\vec{k}}^{(0)})$ is the equilibrium electron distribution function, $M_{l'\vec{k},l\vec{k}}$ is the composite

matrix element of the optical transition between the states $|\vec{l}\vec{k}\rangle$ and $|\vec{l}'\vec{k}'\rangle$, with the help of which the linear-circular dichroism of multiphoton absorption of light is determined (see, for example, [1–9]).

Therefore, below we consider two-photon optical transitions described by Feynman diagrams of the  type and differing from each other by the following initial states:

a) the initial states are in the subband of heavy holes, and the virtual states are in the subbands of the valence band. Then the matrix element of the optical transition $|V, +3/2\rangle \rightarrow |m\rangle \rightarrow |c, +1/2\rangle$ is determined by the sum $\frac{M_{c,+1/2;V,+3/2}^{(1)} M_{V,+3/2;V,+3/2}^{(1)}}{-\hbar\omega}$, $\frac{M_{c,-1/2;V,-1/2}^{(1)} M_{V,-1/2;-3/2}^{(1)}}{(E_{lh} - E_{hh} - \hbar\omega)}$, which in the Kane model is equal to $\left(\frac{eA_0}{\hbar c}\right)^2 pk \left[\frac{e'_+ 2(A-B)e_{z'}}{(-\hbar\omega)} + \frac{e'_- e'_- B}{(E_{lh} - E_{hh} - \hbar\omega)} \right]$ for the optical transition of the type $|V, -3/2\rangle \rightarrow |m\rangle \rightarrow |c, -1/2\rangle$ is determined by the sum $\frac{M_{c,-1/2;V,-3/2}^{(1)} M_{V,-3/2;V,-3/2}^{(1)}}{(-\hbar\omega)}$, $\frac{M_{c,+1/2;V,+1/2}^{(1)} M_{V,+1/2;V,+3/2}^{(1)}}{E_{lh} - E_{hh} - \hbar\omega}$, which is equal to

$$\|M_{m',m}^{(2)}\| = \left(\frac{eA_0}{\hbar c}\right)^2 pk \left\| \begin{array}{c} \frac{2(A-B)e'_+ e_{z'}}{-\hbar\omega} + \frac{e'_- B}{E_{lh} - E_{hh} - \hbar\omega} \\ \frac{i\sqrt{2}e'_+ e'_- B}{E_{lh} - E_{hh} - \hbar\omega} \\ -i \left(\frac{2(A-B)e'_- e_{z'}}{-\hbar\omega} + \frac{e'_+ B}{E_{lh} - E_{hh} - \hbar\omega} \right) \end{array} \right\|.$$

b) the initial states are in the subband of light holes, and the virtual states are in the subbands of the valence band. Then the matrix element of the optical transition $|V, +1/2\rangle \rightarrow |m\rangle \rightarrow |c, +1/2\rangle$ is determined by the sum $\frac{M_{c,+1/2;V,+3/2}^{(1)} M_{V,+3/2;V,+1/2}^{(1)}}{E_{hh} - E_{lh} - \hbar\omega}$, $\frac{M_{c,+1/2;V,+1/2}^{(1)} M_{V,+1/2;V,+1/2}^{(1)}}{-\hbar\omega}$, which in the Kane model is equal to $\left(\frac{eA_0}{\hbar c}\right)^2 pk \times \left(\frac{\sqrt{3}Be'_+{}^2}{E_{hh} - E_{lh} - \hbar\omega} + \frac{1}{\sqrt{3}} \frac{e'_- 2(A+B)e_{z'}}{-\hbar\omega} \right)$, for the optical transition of the

$-i \left(\frac{eA_0}{\hbar c}\right)^2 kp \left[\frac{(e'_-) 2(A-B)e_{z'}}{(-\hbar\omega)} + \frac{e'_+ e'_+ B}{(E_{lh} - E_{hh} - \hbar\omega)} \right]$ in the Kane model, for the optical transition of the type $|V, +3/2\rangle \rightarrow |m\rangle \rightarrow |c, -1/2\rangle$ is determined by the sum $\frac{M_{c,-1/2;V,+3/2}^{(1)} M_{V,+3/2;V,+3/2}^{(1)}}{-\hbar\omega}$, $\frac{M_{c,-1/2;V,+1/2}^{(1)} M_{V,+1/2;V,+3/2}^{(1)}}{E_{lh} - E_{hh} - \hbar\omega}$, which is equal to $\left(\frac{eA_0}{\hbar c}\right)^2 \frac{\sqrt{2}pkBe'_+ e'_-}{E_{lh} - E_{hh} - \hbar\omega}$ in the Kane model, for the optical transition of the type $|V, -3/2\rangle \rightarrow |m\rangle \rightarrow |c, +1/2\rangle$ is determined by the sum $\frac{M_{c,-1/2;V,+3/2}^{(1)} M_{V,+3/2;V,+3/2}^{(1)}}{-\hbar\omega}$, $\frac{M_{c,-1/2;V,+1/2}^{(1)} M_{V,+1/2;V,+3/2}^{(1)}}{E_{lh} - E_{hh} - \hbar\omega}$, which in the model Kane is equal to $\left(\frac{eA_0}{\hbar c}\right)^2 \frac{i\sqrt{2}Bkpe'_+ e'_-}{E_{lh} - E_{hh} - \hbar\omega}$, where $M_{c,m';V,m}^{(1)}$ is the matrix element of one-photon (\rightarrow) transition of the type $|c, m'\rangle \rightarrow |V, m\rangle$, where $m' = \pm 1/2$, $m = \pm 3/2$, p is the Kane parameter [11; 12], A and B are the band parameters of the semiconductor. The energy conservation law for these transitions is described by the function $\delta(E_{cond} - E_{hh} - 2\hbar\omega)$. Matrix elements in the representation $(c, +1/2), (c, -1/2)$ and $(V, +3/2), (V, -3/2)$ are conveniently rewritten as the following matrix

type $|V, -1/2\rangle \rightarrow |m\rangle \rightarrow |c, -1/2\rangle$ is determined by the sum $\frac{M_{c,-1/2;V,-3/2}^{(1)} M_{V,-3/2;V,-1/2}^{(1)}}{E_{hh} - E_{lh} - \hbar\omega}$, $\frac{M_{c,-1/2;V,-1/2}^{(1)} M_{V,-1/2;-1/2}^{(1)}}{-\hbar\omega}$, which in the Kane model is equal to $-i \left(\frac{eA_0}{\hbar c}\right)^2 pk \times \left(\frac{e'_- \sqrt{3}e'_- B}{E_{hh} - E_{lh} - \hbar\omega} - \frac{1}{\sqrt{3}} \frac{2(A+B)e'_+ e_{z'}}{\hbar\omega} \right)$ for the optical transition of the type $|V, +1/2\rangle \rightarrow |m\rangle \rightarrow |c, -1/2\rangle$ is determined by the sum $\frac{M_{c,-1/2;V,+3/2}^{(1)} M_{V,+3/2;V,+1/2}^{(1)}}{E_{hh} - E_{lh} - \hbar\omega}$,

$\frac{M_{c,-1/2;V,+1/2}^{(1)} M_{V,+1/2;V,+1/2}^{(1)}}{-\hbar\omega}$, which is equal to $-2\sqrt{\frac{2}{3}} \left(\frac{eA_0}{c\hbar}\right)^2 \frac{pk(A+B)e'_z}{\hbar\omega}$ in the Kane model, for the optical transition of the type $|V,-1/2\rangle \rightarrow |m\rangle \rightarrow |c,+1/2\rangle$ is determined by the sum $\frac{M_{c,+1/2;V,-3/2}^{(1)} M_{V,-3/2;V,-1/2}^{(1)}}{E_{hh} - E_{lh} - \hbar\omega}$, $-\frac{M_{c,+1/2;V,-1/2}^{(1)} M_{V,-1/2;-1/2}^{(1)}}{\hbar\omega}$,

$$\|M_{m',m}^{(2)}\| = \left(\frac{eA_0}{c\hbar}\right)^2 pk \left\| \begin{pmatrix} \frac{\sqrt{3}Be'_+{}^2}{E_{hh} - E_{lh} - \hbar\omega} - \frac{2}{\sqrt{3}} \frac{(A+B)e'_+e'_z}{\hbar\omega} & 2\sqrt{\frac{2}{3}} \frac{(A+B)e'_z{}^2}{(-\hbar\omega)} \\ -i2\sqrt{\frac{2}{3}} \frac{(A+B)e'_z{}^2}{\hbar\omega} & -i \left(\frac{\sqrt{3}Be'_-{}^2}{E_{hh} - E_{lh} - \hbar\omega} - \frac{2}{\sqrt{3}} \frac{(A+B)e'_+e'_z}{\hbar\omega} \right) \end{pmatrix} \right\|;$$

c) virtual states are in the conduction band, and the initial states are in the branch of light holes of the valence band. Then the matrix element of the optical transition $|V,+1/2\rangle \rightarrow |m\rangle \rightarrow |c,+1/2\rangle$ is determined by the sum $\frac{M_{c,+1/2;c,+1/2}^{(1)} M_{c,+1/2;V,+1/2}^{(1)}}{E_c - E_{lh} - \hbar\omega}$, which in

the Kane model is equal $\frac{1}{\sqrt{3}} \left(\frac{eA_0}{c\hbar}\right)^2 \frac{1}{\hbar\omega} \left(E_g + \frac{\hbar^2 k^2}{2m_c}\right) pe'_+$, for the optical transition of the type is determined $|V,-1/2\rangle \rightarrow |m\rangle \rightarrow |c,-1/2\rangle$ by the sum $\frac{1}{\hbar\omega} M_{c,-1/2;c,-1/2}^{(1)} M_{c,-1/2;V,-1/2}^{(1)}$ which is equal in the Kane model $\frac{i}{\sqrt{3}} \left(\frac{eA_0}{c\hbar}\right)^2 \frac{1}{\hbar\omega} \left(E_g + \frac{\hbar^2 k^2}{2m_c}\right) pe'_-$. For an optical transition, the type $|V,+1/2\rangle \rightarrow |m\rangle \rightarrow |c,-1/2\rangle$

$$\|M_{m',m}^{(2)}\| = \frac{1}{\sqrt{3}} \left(\frac{eA_0}{c\hbar}\right)^2 \frac{1}{\hbar\omega} \left(E_g + \frac{\hbar^2 k^2}{2m_c}\right)' pk \left\| \begin{pmatrix} e'_+ & \sqrt{2}e'_z \\ -i\sqrt{2}e'_z & ie'_- \end{pmatrix} \right\|.$$

d) virtual states are in the conduction band, and the initial states are in the branch of light holes in the valence band. Then the matrix element of the optical transition $|V,+1/2\rangle \rightarrow |m\rangle \rightarrow |c,+1/2\rangle$ is determined by the sum $\frac{M_{c,+1/2;c,+1/2}^{(1)} M_{c,+1/2;V,+1/2}^{(1)}}{E_c - E_{lh} - \hbar\omega}$, which is equal to

$-i \left(\frac{eA_0}{c\hbar}\right)^2 \frac{1}{\hbar\omega} \left(E_g + \frac{\hbar^2 k^2}{2m_c}\right) \sqrt{\frac{2}{3}} pe'_z$ in the Kane model,

which in the model is Kane is equal to $-i2\sqrt{\frac{2}{3}} \left(\frac{eA_0}{c\hbar}\right)^2 (A+B)pk \frac{e'_z{}^2}{\hbar\omega}$. The energy conservation law for these transitions is described by the function $\delta(E_c - E_{lh} - 2\hbar\omega)$. Matrix elements in the representation $(c,+1/2),(c,-1/2)$ and $(V,+1/2),(V,-1/2)$ are conveniently rewritten as the following matrix

is determined by the sum $\frac{1}{\hbar\omega} M_{c,-1/2;c,-1/2}^{(1)} M_{c,-1/2;V,+1/2}^{(1)}$,

which in the Kane model is equal to $\left(\frac{eA_0}{c\hbar}\right)^2 \frac{1}{\hbar\omega} \left(E_g + \frac{\hbar^2 k^2}{2m_c}\right) \sqrt{\frac{2}{3}} pe'_z$. For an optical transition, the type $|V,-1/2\rangle \rightarrow |m\rangle \rightarrow |c,+1/2\rangle$ is determined by the sum $\frac{1}{\hbar\omega} M_{c,+1/2;c,+1/2}^{(1)} M_{c,+1/2;V,-1/2}^{(1)}$, which in the Kane model is equal to $-i \left(\frac{eA_0}{c\hbar}\right)^2 \frac{1}{\hbar\omega} \left(E_g + \frac{\hbar^2 k^2}{2m_c}\right) \sqrt{\frac{2}{3}} pe'_z$. Here

$|m\rangle = |c,\pm 1/2\rangle$, E_g - is the band gap. The energy conservation law for these transitions is described $\delta(E_c - E_{lh} - 2\hbar\omega)$ by the function. Matrix elements in the representation $(c,+1/2),(c,-1/2)$ and $(V,+1/2),(V,-1/2)$ are conveniently rewritten as a matrix

for the optical transition of the type $|V,-1/2\rangle \rightarrow |m\rangle \rightarrow |c,-1/2\rangle$ is determined by the sum $\frac{1}{\hbar\omega} M_{c,-1/2;c,-1/2}^{(1)} M_{c,-1/2;V,-1/2}^{(1)}$, which is equal to

$\frac{i}{\sqrt{3}} \left(\frac{eA_0}{c\hbar}\right)^2 \frac{1}{\hbar\omega} \left(E_g + \frac{\hbar^2 k^2}{2m_c}\right) pe'_-$ in the Kane model.

For an optical transition $|V,+1/2\rangle \rightarrow |m\rangle \rightarrow |c,-1/2\rangle$ the type is determined by the sum

$\frac{1}{\hbar\omega} M_{c,-1/2;c,-1/2}^{(1)} M_{c,-1/2;V,+1/2}^{(1)}$ which in the Kane model is equal to $\left(\frac{eA_0}{c\hbar}\right)^2 \frac{1}{\hbar\omega} \left(E_g + \frac{\hbar^2 k^2}{2m_c}\right) \sqrt{\frac{2}{3}} p e'_z$. For an optical transition $|V,-1/2\rangle \rightarrow |m\rangle \rightarrow |c,+1/2\rangle$, the type $|V,-1/2\rangle \rightarrow |m\rangle \rightarrow |c,+1/2\rangle$ is determined by the sum $\frac{1}{\hbar\omega} M_{c,+1/2;c,+1/2}^{(1)} M_{c,+1/2;V,-1/2}^{(1)}$, which in the Kane

$$\|M_{m',m}^{(2)}\| = \frac{1}{\sqrt{3}} \left(\frac{eA_0}{c\hbar}\right)^2 \frac{1}{\hbar\omega} \left(E_g + \frac{\hbar^2 k^2}{2m_c}\right) p k \begin{vmatrix} e'_+ & \sqrt{2}e'_z \\ -i\sqrt{2}e'_z & ie'_- \end{vmatrix}.$$

e) virtual states are in the spin-split band, and the initial states are in the heavy hole branch of the valence band. Then the matrix element of the optical transition $|V,+3/2\rangle \rightarrow |m\rangle \rightarrow |c,+1/2\rangle$ is determined by the sum

$$\left(\frac{eA_0}{c\hbar}\right)^2 \frac{1}{E_\Delta - E_{hh} - \hbar\omega} \times \left[M_{c,+1/2;\Delta,+1/2}^{(1)} M_{\Delta,+1/2;V,+3/2}^{(1)} + M_{c,+1/2;\Delta,-1/2}^{(1)} M_{\Delta,-1/2;V,+3/2}^{(1)} \right],$$

which is equal $-\frac{i}{\sqrt{6}} \left(\frac{eA_0}{c\hbar}\right)^2 \times \frac{P}{E_\Delta - E_{hh} - \hbar\omega} (-ie'_z H^* + 2e'_+ I^*)$ in the Kane model,

for the optical transition of the type $|V,-3/2\rangle \rightarrow |m\rangle \rightarrow |c,-1/2\rangle$ is determined by the

$$\text{sum} \left(\frac{eA_0}{c\hbar}\right)^2 \frac{1}{E_\Delta - E_{hh} - \hbar\omega} \times \left[M_{c,-1/2;\Delta,+1/2}^{(1)} M_{\Delta,+1/2;V,-3/2}^{(1)} + M_{c,-1/2;\Delta,-1/2}^{(1)} M_{\Delta,-1/2;V,-3/2}^{(1)} \right],$$

which is equal to $\frac{1}{\sqrt{3}} \left(\frac{eA_0}{c\hbar}\right)^2 \times \frac{P}{E_\Delta - E_{hh} - \hbar\omega} (-ie'_z H^* - 2e'_- I^*)$ in the Kane model. for an optical transition, the type $|V,-3/2\rangle \rightarrow |m\rangle \rightarrow |c,+1/2\rangle$ is determined by the

$$\|M_{m',m}^{(2)}\| = \frac{i}{\sqrt{6}} \left(\frac{eA_0}{c\hbar}\right)^2 \frac{P}{E_\Delta - E_{hh} - \hbar\omega} \begin{vmatrix} -e'_z H^* - i2e'_+ I^* & -e'_z H^* + 2ie'_z I^* \\ 2e'_z I^* - ie'_+ H^* & 2e'_- I^* + ie'_z H^* \end{vmatrix}.$$

d) virtual states are in the spin-split band, and the initial states are in the branch of light holes of the valence band. Then the matrix element of the optical transition $|V,+1/2\rangle \rightarrow |m\rangle \rightarrow |c,+1/2\rangle$ is determined by the sum

$$\left(\frac{eA_0}{c\hbar}\right)^2 \frac{1}{E_\Delta - E_{lh} - \hbar\omega} \left[M_{c,+1/2;\Delta,+1/2}^{(1)} M_{\Delta,+1/2;V,+1/2}^{(1)} + \right.$$

model is equal to $-i \left(\frac{eA_0}{c\hbar}\right)^2 \frac{1}{\hbar\omega} \left(E_g + \frac{\hbar^2 k^2}{2m_c}\right) \sqrt{\frac{2}{3}} p e'_z$.

Here, E_g is the energy gap. The energy conservation law for these transitions is described by the function $\delta(E_c - E_{hh} - 2\hbar\omega)$. Matrix elements in the representation $(c,+1/2), (c,-1/2)$ and $(V,+1/2), (V,-1/2)$ are conveniently rewritten as the following matrix

$$\text{sum} \left(\frac{eA_0}{c\hbar}\right)^2 \frac{1}{E_\Delta - E_{hh} - \hbar\omega} \times \left[M_{c,+1/2;\Delta,+1/2}^{(1)} M_{\Delta,+1/2;V,-3/2}^{(1)} + M_{c,+1/2;\Delta,-1/2}^{(1)} M_{\Delta,-1/2;V,-3/2}^{(1)} \right],$$

which in the Kane model is equal to $\frac{1}{\sqrt{3}} \left(\frac{eA_0}{c\hbar}\right)^2 \frac{P}{E_\Delta - E_{hh} - \hbar\omega} (-ie'_z H^* - 2e'_z I^*)$.

For an optical transition, the type $|V,-3/2\rangle \rightarrow |m\rangle \rightarrow |c,+1/2\rangle$ is determined by the su

$$\left(\frac{eA_0}{c\hbar}\right)^2 \frac{1}{E_\Delta - E_{hh} - \hbar\omega} \times \left[M_{c,+1/2;\Delta,+1/2}^{(1)} M_{\Delta,+1/2;V,-3/2}^{(1)} + M_{c,+1/2;\Delta,-1/2}^{(1)} M_{\Delta,-1/2;V,-3/2}^{(1)} \right],$$

which in the Kane model is equal to $\frac{1}{\sqrt{6}} \left(\frac{eA_0}{c\hbar}\right)^2 \frac{P}{E_\Delta - E_{hh} - \hbar\omega} (2ie'_z I^* + e'_+ H^*)$.

Here $|m\rangle = |SO, \pm 1/2\rangle$, E_Δ is the energy spectrum of current carriers in the spin-split band, G', F', H' -determined by relations (24.20) in [12], * is the sign of complex conjugation. The energy conservation law for these transitions is described by the function $\delta(E_c - E_{hh} - 2\hbar\omega)$. Matrix elements in the representation $(c,+1/2), (c,-1/2)$ and $(V,+3/2), (V,-3/2)$ are conveniently rewritten as the following matrix

$$\begin{vmatrix} -e'_z H^* - i2e'_+ I^* & -e'_z H^* + 2ie'_z I^* \\ 2e'_z I^* - ie'_+ H^* & 2e'_- I^* + ie'_z H^* \end{vmatrix}.$$

+ $M_{c,+1/2;\Delta,-1/2}^{(1)} M_{\Delta,-1/2;V,+1/2}^{(1)}$], which is equal to $\frac{i}{\sqrt{6}} \left(\frac{eA_0}{c\hbar}\right)^2 \frac{P}{E_\Delta - E_{lh} - \hbar\omega} [ie'_z (\sqrt{3}H^*) - e'_z (G' - F')]$ in the Kane model, for the optical transition of the type $|V,-1/2\rangle \rightarrow |m\rangle \rightarrow |c,-1/2\rangle$ is determined by the sum

$$\text{sum} \left(\frac{eA_0}{c\hbar}\right)^2 \frac{1}{E_\Delta - E_{lh} - \hbar\omega} \times \left[M_{c,-1/2;\Delta,-1/2}^{(1)} M_{\Delta,-1/2;V,-1/2}^{(1)} + \right.$$

+ $M_{c,-1/2;\Delta,+1/2}^{(1)} M_{\Delta,+1/2;V,-1/2}^{(1)}$] which is equal to $\frac{i}{\sqrt{6}} \left(\frac{eA_0}{\hbar c} \right)^2 \times \frac{p}{E_{\Delta} - E_{lh} - \hbar\omega} \left[\sqrt{3}e'_- H' - ie'_z (G' - F') \right]$ in the Kane model. for an optical transition, the type is determined by the sum $\left(\frac{eA_0}{\hbar c} \right)^2 \frac{1}{E_{\Delta} - E_{lh} - \hbar\omega} \times \left[M_{c,-1/2;\Delta,+1/2}^{(1)} M_{\Delta,+1/2;V,+1/2}^{(1)} + M_{c,-1/2;\Delta,-1/2}^{(1)} M_{\Delta,-1/2;V,+1/2}^{(1)} \right]$, which in the Kane model is equal to $\frac{1}{\sqrt{6}} \left(\frac{eA_0}{\hbar c} \right)^2 \frac{p}{(E_{\Delta} - E_{lh} - \hbar\omega)} \left[e'_z H^* - ie'_- (G' - F') \right]$. For an optical transition, the type $|V,-1/2\rangle \rightarrow |m\rangle \rightarrow |c,+1/2\rangle$ is determined by the

$$\|M_{m',m}^{(2)}\| = \frac{1}{\sqrt{6}} \left(\frac{eA_0}{\hbar c} \right)^2 \frac{p}{E_{\Delta} - E_{hh} - \hbar\omega} \begin{vmatrix} -\sqrt{3}e'_+ H^* - ie'_z (G' - F') & -ie'_- (G' - F') + e'_z H^* \\ ie'_z H' - e'_+ (G' - F') & e'_z (G' - F') + i\sqrt{3}e'_- H' \end{vmatrix}.$$

From the energy conservation law, the wave vector of photoexcited electrons participating in optical transitions from the subband of light holes to the conduction band is determined by the expression

$$k_{c,L}^{(2\omega)} = \sqrt{\frac{2\mu_+^{(c,L)}}{\hbar^2} (2\hbar\omega - E_g)}, \text{ where } m_c \text{ are the masses of electrons in the conduction band, } m_L \text{ is the effective mass of holes in the subband } L, L = lh (L = hh) \text{ for light (heavy) holes, } \mu_+^{(c,L)} = \frac{m_c m_L}{m_c + m_L}.$$

From the latter relations, it is easy to obtain expressions for the energies of the intermediate state for light, heavy holes:

a) if the transition comes from heavy holes, then $E_{L=hh}(k_{c,L=hh}^{(2\omega)}) = \frac{m_c}{m_c + m_{hh}} (2\hbar\omega - E_g)$, $E_{lh}(k_{c,L=hh}^{(2\omega)}) = \frac{m_c \cdot m_{hh}}{m_{lh} (m_c + m_{hh})} (2\hbar\omega - E_g)$. b) if the transition comes from light holes, then $E_{L=hh}(k_{c,L=hh}^{(2\omega)}) = \frac{m_c \cdot m_{lh}}{m_{hh} (m_c + m_{lh})} (2\hbar\omega - E_g)$, $E_{lh}(k_{c,L=hh}^{(2\omega)}) = \frac{m_c}{m_c + m_{lh}} (2\hbar\omega - E_g)$. Then the energy denominators in the composite matrix elements, de-

sum $\left(\frac{eA_0}{\hbar c} \right)^2 \frac{1}{E_{\Delta} - E_{lh} - \hbar\omega} \times \left[M_{c,+1/2;\Delta,+1/2}^{(1)} M_{\Delta,+1/2;V,-1/2}^{(1)} + M_{c,+1/2;\Delta,-1/2}^{(1)} M_{\Delta,-1/2;V,-1/2}^{(1)} \right]$, which in the Kane model is equal to

$$-\frac{i}{\sqrt{6}} \left(\frac{eA_0}{\hbar c} \right)^2 \frac{p}{E_{\Delta} - E_{lh} - \hbar\omega} \left[(G' - F') e'_- + ie'_z H^* \right].$$

Here $|m\rangle = |SO, \pm 1/2\rangle$. The energy conservation law for these transitions is described by the function $\delta(E_c - E_{lh} - 2\hbar\omega)$. Matrix elements in the representation $(c,+1/2), (c,-1/2)$ and $(V,+1/2), (V,-1/2)$ are conveniently rewritten as the following matrix

depending on the frequency of light and the band parameters, will be written as:

1) at an optical transition from light holes to the conduction band:

$$E_{lh}(k_{c,L=lh}^{(2\omega)}) - E_{hh}(k_{c,L=lh}^{(2\omega)}) = \frac{\mu_+^{(c,lh)}}{\mu_-^{(lh,hh)}} (2\hbar\omega - E_g),$$

$$E_c(k_{c,L=lh}^{(2\omega)}) - E_{hh}(k_{c,L=lh}^{(2\omega)}) = E_g + \frac{\mu_+^{(c,lh)}}{\mu_+^{(c,hh)}} (2\hbar\omega - E_g).$$

$$E_c(k_{c,L=lh}^{(2\omega)}) - E_{lh}(k_{c,L=lh}^{(2\omega)}) = 2\hbar\omega;$$

2) at optical transition from heavy holes to the conduction band:

$$E_{lh}(k_{c,L=hh}^{(2\omega)}) - E_{hh}(k_{c,L=hh}^{(2\omega)}) = \frac{\mu_+^{(c,hh)}}{\mu_-^{(lh,hh)}} (2\hbar\omega - E_g),$$

$$E_c(k_{c,L=hh}^{(2\omega)}) - E_{hh}(k_{c,L=hh}^{(2\omega)}) = 2\hbar\omega,$$

$$E_c(k_{c,L=hh}^{(2\omega)}) - E_{lh}(k_{c,L=hh}^{(2\omega)}) = E_g + \frac{\mu_+^{(c,hh)}}{\mu_+^{(c,lh)}} (2\hbar\omega - E_g).$$

Thus, the interband matrix elements of two-photon optical transitions in narrow-gap semiconductors have been calculated, which can be used to calculate the two-photon linear - circular dichroism caused by interband optical transitions in the Kane model.

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References:

1. Ivchenko E. L. Two-photon light absorption and optical orientation of free carriers // *Physics and Technology*. 1972.– T. 14.– 3489 p.
2. Rasulov R. Ya. Polarization optical and photovoltaic effects in semiconductors with linear and nonlinear absorption of light. Dissertation for the degree. uch. doctor's degree phys.-mat. sciences. – St. Petersburg. 1993.– 306 p.
3. Ganichev S. D., Ivchenko E. L., Rasulov R. Ya., Yaroshetskiy I. D., Averbukh B. Ya. Linear-circular dichroism of the drag current in the case of nonlinear intersubband absorption of light in p-Ge // *FTT*. 1993.– T. 35.– P. 198–207.
4. Rasulov R. Ya. The drag effect upon three-photon absorption of light in Ge-type semiconductors, *Phys.*– No. 11.– P. 2077–2080.
5. Rasulov R. Ya., Khoshimov G. Kh., Kholitdinov Kh. Linear-circular dichroism of nonlinear light absorption in n-GaP // *Semiconductors (in Russian)*, 1996.– Vol. 30.– No. 2.– P. 274–272.
6. Rasulov R. Ya. Linear circular dichroism in multiphoton interband absorption in semiconductors // *Semiconductors (in Russian)*. 1993. – T. 35.– Vol. 6.– 1674–1678.
7. Rasulov R. Ya. Linear-circular dichroism in multiphoton interband absorption in semiconductors // *Solid State Physics*, 1993.– Vol. 35.– No. 6.– P. 12674–1677.
8. Rasulov V. R. Rasulov R. Ya., Eshboltaev I. Linearly and circular dichroism in a semiconductor with a complex valence band with allowance for four-photon absorption of light // *Physics of the Solid State*.– Springer, 2017.– Vol. 59.– No. 3.– P. 463–468.
9. Rasulov V. R., Rasulov R. Ya., Eshboltaev I. Linear-Circular Dichroism of Four-Photon Absorption of Light in Semiconductors with a Complex Valence Band // *Russian Physics Journal*.– Springer, 2015.– Vol. 58.– No. 12.– P. 1681–1686.
10. Parshin D. A., Shabaev A. R. Theory of nonlinear absorption of infrared radiation in semiconductors with degenerate bands // *ZhETF*. 1987.– T. 92.– No. 4.– P. 1471–1484.
11. Bir G. L., Pikus G. E. Symmetry and deformation effects in semiconductors.– M.: Science. 1973.– 672 p.
12. Ivchenko E. L., Rasulov R. Ya. Symmetry and real band structure of half-conductors.– Tashkent. Fan. 1989.– 126 p.

Section 8. Philology and linguistics

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Garifullina Elvira Ildusovna,

Ph. D. in Philology,

Kazan National Research Technical University

named after A. N. Tupolev-KAI (branch "Vostok")

E-mail: elviraig@mail.ru

LANGUAGE TRANSFORMATIONS AS A NATURAL FACT OF LINGUISTIC REALITY IN MODERN ENGLISH

Abstract. The article deals with some ways of replenishing vocabulary of modern English as a result of changing linguistic view of the world. Formation of new elements of the language as well as change of the existing ones through the use of internal word-building resources are analyzed.

Keywords: language transformations, word formation, semantic structure of a word, lexical equivalent, descriptive equivalent, semantic shifting.

A language and its functions are studied and analyzed in modern science. Since human interaction implies certain awareness of the real world, language is considered to be one of the multi-functional and effective means of the world cognition.

The role of a language to be a means of communication is evident for anyone, as well as the opportunity to share information (interchangeability). According to Wilhelm von Humboldt, the language origin and language transformations never belong to one man only, but to a community in the whole; language capacity reposes at the bottom of every human heart and it is activated just in communication [3, 382].

In the meantime, Humboldt draws our attention to one of the cornerstones of a true linguistic research in which a language is examined not just as a means of communication but the one having a purpose in and not apart from itself, a language as a tool of thoughts and feeling. Humboldt strongly believes that the character and structure of a language express

the entity and knowledge of its native speakers, as well as non-native speakers, consequently, careful and detailed language studying and analyzing must involve anything that is connected with the inner world of a human being from the point of view of history and philosophy [3, 375].

In view of this, one must admit a language not only as a means of communication, but as the way to express culture and to preserve it for future generations. Language as a functional system is inextricably connected with every aspect of a social life. Language is a social phenomenon and its vocabulary bear the impress of material and cultural life of any society. Thus, specific features of language development are reflected in the size and nature of its vocabulary. Any language functions and develops within certain social environment: human society using this language, the structure of this society, the level of culture and education of language speakers, their social standing, as well as peculiarities and differences in their language

behaviour according to communicative situation or context. These issues connected with social aspects of language are of great interest to sociolinguistics that studies and analyzes society's effect on a language.

Changes in a social life, development of science, technology and culture provide occurrence of new subjects and new notions that inevitably involves creation of fresh naming units. In this way, language functioning is significantly associated with a word-formative system development, occurrence of new semantic units, appearance of new derivational models as well as transformation of existing ones, increase or decrease of productive means of word formation. Consequently, direct impact of extralinguistic context on vocabulary provides its motion.

Speaking about vocabulary motion, one should take into consideration possible transformation of semantic structure resulting in the shifting of interdependence of direct nominative meaning and figurative meaning of lexical units. Let's consider an example of semantic shift in a word combination "sandwich generation" where we can see displacement of the original meaning of the word "sandwich" known as "two pieces of bread with cheese, salad, or meat, usually cold, between them" [2, 1132] by the figurative meaning of the same lexical unit resulting in a new nomination that in Cambridge Dictionary is defined as "a group of people who have old parents as well as young children, so they have to take care both of their parents and of their children" [7]. The new lexeme characterizes this generation as people in their 40's, 50's or 60's who have to reconcile their employment and private life, taking care of elderly parents while caring for their own children. There are some contributory factors in the growth of this generation: changes in lifespan, a later age for child-bearing as well as economic (financial) problems suggesting that children require more money and "capital-intensive" care, while aging parents require more time and "labour-intensive" care:

Here is a dilemma. You're both working, raising kids and saving or paying for college. Saving for retirement.

You're active in your community. Dad died and mom needs help getting around ... You're the adults on-deck. Welcome to the sandwich generation [9].

This interlanguage lexical unit "sandwich generation" can be considered as a natural fact of linguistic reality since the phenomenon of "sandwiching" is recognized in different societies all over the world, hence, it can be used in various languages without loss of information.

Along with traditional ways of replenishing vocabulary of modern English linguists pay attention to active usage of word groups with transformed semantic structure as well as stylistic colouring, that is to say, change or extension of the word meaning through the influence of the changing linguistic view of the world.

Here is the example of introduction and active use of a word combination "crowd birthing / crowdbirthing / crowd-birthing" defined in Macmillan Dictionary as "giving birth to a baby in the presence of a large number of close relatives and / or friends [8]:

'Crowd birthing' – or inviting throngs of people into the delivery room and/or documenting the experience on social media – might be the latest trend among pregnant women [5].

This new practice is so characteristic of contemporary life that this lexical unit "crowdbirthing" has come into the language.

The two other English lexemes childbirth related "freebirthing" and "hypnobirthing" are of equally great interest for those who take keen interest in different ways of replenishment and development of modern English vocabulary. "Hypnobirthing" is defined in Cambridge Dictionary as "the use of deep breathing, meditation and visualization in labour in order to help woman relax and deal with pain, while "freebirth/freebirthing" is used to describe the process of giving birth without the presence of a medical professional [7].

Pia Goodman was terrified at the thought of giving birth, but she astonished midwives by having her first baby in just over three hours at home without any painkillers. Ms Goodman admits the thought of labour pains and the fears of what could go wrong were almost

too much. So, when she was about 22 weeks pregnant she decided to try a pioneering new technique called hypnobirthing. Hypnobirthing, which started in the States, uses self-hypnosis, relaxation, visualization and breathing techniques to prepare the mother for birth [6].

Besides, a lexical unit “crowdbirthing” has the same prefix “crowd-” as the other very popular words “crowdsourcing” known as “the activity of giving tasks to a large group of people or to the general public, for example, by asking for help on the Internet” [7] and “crowdfunding” known as “the practice of getting a large number of people to each give small amounts of money in order to provide the finance for a business project, typically using the Internet [7]. This prefix “crowd” represents the concept of inviting a lot of people for collaborative work and with the assistance of social media. It should be pointed out that these recent terms “crowdsourcing” and “crowdfunding” have already become a part of international vocabulary and they are known to be in a current use in modern languages, so there is no need to translate them and explain their meaning, which is not the case for words “crowdbirthing”, “hypnobirthing”, and “freebirthing”. They are hardly to be named fixed language units. Therefore, when translating them into the second language a descriptive method

is used for more perfect and complete information, that is a descriptive construction (equivalent) which can clarify the meaning of these lexical units.

Integrity of material reality that is substantially identical to the entire human society and reality reflected in notions of lexical units enables to speak about increasing correlation of languages. According to V. S. Vinogradov, since the world, material and cultural achievements of science and technology of the past and present have striking resemblance and common features, acquire greater integration in the worldwide civilization, then semantic content of vocabulary of different languages all over the world demonstrates linguistic affinity reducing the amount of so-called non-equivalent vocabulary and difference in denotative meaning of lexical units [1, 70].

In conclusion, it should be mentioned that borders of the human worldview (in other words, the way any human being assesses, interprets and interacts with the world to form his values, morals and beliefs) are spreading out, since variety of languages suggests different ways of the world perception and conceptualization of reality. That is why the process of cognitive activity of a man, with a focus on comprehension of information and concept activation, deserves consideration.

References:

1. Vinogradov V. S. *Perevod: obschiye i leksicheskiye voprosy: ucheb. posobiye*. 5-e izd. – M.: KDU, 2009. – 238 p.
2. Hornby A. S. *Oxford Advanced Learner’s Dictionary of Current English*. Sixth Edition. Oxford University Press, 2000. – 1540 p.
3. Humboldt W. *Jazyk i philisofia kultury*. – M., 1985. – 448 p.
4. Kuprieva I. A. *Linguo-culturological aspects of mental cultures language representation // Philological Sciences. Issues of Theory and Practice*. – Tambov: Gramota, 2011. – № 4 (11). – P. 105–109.
5. URL: [http://abcnews.go.com/Lifestyle/crowd-birthing-latest-delivery-room-trend/ story-32756642/](http://abcnews.go.com/Lifestyle/crowd-birthing-latest-delivery-room-trend/story-32756642/) (date of application: 30.07.2020).
6. URL: <http://www.bbc.co.uk/2/hi/health/2136691.stm/> (date of application: 26.07.2020)
7. URL: <https://dictionary.cambridge.org.ru/> (date of application: 25.07.2020).
8. URL: <https://www.macmillandictionary.com/buzzword/entries/crowdbirthing.html/> [date of application: 10.07.2020).
9. URL: <http://www.portlanddailysun.wordpress.com/> (date of application: 20.07.2020).

Section 9. Chemistry

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*Erkayev Aktam Ulashevich,
doctor of technical sciences, professor of TCTI, Tashkent*

*Reimov Karjawbay Dauletbaevich,
doctor of technical sciences (PHd), associate professor,
of Ajiniyaz Institute, Nukus Kaipbergenov Atabek Tulepbergenovich,
doctor of technical sciences, associate professor of Ajiniyaz Institute, Nukus
E-mail: atabek2004@mail.ru*

PROBLEMS OF UTILIZATION OF DISTILLED SUSPENSION OF SODA PLANTS AND WAYS TO SOLVE THEM

Abstract. The existing methods of utilization of the distilled liquid of the enterprises for the production of soda ash are analyzed. The possibility of processing a distilled suspension of the LLC Kungrad Soda Plant by processing it with sulfate-containing salts of Karakalpakstan to obtain sodium chloride is shown.

The optimal technological parameters of the process have been determined and the kinetics of precipitation of calcium sulfate has been studied.

Keywords: Soda ash, sodium hydroxide, ammonia process, industrial waste, distilled liquid, solid sludge, calcium and sodium chloride, lime, calcium sulfate, magnesium hydroxide.

Soda ash is a traditional product with a long history of production and use. There are currently over 75 soda plants in the world located in 34 countries.

An increase in output can be achieved by improving the technological processes of existing industries, saving material resources, introducing progressive consumption rates per unit of output. The soda industry also faces important challenges. It is planned to further increase production of soda ash, the intensification of technological processes in existing soda plants, searches rational ways of using and manufacturing equipment [1–4].

At present, the production of soda in the world is based on four methods of its production: ammonia, from natural soda, from nepheline and carbonation of

sodium hydroxide. On LLC “Kungrads Soda Plant” soda ash production is based on the ammonia method. The ammonia soda method, however, has serious drawbacks, the main of which are: the low degree of utilization of the feedstock (sodium uses approximately 2/3, and chlorine and calcium is not used at all); a large amount of liquid and solid waste requiring disposal, discharge and long-term storage; significant consumption of energy resources; large specific investment for the creation of soda production.

Therefore, in this production, simultaneously with the receipt of valuable products, a huge amount of industrial waste accumulates. The most voluminous waste from the production of soda ash by the ammonia method is the distilled suspension, which

is formed in the amount of 8–10 m³ per 1 ton of soda. The distilled slurry can be separated into clarified liquid and solid sludge. Clarified distilled liquid and solid sludge must be processed into products useful for human economic activity.

The main way to reduce the amount of chloride waste of soda production is their processing to obtain marketable products. Currently, there are the following directions for solving the problem of waste disposal: obtaining from a distilled suspension of calcium and sodium chlorides; its application in the oil and gas industry, to obtain ameliorant, calcium hydroxide, cementless binder and other products [5–15].

The use of the distilled slurry on an industrial scale is very low and therefore it is usually sent to sludge ponds or the so-called “white seas”.

Sludge ponds are specially prepared areas of the earth's surface, surrounded by dams up to 20 m high. Sludge ponds occupy significant land areas; in addition, they are sources of intensive pollution of ground and surface waters with sodium and calcium chlorides. Soda production wastes generated in large quantities restrict the further development of existing soda plants and impede the rational geographic location of new plants.

One of the real ways of using distilled liquid is waterflooding of oil reservoirs [5–6]. This method is used in the Shlapovskiy oil field, where a distilled suspension is used instead of fresh water for pumping into oil wells. In this case, the following requirements are imposed on the liquid: it must be free of CaO, not supersaturated with respect to CaSO₄, the MPC of suspended particles in it must be no more than 20 mg/l. The preparation of the liquid consists of the following operations: settling in a sludge storage, dilution with water to the content of Cl – 89 g/l (liquid: water = 4:1), carbonization of the solution to remove Ca(OH)₂; supply of return sludge to the carbonization column, thickening of the liquid containing 10 g/l of CaCO₃ in the thickener and final clarification to a suspension content of 0.02 g/l in a section of 31 hectares.

The clarified liquid is fed through a 140 km pipeline to the oil fields of the Shlapovskiy field. The displacement coefficient of this liquid is not lower than that of fresh water.

For other soda plants, the distilled liquid can be used for pumping into absorbing horizons [5–6]. When injected into absorbing horizons, the effluent should not contain mechanical impurities that can reduce the permeability of the formation, and chemical components that may interact with it, and should not be supersaturated with any of the salts that may precipitate. One of the methods for eliminating cuttings from the “White Seas” is their disposal in salt workings of NaCl leaching wells. Preparation of the slurry consists of the following steps: sedimentation of e and filtration, e; mixing e precipitate supersaturated with NaCl brine to the ratio of T: L of from 1:4 to 1:10 and feeds a pulp pump at a speed of 2 m/s in the leaching chamber. In order to reduce the amount of waste wastes, it is proposed to separate insoluble impurities of sand, calcium carbonate, lime, calcium sulfate, magnesium hydroxide from the distiller suspension and use them in the production of cement or to neutralize acidic soils. For this, the distilled suspension, brine purification sludge and limestone roasting waste are mixed and thickened in the presence of flocculants to a solids content of 8–12 wt%. Then precipitate with 70–90 °C is subjected to multi-stage filtration centrifuge or disc filters, washing the precipitate during filtration fluid containing no ions Cl. The filtrate is then mixed with the original waste, and the sludge containing 50 wt.% Solids can be used in agriculture for liming soils and in the production of cement.

The use of solid precipitates obtained from filtering a distilled suspension is possible at a low NaCl content (~20–25 wt.%). To reduce the chloride content, the precipitate is washed or mixed with chalk waste. The choice of waste preparation method depends on the location of the plant.

Employees of NIOCHIM and the Kharkov Agricultural Institute named after V. V. Dokuchaev jointly

developed a technology for the preparation of solid waste of soda production for reclamation of acidic and alkaline soils [7]. The method is based on thickening the distilled liquid to $t: w=1:10$, filtering it on a FPAKM-50 filter press, followed by partial washing of the precipitate from chlorides on filters with a weak distiller suspension. Next, the sediment containing 50% moisture is mixed with chalk waste in a ratio of $1:(2-3)$, the resulting product is crushed and dried.

It is necessary to note the work of NIOCHIM [8] on the use of filter fluid from soda plants to obtain complex mineral fertilizers used for rice and sugar beets. The scheme provides for the extraction of P_2O_5 from simple superphosphate with a filter liquid and a two-stage filtration of phosphogypsum. A fertilizer containing 35–38% of nutrients is obtained.

Experiments on magnetic processing of a distilled suspension in order to reduce the amount of scale formation during its evaporation were carried out on a flow-type stand of the Slavic Soda Plant. To reduce deposits in the tubes of evaporators in the production of $CaCl_2$, it is advisable to use magnetic treatment of the distiller liquid [9].

To obtain calcium chloride from a distiller suspension containing calcium sulfate, a significant part of $CaSO_4$ is removed during decantation of $CaCO_3$, as a result of which its concentration in the $CaCl_2$ solution decreases, which makes it possible to evaporate without intensive formation of incrustations on the horizontal surface of the heat exchanger. At the first stage of evaporation, a plate heat exchanger should be used, since it is easily freed from incrustations [10].

In the method of purification of the distilled liquid of soda production from calcium sulfate in order to increase the degree of purification, the distilled liquid is preliminarily saturated with carbon dioxide, and the treatment with gypsum and carbonization is carried out simultaneously to pH 7.5–8 [11].

Waste of soda production with a high content of $CaCl_2$ and other salts is decanted to separate solids, the clarified solution (5 m^3) is subjected to saturation to reduce the content of $Ca(OH)_2$, then

concentrated by evaporation in multi-shell evaporators, separating crystallizing $NaCl$ (0.4 t). A solution of $CaCl_2$ in an amount of 1.2 m^3 with a density of $\sim 1.4\text{ kg/m}^3$ at $70\text{ }^\circ\text{C}$ is pumped into subsoil cavities, initially filled with $NaCl$ brine, which is then displaced by $CaCl_2$ and sent for reuse. For 1 ton of produced soda, 0.372 ton of $NaCl$ is recovered [12].

Thus, the analysis of the materials available in the scientific and technical literature testifies to the scientific and practical, economic and environmental significance of research aimed at the development and creation of a waste-free technology for processing a distilled liquid to obtain purified water.

Generalization literature data related to disposal issues of waste soda production and methods of their processing into commercial products and their industrial implementation show that it is acceptable to process distilled liquid to obtain purified water, returned back to the soda ash production cycle [13–15].

However, there are no systematic studies in the literature on the following issues: the reactivity of the components that make up the waste; influence of various parameters on the process of purification of distilled liquid; the influence of the rate of sodium sulfate, brine and lime milk on the process of separating the solid phase from the suspension.

The purpose of this work is to develop a technology for the utilization of the distilled liquid of KSZ LLC, as a result of which the sodium chloride solution is returned to the technological cycle with the simultaneous production of such useful products as gypsum, chalk and magnesium hydroxide.

The essence of the technology lies in the fact that the distilled suspension is treated with sulfate-containing components and subsequently, after the gypsum is separated from the system, magnesium hydroxide and calcium carbonate (chalk) are sequentially precipitated, and the purified distilled suspension is returned back to the technological cycle of soda ash production, which is especially important in such a region as Karakalpakstan, where water is an expensive raw material.

The raw materials used were brine and solid salts of lakes Barsakelmes and Karaumbet, as well as mi-

rabilitate of the Tumryuk deposit, the chemical composition of which is given in (table 1).

Table 1. – The chemical composition of the starting components

Samples	Mass fractions, %				
	Anions		Cations		
	Cl ⁻	SO ₄ ²⁻	Ca ²⁺	Mg ²⁺	Na ⁺ _{calc}
Rapa lake Barsakelmes	16.14	1.94	0.029	1.87	7.74
Rapa lake Karaumbet	13.72	7.07	–	3.98	4.53
Self-precipitated salt of Lake Barsakelmes	60.32	0.06	0.088	0.06	38.95
Salt of Karaumbet Lake No. 1	52.89	3.33	1.0	0.37	34.04
Distiller liquid KSZ LLC	9.62	0.25	3.49	0.031	–
Mirabilite of the Tumryuk field	–	42.6	0.21	–	20.17

To study the effect of sodium sulfate on the degree of purification of the distilled liquid, the concentration of sodium sulfate was varied within 80; one hundred; 120% of stoichiometry with respect to calcium chloride, comprising: a first camping in distiller liquid.

The process temperature varied from 40 to 80 °C. The duration of the process was 30; 60; 90 minutes. The experiment used mirabilite Tumryuk deposit. Before mixing with the distilled liquid, mirabilite was ground to a particle size of 0.03 mm.

A certain amount of distillation liquid and sodium sulfate (mirabilite) were introduced into a round bottom flask equipped with a mechanical stirrer. Precipitation of calcium sulfate proceeded at room temperature. After stirring the suspension for a given temperature and time, a sample was taken, which was filtered through a dense paper filter.

It can be seen from the data that under the conditions prevailing in the experiments, calcium does not completely precipitate even with an excess of the precipitant of 20% and turbulent stirring of the suspension for 90 minutes. Along with the purification of the distiller suspension, we studied the kinetics of the settling properties of the resulting calcium sulfate. For this, the suspension was placed in a cylinder and the height of the clarified layer was noted every 5–10 minutes. The process took place at room temperature.

The data obtained show that under the conditions prevailing in the experiments, the settling rate of the solid phase is 0.006–0.012 m/h, and the final volume of the cuttings is 37–82% of the initial one.

The highest sedimentation rate is possessed by a suspension obtained at 100% normal Na₂SO₄ at a temperature of 40 °C and the mixing time 60 min. In this experiment, the sedimentation process lasts 95 minutes and the final volume of sludge is 37% of the total. The temperature and mixing time have little effect on the precipitation process. Thus, with a mixing time of 90 minutes, the amount of solid phase is 38.7%, which settles within 140 minutes, and a reduction in the mixing process to 30 minutes leads to an acceleration of the deposition process to 135 minutes. With an increase in the process temperature to 80 °C, the rate of the deposition process decreased and the duration of the deposition process reached 145 min.

Thus, the optimal conditions for the purification process of a distiller suspension using mirabilite from the Tumryuk deposit are: the rate of sulfate salts is 100% relative to calcium, the interaction time of the components is 1.5–2 hours, and the process temperature is not more than 60 °C.

As a result of implementation, there is practically no waste – distilled liquid. The water demand is reduced by 50–92%, the NaCl utilization rate reaches 90–95%.

References:

1. Resolution of the President of the Republic of Uzbekistan. "On the program for the development of the chemical industry for 2017–2021".– August 27, 2017.– 3236 p.
2. Zaitsev I. D., Tkach G. A., Stoev N. D. Soda production.– M.: Chemistry, 1986.– 312 p.
3. Krashennikov S. A. Soda technology.– M.: Chemistry, 1988.– 304 p.
4. Rambergenov A. K. Development of technology for the production of soda ash from low–concentration furnace gas. Diss. on competition Scientists degree Ph.D.– Tashkent, 2009.– 174 p.
5. Tkach G. A., Shaporev V. P., Titov V. M. Soda production using low–waste technology.– Kharkov: Kh-GPU, 1998.– 429 p.
6. Patent No. 100943 Poland. Recycling distiller liquid / Krizala Josef, Danek Rostislav. // R. Zh. Khim 1979, 21 L,– 188 p.
7. Kutsina M. I., Rastorgueva K. V. A method of preparing solid waste of soda production for their use in agriculture.– Proceedings of NIOCHIM, Cherkassy, 1977.– Issue. 12.– 28 p.
8. Postoronko A. I. The use of filter fluid from soda plants to obtain complex mineral fertilizers.– Proceedings of NIOCHIM, Cherkassy, 1978.– 53,– 8 p.
9. Kutsina M. I. Recycling of waste in the soda industry.– Proceedings of NIOCHIM, Kharkov, 1978.– Issue. 47.– 19 p.
10. Halilagic Muradif, Ivanovic Ivica. The possibility of obtaining calcium chloride from of waste distiller liquid soda production // "Arh. rud. i tehnol", 1972.– No. 4.– P. 57–62.
11. Auth. St. France № 2232494. Removal of waste water carbonation process during production of soda ash / Solvay & Cie // RZhKhim 15L08P.– B.I. 1976.– No. 73.
12. Auth. St. USSR No. 829568. Method for processing distilled suspension of ammonia–soda production / Korobanov V. N., Mitkevich E. M., Grisheva S. A., Demidenko A. Ya., Novikova A. V., Ivashina A. D., Goncharov I. Ya., Gavrilovich N. E. // RZhKhim 4L34P.– B.I. 1982.– No. 18.
13. Tursunova D. A., Reimov K. D., Iskenderov A. I. Utilization of distiller suspension of the Kungrad soda plant using sulfate–containing salts of Karakalpakstan // Scientific and technical conference of masters of TCTI "Umidli Kimyogarlari". Collection of works.– Tashkent, 2009.
14. Reimov K. D., Erkaev A. U. Investigation of the process of utilization of distilled liquid – production waste of UE "Kungrad Soda Plant" // Scientific and technical conference of masters of TCTI "Umidli Kimyogarlari". Collection of works.– Tashkent, 2008.
15. Yakubov R. Ya., Erkaev A. U., Rambergenov A. K., Reimov K. D. Development of technology for utilization of distilled liquid – waste production of Kungrad soda plant // International Conference: Abstracts.d OKL.– Volgograd, 2007.– P. 75–78.

Section 10. Economics and management

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*Khudaverdiyeva Elnura Misir,
PhD student, of Ganja State University,
the department of management and tourism business
E-mail: kema.isa@inbox.ru*

PROSPECTS FOR ADAPTING FOREIGN EXPERIENCE IN TAXATION OF SMALL AND MEDIUM ENTERPRISES IN AGRICULTURE

Abstract. The article presents topics that reflect the tax system of foreign countries and the experience of taxation in these countries. The article provides relevant topics for a comparative analysis of the tax system of foreign countries with other countries, including the tax system of Azerbaijan. The article reflects the tax policy and principles of taxation of foreign countries, tax regulation of international economic activity, international tax planning, features of the tax system of foreign countries and the international experience of tax systems of foreign countries. One of the main tasks is to study the features of the formation of the tax system of foreign countries, the budgets of these countries at different levels, the specifics of specific taxes and the mechanism of their influence. In addition to the fiscal role of taxes, the article also discusses the problems of their impact on business.

Keywords: tax system, features of the tax system of foreign countries, international experience of tax systems, entrepreneurship, indicator.

Introduction: The main indicator for the tax systems of countries is the impact of taxes on economic development. The most characteristic feature of developed countries is the level of state intervention in various spheres of economic life. The main goal of government intervention is to regulate the economy. The main goal of state regulation of the economy is to achieve stable economic growth, ensuring price stability, full employment of the able-bodied population, a certain level of income and the creation of a social protection system for citizens. The main instruments of state regulation are tax policy and financial support for free enterprise. Each country pursues a tax policy taking into account its national interests. The tax policy of the state should be aimed at creat-

ing a favorable tax environment in the country and stimulating investment [1].

The main goal of tax regulation of the economy in our country is to improve the tax system in accordance with international standards, taking into account national moral values, implementing an effective tax policy that accelerates the country's socio-economic development. The tax policy in the countries of the European Union (EU) is based on the following two main strategic priorities: 1) economic efficiency; 2) social equality and protection. Countries that joined the European Union can be divided into two main groups. The first group consists of developed countries (Germany, France, England, the Netherlands, Spain, Italy, Sweden, Denmark, Finland, etc.).

The main priorities of the tax policy of this group of countries are to ensure the economic competitiveness of the country, as well as compliance with the principles of social equality in the country. In these countries, most of the tax revenue is used for social protection of the poor and the development of human capital. The second group includes the new EU countries and candidate countries (countries of Eastern Europe and the Baltic States). The main tax policy priority of this group of countries is to increase the country's economic efficiency, and social protection issues are already being addressed in accordance with the country's economic capabilities. Based on these priorities, tax policy differs between two groups of countries within the EU. 1) Equality – the tax system should be equal and fair for all taxpayers, as a result of which the same taxes should be levied on taxpayers under the same conditions, and the same operations should be taxed equally; 2) Simplicity – the tax system should be as simple as possible so that taxpayers can easily understand their obligations and pay taxes in time and in full, while reducing administrative costs of tax authorities and difficulties in tax control; 3) Sufficiency – the tax system should provide the state budget with sufficient and well-known sources of income; 4) Efficiency – the tax system should be efficient and should not prevent or reduce the growth of production of goods and services in the country's economy; 5) Competitiveness [5]. The national tax system of the tax systems of other countries must be competitive, since it must be a system that ensures long-term, sustainable and real economic development, creation and growth of new jobs. The main role of the tax rate for the implementation of public policy is that it has special significance, consisting of various types of tax rates (proportional, progressive and regressive rates). With their help, only the income of different categories of taxpayers is formed. The centralized tax system is quite flexible due to tax rates, which allows for an effective tax policy in accordance with the current economic situation in the country, setting tax rates every year. One of the effective means of implementing tax

policy is tax incentives [2]. This is due to the fact that any individual or legal entity that meets the required conditions may be granted the right to full or partial tax exemption. In recent years, significant work has been done to improve the tax system, expand the tax base, bring the tax service in line with modern European standards, and a number of successes have been achieved in the modernization of tax legislation and tax administration [3].

Features of the tax regulation system of foreign countries. It should be noted that it is impossible to create an effective tax system without successful reforms in the economy. An effective tax system ensures the continuity of the reproduction process and regulates economic development. The introduction of strict tax requirements in the tax system ultimately leads to an increase in tax evasion, problems of stimulating business activity, an increase in income and the creation of a favorable tax environment. The essence of the changes in the tax system should be clear to the taxpayer. Countries with the highest tax rates. There are several ways to compare countries for transporting taxpayers. For comparison, on the basis of a single criterion and preservation of objectivity, we used the highest level of income tax applied to the income of the country's working population [4].

One of the main goals is the formation of a competitive agricultural sector in the Republic of Azerbaijan. The formation of a competitive agricultural sector will help to reduce the share of this sector in employment and increase the income of those working there. Currently, the average monthly nominal wage in agriculture is two times less than the average monthly nominal wage in the country. In accordance with this policy, which will be implemented in the coming years, it is planned to bring the average monthly nominal wage in agriculture closer to the average monthly nominal wage in the country. At the same time, it is important to solve the problem of employment of people who lost their jobs in this area as a result of the formation of a competitive agricultural sector. For this, in order to increase the level of employment of the rural population, it is

important to develop alternative areas of activity, stimulate employment in non-agricultural areas. This will improve income opportunities for those living in rural areas and encourage young people to stay in rural areas. In the coming years, it will be possible to implement projects related to the development of rural tourism, various services, increasing the role of forestry in the field of employment (“non-timber forestry”), as well as training, adopting special programs to increase the employment of women and expand startups in rural areas terrain. Measures will be taken. Taxes have existed since the inception of human civilization as the main source of financial resources of the state. The creation of the state, the formation of the army and the maintenance of the state apparatus necessitated the collection of taxes in ancient times. Taxes have been applied in various forms since ancient times and are still being formed. This development has come a long way from the primitive form of taxation to the improvement of taxes. Taxes have always been and remain an important part of the economic policy of the state [6]. Taxes are individual, gratuitous payments levied on individuals and legal entities by state and local self-government bodies in accordance with the law and transferred to the state budget or local budgets necessary for the state to fulfill its functions. The modern tax system must comply with international standards, taking into account the prospects for socio-economic development. The tax system should ensure timely and complete collection of budget revenues, create conditions for revenue generation and production regulation in various sectors

of the economy. The tax system, as in all countries, plays a leading role in regulating the economy and ensuring the state budget revenues of Azerbaijan. The modern tax system acts not only as a means of providing projected revenues of the state budget, but also as a means of stimulating economic development.

Conclusion: One of the requirements of the tax system in Azerbaijan, as in all countries, is that both the quantity and level of applicable taxes remain stable for a long time. Because the correct forecast of the income and expenses of entrepreneurs for the coming years depends on this factor. Only in this case they have the opportunity to develop an investment program for both production and social infrastructure. The stability of the tax system ensures the balance of revenues and expenditures of the state budget and it is creating wide opportunities for free socio-economic policy in the country. The stability of the tax system also worries foreign businessmen. Foreign investors are more concerned about the instability of the tax system than about benefits and privileges. However, the Azerbaijani government has made progress in this area, has signed a number of international treaties and agreements, thereby eliminating the double taxation of income and property, which protects investments and ensures the stability of the tax regime. Currently, the tax system of the Republic of Azerbaijan ensures the functioning of the country’s economic mechanism, allows financing the urgent needs of the state, prevents the growth of the budget deficit and generally meets all the requirements for the transition to a market economy.

References:

1. Ibragimov I. “Actual problems of the agrarian economy”. – Baku, 2002.
2. Salakhov S. “Problems of state regulation of the agricultural sector”. – Baku, 2004.
3. Zvi Lerman. “Agriculture in Transition Economies: From Common Heritage to Discrepancy,” *Agricultural Economics*, 26, 2001.
4. Peter H. *Agricultural workers and their contribution to sustainable agriculture and rural development*. FAO, 2005.
5. 1. Policy responds to COVID19. [Electronic resource]. URL: http://www.azerbaijan.az/_Economy/_Agriculture/_agriculture_a.html // [electron resurse]
6. 2. Policy responds to COVID19. [Electronic resource]. URL: <http://www.stat.gov.az> [electron resurse]

Section 11. Science of law

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Vede Iuliia Vladimirovna,
postgraduate student,
of Ural State Law University Russia, Yekaterinburg
postgraduate student,
of Martin-Luther University Halle-Wittenberg,
Halle, Germany
E-mail: veda281094@mail.ru

LEGAL REGULATION OF THE PROHIBITION OF ABUSE OF RIGHTS IN THE LEGISLATION OF THE EUROPEAN UNION

Abstract. The author examines the main sources of the prohibition of abuse of procedural rights in the law of the European Union. The article provides the main sources of various levels, as well as summarizes the practice of the European court of human rights and the European court of justice. Summarizing, the author concludes about the impact of judicial practice on the transformation and translation of the ban on abuse of procedural rights in the European Union and its member States.

Keywords: abuse of procedural rights, prohibition of abuse of procedural rights, European Union law, European court of human rights, European court of justice.

1. Universal legal acts

1.1 *Universal Declaration of human rights (article 30)*

Judicial practice has a very negative attitude to unfair behaviour of participants in any relations, agreements, obligations, since abuse of rights violates normal movement within the framework of economic turnover, economic activity, and judicial processes. This thesis has legal origins at the international level, confirmed by law enforcement practice and is textually recorded in article 30 of the Universal Declaration of Human Rights [13].

The establishment of provisions on the impossibility of using the rights provided by the Declaration contrary to its goals is a prerequisite for the inclusion of a direct ban on abuse of rights in the text of

the Convention for the protection of human rights and fundamental freedoms and the Charter of fundamental rights of the European Union, and, subsequently, for the further development of a mechanism to combat abuse in both substantive and procedural law. Fixing the relevant provisions on the inadmissibility of abuse of rights in the acts at this level creates obligations for the member States of the European Union to develop a legal framework that allows implementing the provisions of these legal acts, thus is a kind of engine on the way to creating an appropriate mechanism.

1.2 *Convention for the protection of human rights and fundamental freedoms of 1950*

Article 17 of the Convention for the protection of human rights and fundamental freedoms contains

a direct prohibition on the abuse of rights, which is also duplicated in the norms of other international legal acts.

The article in question does not simply establish a ban on abuse of rights, but rather elevates this provision into a generally recognized Convention principle of law – the principle of fair use of rights, organically covering the sphere of fair use of procedural rights.

The Convention does not provide protection to those whose actions are deliberately aimed at undermining or destroying the democratic principles and freedoms protected by this international act. It is unacceptable to use or abuse the rights and freedoms guaranteed by the Convention for destructive purposes.

As early as 1961, the European court of human rights in the case of *Lawless v. Ireland* [10] stated that the purpose of article 17 of the Convention for the protection of human rights and fundamental freedoms is to prevent a group of persons or individuals from using the Convention as a legal tool that would allow them to engage in activities or carry out individual acts aimed at undermining the rights and freedoms guaranteed by the Convention, thereby prohibiting the abuse of all the rights set forth in the Convention, including procedural rights [12].

The inclusion of provisions prohibiting the abuse of rights in article 17 of the Convention for the protection of human rights and fundamental freedoms brings it to the level of a generally recognized Convention principle, with guarantees set out in other articles of the Convention and expressed in the legal positions of the European court of human rights in its rulings [3]. Violation of article 17 is considered as a rule in connection with violation of other articles of the Convention, as an element of strengthening the effect of negative consequences of violation of fundamental principles and norms of international law.

The legal positions of the European court of human rights and the European court of justice, including detection and suppression of abuse of procedural rights, should be considered and implemented by na-

tional systems of individual States, as the interaction of European and domestic legal orders is impossible in conditions of subordination, as only a dialogue between different legal systems is the Foundation of balance. The opposite situation would lead to the deformation of the state's legal system and the creation of multiple conflicts [6, 336].

2. Special legal acts

2.1 The Brussels Convention of 1968

The Brussels Convention on jurisdiction and enforcement of judgments in civil and commercial disputes [1] was adopted two years after the entry into force of the Treaty on the EEC (01.01.1958) and is an independent international legal Treaty closely related to the EU and yet is not a primary or secondary law of the Union [9, 116]. In accordance with the preamble, the purpose of this Convention was to strengthen the legal protection of persons residing there within the Community. For the same purpose, the rules on recognition of decisions of foreign courts were unified, but also the rules on international competence in terms of making a decision, which at that time was a huge progress in terms of the qualitative characteristics of the existing rules of law.

Thus, the Brussels Convention of 1968 was the first document containing elements of a mechanism for regulating the rules of jurisdiction.

2.2 Luhansk Convention of 1988 and Luhansk Convention of 2007

The Convention on jurisdiction and enforcement of judgments in civil and commercial matters [4] has not just adopted a number of norms of the Brussels Convention of 1968. (with subsequent changes), but also in some parts I have improved its provisions qualitatively, and in some parts I have gone my own way, while acting in parallel with the Brussels Convention.

Subsequently, after the cancellation of the Brussels Convention of 1968. in connection with the adoption of Regulation No. 44/2001, the Luhansk Convention of 1988. lost its force and was replaced by the Convention on jurisdiction, recognition and

enforcement of judgments in civil and commercial matters, concluded in Lugano on 30.10.2007 [5]. In essence, the Luhansk Convention of 2007, which is currently in force in parallel with Regulation N1215/2012 of the European Parliament and of the Council of the European Union on jurisdiction, recognition and enforcement of judgments in civil and commercial cases, contains provisions that overlap with those contained in it on determining the rules of jurisdiction, and is also one of the sources containing rules that prevent such open abuse of procedural rights.

5. Regulations no. 44/2001 and No. 1215/2012.

Regulation no. 44/2001 and the new Regulation No.1215/2012 of the European Parliament and of the Council of the European Union on jurisdiction, recognition and enforcement of judgments in civil and commercial cases, which repealed and substantially revised some of its provisions, are among the main sources regulating the rules for determining jurisdiction in cross-border disputes. In addition to fixing the rules for determining jurisdiction, Regulation No. 1215/2012 is also one of the results of the gradual harmonization of European Union law, which is undoubtedly also one of the key points in the fight against procedural abuse.

B. The role of the ECHR's jurisprudence in shaping the mechanism for prohibiting abuse of procedural rights in cross-border disputes.

1. the Case "Grasser V. Germany".

The decision of the European court of human rights of 05.10.2006 "Case" Grasser V. Germany [7] was one of the main reasons for the significant revision of the provisions on temporary priority and rules of jurisdiction contained in Regulation No. 44/2001 and the adoption of Regulation No. 1215/2012, establishing that the criterion of the duration of the dispute is not fundamental in determining the competent court, because such an exception would create legal uncertainty and violate the principle of mutual trust between the courts of the member States of the European Union.

2. The case of Weber.

The question of the exclusive competence of the second-called court and the limits of its competence under article 22 of Regulation No. 44/2001 was raised immediately before the German Federal court and later before the European court of justice [2]. The position of the Federal court on this issue was quite clearly indicated: "there is no reason to suspend the exclusive jurisdiction of the last court called." However, the European court of justice did not support the Decision of the German Federal court and took a diametrically opposite position. Referring to the principle of justice to act on lawful and honest grounds, it is argued that the last called court, which, in accordance with article 22 of Regulation No. 44/2001, has exclusive competence, should postpone the trial until the final resolution of the issue of incompetence of the first called court is established [11, 344].

Thus, the European court of justice wanted to minimize the negative components of the principle of mutual trust, which arose due to the restriction of the powers of the courts of the EU member States on issues of verification of exclusive competence.

3. The Significance of the rulings of the European court of justice and the European court of human rights in the formation of a mechanism to combat abuse of procedural rights.

The rulings of the European court of human rights and the European court of justice are important for the development of not only European Union law, but also for most of the world's modern legal systems. They affect the practice of applying international legal acts and national laws of a particular country, create prerequisites for rejecting a narrow interpretation of national legal norms, and contribute to changing legal acts in terms of regulating the rights and freedoms of participants in certain legal relations, including procedural ones. Currently, the European court of human rights is considered the most authoritative human rights court [8, 81]. For example two judgments of the European court of human rights discussed above,

which is only “a drop in the ocean”, it is obvious that the ECHR is one of the main engines of progress, not only in terms of suppression of procedural abuses, but also in the formation of European Union law and

harmonization of the national laws of the member countries of the EU and other countries in which the ECHR judgments are binding.

References:

1. Brussels Convention on Jurisdiction and Enforcement of Judgments in Civil and Commercial Disputes, 27.09.1968.
2. EuGH, Urteil v. 03.04.2014.
3. Convention for the Protection of Human Rights and Fundamental Freedoms, 04.11.1950.
4. Convention on Jurisdiction and the Enforcement of Judgments in Civil and Commercial Matters, 16.09.1988.
5. Convention on Jurisdiction, Recognition and Enforcement of Judgments in Civil and Commercial Matters, 30.10.2007.
6. Commentary on the Convention for the Protection of Human Rights and Fundamental Freedoms and the Practice of its Application / Ed. ed. V. A. Tumanova, L. M. Entina. – M.: Norma, 2002.
7. Judgment of the European Court of Human Rights of 05.10.2006 “Grasser v. Germany”.
8. Ispolinov A. S. Precedent in international law // Legislation. 2017.– No. 1.
9. Kropholler Europ. Zivilprozessrecht, 1993.
10. Lawless v. Ireland. Decision of the European Court of Human Rights, 1.07.1961 r.
11. Matthias Klöpfer: Missbrauch im Europäischen Zivilverfahrensrecht (Veröffentlichungen zum Verfahrensrecht), Mohr Siebeck, Tübingen 2016.
12. Villiger M. Article 17 ECHR and Freedom of Speech in Strasbourg Practice // Freedom of Expression: Essays in Honour of Nicolas Bratza. Oisterwijk, 2012.
13. Universal Declaration of Human Rights, 10.12.1948.

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