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Short Title: Adaptation potential of alfalfa among other crops with resource-saving technologies while preserving ecological biodiversity

RESEARCH ARTICLE

Adaptation potential of alfalfa among other crops with resource-saving technologies while preserving ecological biodiversity

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Abstract

The use of Urea–Ammonia Mixture (UAM), 32% contributes to an in–crease in the productivity of agricultural land, with a decrease in the cost per unit of production of fodder and other crops. The composition and ratio of components, UAM, 32% contains three forms of nitrogen–ammonia (25%), amide (50%) and nitrate (25%), due to which the fertilizer acts for a long time, and vegetative alfalfa plants are provided with nitrogen throughout the growing season of the crop. The cost of nitrogen in UAM, 32% is the lowest, since its losses when using UAM, 32% on alfalfa do not exceed 10% of the total content. When applying UAM, 32%, the stability of organic diversity, characterized by a positive evolutionary process and adaptability of a complex of organisms associated with external factors of the environment without violations of the ratios of dominant species of organisms, was established. UAM, 32% does not affect levels of global biodiversity, with abiotic levels of agrocenoses, which provide optimal indicators of the circulation of substances, energy and information, as well as mechanisms for preserving the ecological niche and conditions for the existence of a diversity of biota.

Keywords: Urea ammonia mixture, Mineral nutrients, Alfalfa, Organic diversity, Plant protection, Vegetation, Green Mass, Pests

INTRODUCTION

In 2015–2021 when applied in the field, a high uniformity and accuracy of dosage was achieved with a qualitative distribution both on the soil surface and on alfalfa in comparison with solid nitrogen fertilizers. The use of UAM, 32% in combination with plant protection products helped to minimize the costs of their use and increase efficiency by 32%–35% compared to other options. The use of UAM, 32% provides a reduction in the cost of transportation, unloading from 25% to 30% compared to solid nitrogen fertilizers. The UAM, 32% does not pollute the environment, improves the supply of nitrogen to plants during a drought, and the operating costs for its application are much lower compared to other alfalfa nutrition and protection systems (Kovalenko, 2019; Wawrzyniak et al., 2021).

The nodule weevils (*Sitona lineatus L.*) caused damage in areas traditional for growing alfalfa with an average abundance of the pest during the period of plant growth after the first slope of 5 specimens–14 specimens per 100 net mowing and did not migrate to agrocenoses with the introduction of UAM, 32% and into the phase after the second slope (the number ranged from 7 to 22 specimens per 100 net mowing). With mass budding, the average number of phytophages in the fields after the 1st slope increased to 19.5 ind. for 100 mowings with a net, and after the second up to 21.5 copies for 100 net mowing. During flowering, the number of nodule weevils did not differ significantly depending on the feeding system of UAM, 32%. Throughout the entire growing season, phytophage abundance indicators were noted in the Vinnitsa region, in particular, in the phase of mass budding-53–31 ind. for 100 mowings with a net, respectively, in the fields after the 1st and 2nd slopes (Kovalenko, 2019; Polishchuk et al., 2021). In 2021–2022 years, observed the development of the pest within last year's indicators, however, under special overwintering conditions and favorable weather conditions in spring, wet weather in May–June, a focal increase in their number and a threat to crops throughout the growing area is possible. Puffed alfalfa long–noses–phytonomes (*Phytonomus variabilis Herbst.*), during the period of crop growth after the first cut, were found everywhere where alfalfa was grown, with an average number of 3, max 11 ind. for 100 mowing nets in the Mykolaiv region. When the culture grew after the second slope, the situation with phytonomus did not change significantly and averaged 2.5 ind. for 100 net mowing. In the phase of mass budding, on the crops after the 1st slope, an increase in the average abundance of long-bosom up to 5 ind. for 100 net mowing (Kovalenko, 2019; Hryhoriv et al., 2022). However, in the Kherson region, the number was 15 ind. for 100 net mowing. On crops after the second slope, the number increased to 24 specimens for 100 net mowing. In the flowering phase, the number of the pest in the fields after the first slope continued to increase to 21 ind. for 100 mowings with a net, after the second up to 42 copies for 100 net mowing. During the years of research, puff alfalfa weevils during overwintering and favorable warm weather in spring developed massively on seed alfalfa of the first slope and spring crops.

Bed bugs (*Adelphocoris lineolatus Goeze.*) inhabited alfalfa crops during the growth of the culture after the 1st slope and an average number of 2.5 ind. for 100 net mowing, and after the 2nd slope up to 5.4 specimens for 100 net mowing. In the study area, this indicator during the period of crop growth after the 1st slope fluctuated within the range of 1–7 specimens per 100 mowings with a net, and the accumulation of the phytophage was noted in the Rivne and Poltava regions, 11 and 26 ind. for 100 mowing with a net, respectively. In Rivne, Poltava and Zaporizhzhia regions, the number of the pest was higher (16 specimens, 17 specimens and 41 specimens per 100 net slopes, respectively). In the phase of mass budding, the average abundance of the pest in the fields after the 1st slope increased to 35 ind. per 100 mowings with a net, and after the 2nd slope it slightly decreased and amounted to 43 specimens for 100 net mowing. In the surveyed area where alfalfa was grown, the average number of these phytophages did not exceed the threshold (EPSh-15–20 ind. per 100 samples). Under the current conditions of overwintering of the pest and relatively warm weather in summer, in 2021–2022 years economically significant damage by alfalfa bugs is predicted in the Poltava, Rivne and Cherkasy regions (Kovalenko, 2019; Borek & Romaniuk, 2020a).

The aim of the research was to study adaptive potential of alfalfa, wheat and chrysanthemums under resource–saving technologies for the use of fertilizers (UAM, 32%) and plant protection products.

MATERIALS AND METHODS

When conducting pest counts, determined two interrelated indicators-accounting for stationary distribution or prevalence and accounting for the density of settlements or abundance in populated stations. At the same time, it should be taken into account that the number in different stations and crops of the same crop with different terms of sowing, irrigation, cultivation, the state of plants, etc. may be different. This is due to the timing of the settlement of the land, the degree of favorable conditions for the reproduction and survival of this species.

The distribution, or the degree of colonization of a crop, land is expressed as a percentage of inhabited hectares, plants or organs, samples relative to those surveyed and calculated by the formula: $P = \Sigma a / \Sigma A \times 100$, (1), where P–distribution of the pest (% of the populated area); Σa–the sum of populated areas, ha^{-1}; ΣA–the total amount of surveyed areas, ha^{-1}.

The distribution of the pest depends on the phase of population dynamics. In the phases of dispersal, mass reproduction and the peak of harmfulness, the greatest distribution of the species is observed, in the phase of depression it is less.

The prevalence of pests and diseases in the territory (percentage of infested (affected) areas) and plants, (percentage of infested (affected) plants is characterized by the following indicators:

- 0–healthy seeding;
- 1–very limited distribution (up to 5% of the area, plants);
- 2–weak distribution (up to 25% of the area, plants);
- 3-medium distribution (up to 50% of the area, plants);
- 4–strong distribution (up to 75% of the area, plants);
- 5–very strong distribution (more than 75% of the area, plants).

In order to select and use rational means of protecting the drug and the norms of their costs, the following gradations of colonization by harmful organisms of agrocenosis are determined: single (below the threshold of harmfulness); weak (at the level of the pancreas); average (more than 1.1-3 times the unit of measurement of life expectancy); strong (>3 PN units).

Along with the settlement of lands, one should also take into account the number of each type of stations, which also characterizes the phase of population dynamics.

The density of the settlement, or abundance, is expressed by any indicator indicating the amount of the pest in any surrounding space (per 1 m^2, 1 kg^{-1}, 1 or 100 plants per day, etc.) by a scoring assessment of plant habitability with a simultaneous indication of the percentage of inhabited plants.

The average number of the pest in the lands is calculated by the formula: $H=(\Sigma a \times K/m)$, (2), where H–the average abundance of the pest, ind. per 1 m^2; Σa-the sum of the amount of the pest in the samples; K-the number of samples per 1 m^2; m-the number of samples taken.

The number of small insects (aphids, mites) is estimated according to the distribution indicators or the percentage of infested plants (P), settlement (B). The first indicator is determined by the formula: $P=a / A \times 100$, (3), where P-pest distribution, % of inhabited plants; a-the number of populated plants; A-the total number of registered plants.

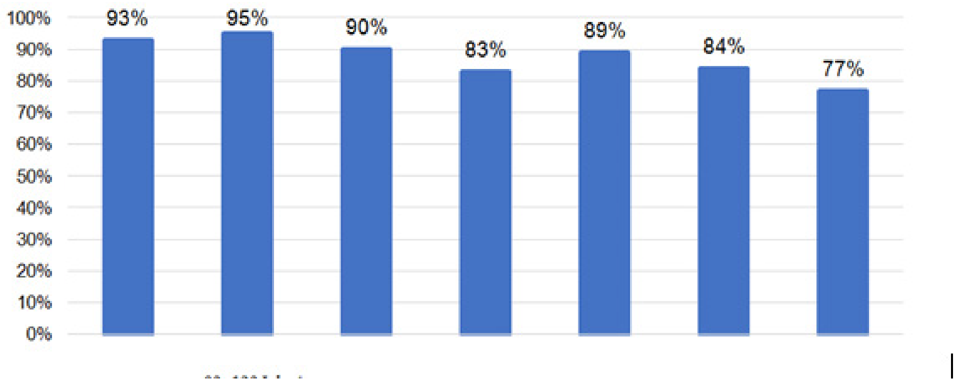
The degree of pest colonization of plants is estimated in points on scales. The average infestation score (B) of plant pests in the field is calculated by the formula: B=(Σ (a × b))/ A, (4), where Σ(a × b)-the sum of the products of the number of infested plants (a) and the corresponding infestation score (b); A-the total number of plants in the samples.

To characterize the average pest abundance in general by crop, economy, region, country, the weighted average abundance indicator (Ws) relative to the populated area is determined: Hs=(Σ (n × a)) / Σa, (5), where Σ (n × a)-the sum of the products of the average pest abundance (n) and the corresponding populated area (a); a –the sum of populated areas, ha^{-1}.

RESULTS AND DISCUSSION

In 2000–2021 years, alfalfa crops damaged alfalfa yellow seed (*Tychius flavus Berck.*), alfalfa pachyderm (*Bruchophagus roddi Guss.)*, alfalfa cutworms and other positions. Growing herbs for several years (Polishchuk et al., 2020). To predict the population of the alfalfa pest complex, it is essential to estimate the Selyaninov Hydrothermal Coefficient (HTC).

During the years of research, high efficiency up to 95% of the spring application of the urea-ammonia mixture, in particular, in the second year of the use of perennial grasses before the restoration of alfalfa vegetation, was noted at a rate of 80 l ha^{-1}–120 l ha^{-1}. However, the efficiency and norms of top dressing varied according to the stages of organogenesis: before sowing-within 100 l ha^{-1}–150 l ha^{-1}, in the second or third years of use before the restoration of vegetation-80 l ha^{-1}–120 l ha^{-1}, while during the growing season their relatively optimal norm is 10 l ha^{-1}–20 l ha^{-1} (Fig. 1).



100–150 l ha^{-1} before sowing	80–120 l ha^{-1} 2 years, before the resumption of vegetation	10–15 l ha^{-1} 2 years, before blooming	15–20 l ha^{-1} 2 years, after blooming	80–120 l ha^{-1} 3 years, before the resumption of vegetation	10–15 l ha^{-1} 3 year, before blooming	15–20 l ha^{-1} 3 years, after blooming

Figure 1. **Comparative efficiency of technologies for feeding alfalfa UAM, 32%**

Thus, the effectiveness of the use of UAM, 32%, increases with the use of fertilizers in the phases of growth and development of alfalfa by fine feeding of vegetative plants. In this case, both root and foliar nutrition occur simultaneously. The need for foliar feeding is due to a complex of factors: air and soil temperature, humidity, indicators of the growth of the vegetative mass, in which the reserves of easily accessible mineral nutrients from the soil are absorbed with the accompanying plant growth rates, as well as the optimization of the assimilation of nutrients by the root system of the complex affects the growth rate and development of alfalfa.

The degree and rate of assimilation of nutrients from fertilizer UAM, 32% through the leaf surface is higher than from fertilizers introduced into the soil. It is justified to use a solution of UAM, 32% (10:100) diluted with water, since the amide form of nitrogen quickly penetrates through the leaf surface of alfalfa. However, it is advisable to combine puff nutrition with the introduction of modern plant protection products in the following ways: in autumn-for the main tillage; in spring-for pre-sowing soil treatment; during the growing season of alfalfa for root and foliar nutrition; use of mineral nitrogen as a compensatory dose to increase the coefficient of humification of plant residues with the elimination of its depressive effect on the growth of alfalfa by balancing the ratio of carbon and nitrogen in the soil.

The effectiveness of technologies using fertilizers (generally accepted) and using liquid fertilizer UAM, 32% allow us to assert the advantages of the latter, because the yield of alfalfa green mass increases from 3.6 t ha^{-1} to 5.0 t ha^{-1} compared to other options (Tab. 1).

Table 1. **Comparative efficiency of alfalfa growing technologies.**

Index	Technology		
	Generally accepted with the use of fertilizers (standard)	With the use of liquid fertilizer UAM, 32%	To standard, ±
Harvest of green mass: for the second year	36.2	39.8	3.6
for the third year	35.2	40.2	5

Green mass growth: in the second year	2.1	4.3	2.2
for the third year	1.7	4.3	2.6
Hay harvest: for the second year	2.7	3.5	0.8
for the third year	2.5	3.2	0.7

The third year of use with the use of liquid UAM, 32%, the yield of green mass increases by 4 t ha^{-1}–5 t ha^{-1}, since there is an effective aftereffect of the second year of using the nutrition system. UAM, 32%, provides an increase in green mass both in the second and third years of alfalfa vegetation. In particular, the increase in hay yield by 0.8 t ha^{-1} and 0.7 t ha^{-1} in the second and third years, respectively (Tab. 2).

Table 2. The impact of urea-ammonia mixture on the yield of alfalfa green mass.

Variant	Productivity, tons ha^{-1}	Standard, ±
Standard	3.65	0
$P_{60} K_{60}$+N_{60} (ammonium nitrate)	3.86	0.21
$N_{90} P_{90}$+K_{120} (ammonium nitrate)	4.2	0.55
$P_{60} K_{60}$+N_{60} UAM-32	4.09	0.44
$N_{90} P_{90} K_{120}$+UAM-32	4.23	0.58
$N_{90} P_{90} K_{120}$+N_{10} UAM-32+N_{10} UAM-32	4.26	0.61
$P_{60} K_{60}$+N_{60} UAM-32+N_{60} UAM-32+N_{60} UAM-32	4.35	0.7
V,%	0.53	–

The first spring application is advisable to carry out in the absence of snow cover, before the restoration of the vegetation of plants in March, the norm is 80 l ha^{-1}-120 l ha^{-1}, at an air temperature of up to 10°C; in this case, UAM, 32% does not need dilution. It is possible to increase the application rate of this fertilizer depending on the morphophysiological state of plants (Tab. 3). This is confirmed by the coefficient of variation, to 5.3%.

Table 3. Application of fertilizers and plant protection products for alfalfa.

Operation	Terms	Variant	Content of active ingredients	Expenses per 1/ha, kg (l)	Efficiency	Cost per 1 ha^{-1} ($US)
Application of mineral fertilizers	March	UAM, 32		100	97.8	100
Herbicide	End of April	Antisapa + UAM, 32	Metribuzim, 700 g/kg	0.4+10	98	12+10
Herbicide	May	Selenite + UAM, 32	Kletodim, 120 g/l	1+10	97.6	16+10
Insecticide	June	Fas+Vanguard (microfertilizers)	Alphacy-permethrin, 100/l	0.2+1.5	98.2	3+5
Total expenses						165

Effective combined top dressing, with the addition of plant protection products, during the growth of alfalfa at the end of April. At the same time, a single rate of UAM, 32% should not exceed 10 l/ha–20 l/ha with the addition of a herbicide (active ingredient metribuzim, 700 g/kg). In the case of feeding alfalfa, in order to avoid burns, it is advisable to dilute UAM, 32% with water in a ratio of 1:2, and when combined with a herbicide-1:3, 1:4.

The development of pests and an intensive increase in green mass in June, the introduction of a tank mixture of an insecticide is effective-0.2 kg ha^{-1} (active ingredient alphaci–permethrin 100 g/l) with the addition of 1.5 l/ha of Avangard microfertilizer (Rogovskii et al., 2020; Polishchuk et al., 2020; Debowski et al., 2020; Polishchuk et al., 2021b; Romaniuk et al., 2022).

Justified for foliar top dressing with solutions of UAM, 32% are morning (in the absence of dew) and evening hours. In cool and cloudy weather, it is advisable to organize this work during the day. It is not recommended to feed the plants with UAM, 32% solutions at temperatures above 20°C, low relative humidity on a sunny day, since in these cases slight burns of the deciduous surface of plants are possible.

The structure of harmful organisms in the crops of clover, winter wheat, as well as in modern conditions of growing chrysanthemum was formed with separate patterns in biology, ecology, distribution of certain species and technologies for growing the studied objects. The species are characterized by a relatively high level of viability at the main stages of their development with distribution characteristics under intensive cultivation factors of both field crops and *chrysanthemum*. Modern systems for growing these crops contribute to the formation of relatively high levels of development of both diseases and other pests (Wawrzyniak et al., 2021). This indicates the primary importance of varieties and the study of the mechanisms of plant resistance according to the assessment and forecast models of the formation of the structure of harmful species in various forms of survival (Figs. 2–5).

In the case of using UAM, 32% for foliar top dressing, the pH of the solution should be in the range of 8 units–9 units. The effectiveness of this type, as well as other types and forms of fertilizers, depends on weather conditions and other factors. High efficiency is achieved by technology with a solution remaining on the surface of the leaves for a long time in gloomy cool weather.

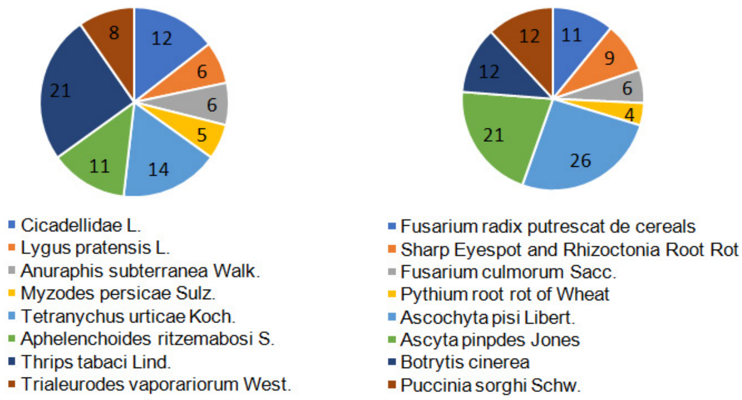


Figure 2. **Comparative structure of harmful organisms according to the technology of using urea-ammonia mixture on *Trifolium repens L.***

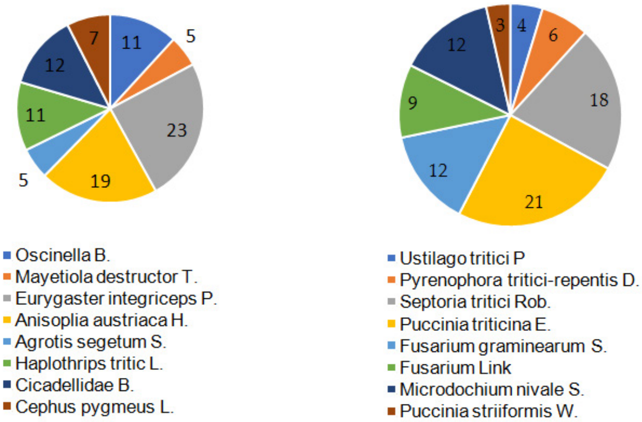


Figure 3. **Comparative structure of harmful organisms according to the technology of using urea-ammonia mixture on winter wheat**

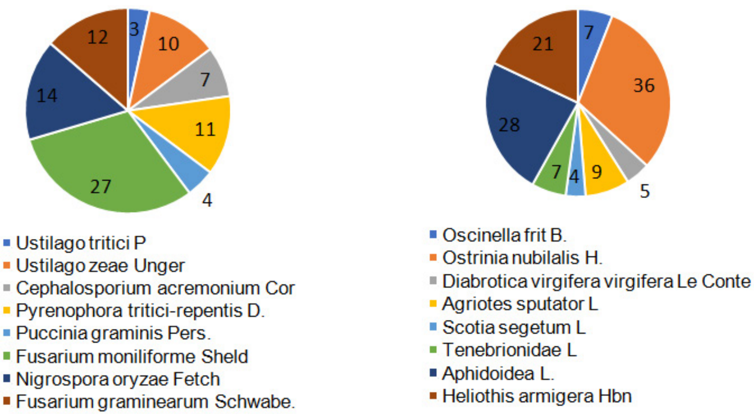


Figure 4. **Comparative structure of harmful organisms according to the technology of using urea-ammonia mixture on corn**

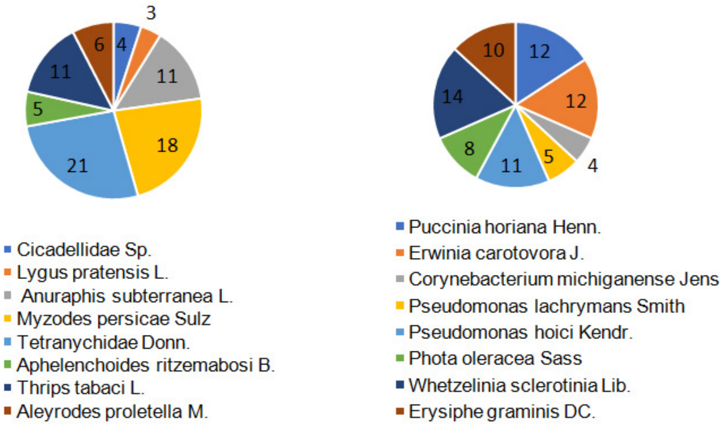


Figure 5. **Comparative structure of harmful organisms according to the technology of using urea-ammonia mixture on chrysanthemums**

After intense, heavy rains in the presence of heavy dew, it is not recommended to use UAM, 32% in a mixture with plant protection products, because during precipitation the structure of the upper leaf plate becomes relatively permeable (respectively, more sensitive), so spraying should be carried out after the leaves have dried on the plants.

The optimal time for applying UAM, 32% in a mixture with herbicides is in the evening hours of the day, since it is known that nitrogen uptake at night is slower. When applying UAM, 32%, it is necessary to use sprayers with a droplet size twice as large as for herbicides. Any sprayer can be re-equipped to apply UAM, 32%. To do this, it is necessary: to replace parts made of non-ferrous metals with PVC, stainless or fiberglass; to carry out foliar top dressing, replace slotted sprayer nozzles with deflector nozzles.

The adaptation of existing strategies to the concept of biological diversity in modern land use conditions goes through alternative or biological farming. This is a system of methods in which more attention is paid to environmental patterns in the organization of the process of agricultural production, in addition, traditional technological forms are required (Perederiy & Kovalenko, 2018; Kovalenko et al., 2020; Tabatabaei et al., 2020; Wawrzyniak et al., 2021; Tryhuba et al., 2021).

The main features of alternative farming are the refusal to use easily soluble mineral fertilizers, as well as synthetic plant protection products. It is expedient to stimulate the biological activity of the soil, including the widespread use of organic crop and livestock waste, compost, green fertilizers and the fixation of atmospheric nitrogen by nodule bacteria.

In 2010–2022, scientifically based farming methods based on biological and ecological principles were developed, which suggest that a scientifically based solution to this issue is based on the law of indispensability and equivalence of plant productivity factors, the interaction of these factors from simple to complex total. However, it is important to rotate crops in new crop rotations. In the agrocenoses of different cultures in the Dnieper part of the Forest-Steppe of Ukraine, 58 main species of carnivorous ground beetles belonging to 22 genera were found. There are three groups according to their abundance: massive, common and rare. In a typical agrocenosis, the groups are represented by 6 species: *Poecilus cupreus L., Pterostichus L, Bembidion properans Steph., B. Quadrimaculatum L., B. Lampros Herbst., Pseudoophonus mfipes Deg.* Their proportion was about 75% of all identified species of ground beetles of the entomocomplex. These species made it possible to carry out a comprehensive assessment of the population dynamics of predatory ground beetles during the growing season under various systems of modern farming (Mierzwa-Hersztek et al., 2019; Cucchiella et al., 2019; Borek & Romaniuk, 2020a; Tabatabaei et al., 2020; Borek et al., 2021; Romaniuk et al., 2021; Kukharets et al., 2021; Wawrzyniak et al., 2021; Kucher et al., 2022; Tryhuba et al., 2022; Faichuk et al., 2022).

Regular groups included 25 species, which accounted for about 22% of all collected ground beetles of the entomological complex. Rare species numbered 30 species-their share was less than 3%. This group includes species that have been found from one to three specimens over the entire period of research. According to biological involvement, 5 ecological groups were distinguished: steppe, meadow, tree–shrub, littoral and marsh (Tab. 4).

Table 4. Population of agricultural crops by species of predatory ground beetles

Genus	Species	Groups of ground beetles of the entomocomplex, a trap a day		
		massive	common	rare
Cicindela L.	*Cicindelajermanica L.*		0.8	
Carabus L.	*Carabus excellens F.*			0.3
	Carabus granulatus L.			0.3
	Carabus canxellatus I.			0.4
	Carabus violaceus L.			0.3
Calosoma Web.	*Calosoma auropunctatum Hbst.*		0.8	
Lorocera Latr.	*Lorocera pilicornis F.*		0.6	
Clivina Latr.	*Clivina fossor L.*		0.8	
	Clivina collaris Hbst.			0.3
Dyschirius Bon.	*Dyschirius globosus Hbst.*			0.3
Broscus Pz.	*Broscus cephalotes L.*		0.7	
Asaphidion Goz.	*Asaphidion flavipes L.*		0.4	
Bembidion Latr.	*Bembidion lampros Herbst.*	1.8		
	Bembidion properans Steph.	3.8		
	Bembidion quadrimaculatum L.	1.1		
Tachus Steph.	*Tachus bistriatus F.*			0.3
Trechus Clairv.	*Trechus quadristriatus Schrnk.*		0.4	
Pterostichus Bon.	*Pterostichus punctulUis Schall.*		1.1	
	Poecilus cupreus L.	18.5		
	Poecilus versicolor L.		0.5	
	Pterostichus melanarius I.	1.8		
	Pterostichus vemalis Pz.			0.2
	Pterostichus niger Schall.		0.5	
Agonum Bon.	*Agonum muelleri Hbst.*		0.8	
	Agonum dorsale Pont.			0.3
	Agonum gracilipes Gyll.			0.1
Calathus Bon.	*Calathus fyscipes Pz.*		0.4	
	Calathus helensis Schall.		0.5	

	Calathus ambiguous Pk.			0.2
	Calathus melanocephalus L.			0.2
Amara Bon.	*Amara plebeja Gyll.*		0.7	
	Amara familiaris Duft.		0.8	
	Amara eurinota Pz.		0.5	
	Amara similata Gyll.		0.6	
	Amara aenae Deg.		0.5	
	Amara communis Pz.		0.6	
	Amara convexior Steph.			0.2
	Amara bifrons Gyll.			0.3
	Amara consularis Duft.		0.4	
	Amara apricaria Pk.			0.1
	Amara majuscule Chd.			0.2
	Amara ingenua Duft.			0.2
Ophonus Steph. Harpalus Latr.	*Pseudoophonus rufipes Deg.*	0.9		
	Harpalus affinis Schrnk.			0.3
	Harpalus distinguendus Duft.		1.5	
	Harpalus smaragdinus Duft.			0.3
	Harpalus rubripes Duft.			0.3
	Harpalus modestus Duft.			0.2
	Harpalus pygmaeus Dej.			0.1
	Harpalus anxius Duft.			0.1
	Harpalus serripes Quens.			0.2
	Harpalus winkleri Schaub.			0.1
	Harpalus hirtipes Pz.			0.1
Anisodactylus Dej.	*Anisodactylus signatus Pz.*		0.5	
	Anisodactylus binotatus F.			0.1
Microlestes Schm-Ggeb.	*Microlestes minutulus L.*			0.2
Lasiotrechus Ggeb.	*Lasiotrechus discus F.*			0.1
Acupalpus Latr.	*Acupalpus mridianus L.*		0.4	

Representatives of the *Staphilinidae* family were also found in the agrocenosis, of which the following genera were numerous: *Pilonthus Curt., Paederus (P. Fuscipes Curt.), Tachuporus Grav.; Histeriadae: Hister L. (H. Bipusulatus Ol., H. Purpurascens Hbst., H. Uncinatus I., H. Quadrinotatus Scr.); Silphidae: Necrophorus F. (N. Vespillo L., N. Fossor Er., N. Germanicus L.), Thanatophillus Leach.*

Based on the results of studies, three periods were distinguished in the seasonal dynamics of the abundance of phytophages and predatory ground beetles.

- I period. The beginning of the spring vegetation of the cultivar (III decade of April-II decade of May). These terms fall on the spring vegetation period (III–IV stages of organogenesis). During this period, blacksmith larvae (Elateridae) cause great damage to crops: sowing (*Agriotes sputator L.*), striped (*A. lineatus*), dark (*A. Obscurus L.*) and others. In some places, black cherries (*Tenebrionidae*), in particular, lingering *Crypticus quisquilius L.*, become important. The larvae of these pests damage the underground part of the stems and the root system.So, after the restoration of the vegetation of cultivated plants, from the overwintered eggs, formed larvae of wheat opomysa (*Opomysa F.*) are obtained, which penetrate into the shoots of the main stem. The larva eats away the growth cone, the tissue turns brown, often rots, the central leaf turns yellow and dries up. The stems are damaged by the middle of the tube exit phase (V–VI stages of organogenesis). During this period, the seasonal population of winter wheat crops by predatory ground beetles depends entirely on the number of pests and is closely related to the stages of organogenesis.
- II period. The beginning of the summer vegetation (III-decade digestive-mid–June). This period is characterized by the development of beetles of the genus *Anisoplia L.*: the beetle (*A. Austriaca Herbst.*) and the beauty beetle (*A. Segetum Herbst.*). The timing of the colonization of crops by these beetles depends on the meteorological conditions in the spring, especially when the larvae are stuck and pupae develop. The period coinciding with the period of formation of the generative organs of cultivated plants is considered favorable for the revival of beetles. It is advisable to take this into account in new forms of land use and modern farming systems. The most numerous species of predatory ground beetles in this period were: *Poecilus cupreus L., Bembidion properans Steph., B. Lampros Herbst., B. Quadrimaculatum L.*
- III period. The end of the growing season of cultivated plants (the second half of July-the first decade of September). For aphids, nutritional conditions worsen and their development is inhibited. A small part of the aphid population is in a state of diapause, the rest migrate to other crops. Thrips finish their development and go to winter in the soil. Caterpillars of the winter scoop hobble. This period is accompanied by a general decrease in the habitability of crops of cultivated plants by predatory ground beetles.

As shown by the studies presented in (Cucchiella et al., 2019; Mudryk et al., 2019; Bryś et al., 2019; Borek & Romaniuk, 2020b; Kokovikhin, 2020; Tabatabaei et al., 2020; Tonkha et al., 2020; Kovalenko et al., 2020; Rogovskii et al., 2020; Polishchuk et al., 2021a; Vasylenko et al., 2021; Zieliński et al., 2021; Wawrzyniak et al., 2021; Mensah et al., 2021; Kovalenko et al., 2021a; Kovalenko et al., 2021b; Kovalenko et al., 2021c; Kucher et al., 2022; Havryliuk et al., 2022a; Havryliuk et al., 2022b) for a modern integrated system for the protection of field, fodder crops and flowers, measures to optimize the self-regulation of cenoses, in particular, agrotechnical methods and forms and norms for the use of fertilizers and chemical measures for Standardling a complex of harmful organisms, are essential.

The size of droplets sprayed by sprayers when applying plant protection products (herbicides, fungicides, insecticides) should not exceed 0.1 mm. This is necessary so that the solution covers the harmful object as much as possible, lingers on the leaves, thereby providing a protective effect.

In the case of feeding only UAM, 32%, a drop of such a size is required that the substance rolls off the plant only after wetting the leaves. Otherwise, the plant may get burned. It is the deflector nozzles that form the desired large–drop solution. Slit nozzles should be used exclusively when applying with herbicides with mandatory dilution of UAM, 32% with water; for work in windy weather, it is advisable to use extension hoses; line or band application is carried out using pouring pipes.

Under the conditions of the dominance of arable land in the agrocenoses of the research region with the use of UAM, 32%, the state of biodiversity of various levels, in particular trophically related to plants, is formed under ecological systems, as well as under generally accepted technologies. At the same time, there are no significant changes in the middle of the species and between different species in the studied agrocenoses. The biota interacts with plants and has a dominant pattern of sustainable agricultural production with new feeding systems. The reproduction of harmful and beneficial organisms when applying UAM, 32% is characterized by a complex self-regulating organization, which is based on structural component and functional continuity, which is also noted for the technologies of generally accepted plant nutrition and protection systems with the formation of optimal structural levels: individuals, populations, grouping of ecosystems. The functions of the studied agroecosystems are supported by self-regulation mechanisms and depend on the cultivated varieties of plants of local origin or imported from other parts of the world. Under the conditions of application of UAM, 32%, depletion of land use and changes in the implementation of the biological interaction of the studied species were not noted. No significant impact on ecosystems and the diversity of arthropods and other organisms, affecting the stability, nature of the supply and distribution of resources in ecosystems, which depend in general on the evolutionary process, has been established.

CONCLUSIONS

When applying UAM, 32%, the stability of organic diversity, characterized by a positive evolutionary process and adaptability of a complex of organisms associated with external factors of the environment without violations of the ratios of dominant species of organisms, was established. UAM, 32% does not affect levels of global biodiversity, with abiotic levels of agrocenoses, which provide optimal indicators of the circulation of substances, energy and information, as well as mechanisms for preserving the ecological niche and conditions for the existence of a diversity of biota.

High efficiency of UAM, 32% with phase–by–phase application of urea-ammonia mixture in the second year of alfalfa vegetation until plant vegetation is restored at a rate of 80 l/ha–120 l/ha. The amount of application of UAM, 32% depends on the timing before sowing-within 100 l/ha–150 l/ha, the second or third year of use, before the restoration of vegetation-80 kg ha^{-1}–120 kg ha^{-1}, while during the growing season their norm is 10 kg ha^{-1}–20 kg ha^{-1}. Comparison of the effectiveness of technologies with the use of fertilizers (generally accepted) and with the use of liquid fertilizer UAM, 32% allows us to assert the advantages of the latter, because the yield of green mass here increases 4.4 t ha^{-1}–5.0 t ha^{-1}.

The effectiveness of top dressing with the addition of plant protection products during the growth of alfalfa in April, and a single rate of UAM, 32% should not exceed 10 l/ha–20 l/ha. With the development of pests and an intensive increase in the green mass of alfalfa in June, the introduction of an insecticide tank mixture with the addition of 1.5 l/ha of micro fertilizer and UAM, 32% is highly effective. With such a scheme for the use of fertilizers and plant protection products, the efficiency of the alfalfa nutrition and protection system is 97.6%–98.2%, which is a reasonable and effective indicator. The cost for this is 165.00 dollars.

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