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AGRO ECOLOGICAL BASIS OF FERTIGATION APPLICATION IN THE NORTHEN STEPPE OF UKRAINE

The area of irrigated lands in Ukraine is 2,17 million hectares, over 60% of them are black soils. Nowadays under the current agricultural system on the irrigated lands we often deal with deterioration of their soil and ecological conditions such as the loss of soil fertility and the imbalance of the natural systems in general. This happens because the modern system of agriculture in the most cases is oriented on receiving agricultural products and doesn't take into account the need to preserve the soil, to harmonize of its productive and ecological functions.

An important factor in the development of land irrigation is environmental and climatic conditions. According to these conditions there are three climatic zones in Ukraine:

- excessively wet forest (25% of the territory);
- insufficient moisture steppe (35%);
- arid steppe (40%).

Almost on the 75% of the territory of Ukraine agricultural crops are grown in the insufficient natural dampening. Moisture deficit is a major limiting factor in crop productivity.

Another important factor that should be taken into account while analyzing the conditions of existence and development of irrigation in Ukraine is global climate change. On the global, and as a consequence, on the regional level the society should solve the extremely important and complex issues associated with developing and implementing strategies of its existence in terms of global climate change.

Ukraine is among the world's regions, where ongoing climate change is visible. Even without carrying out special observations, one can see that the duration of winter periods decreased significantly and the winters themselves became less cold. Droughts were observed more often. In the last century 43 years of drought were recorded on the territory of Ukraine, including 7 of them in the past 15 years [3].

Good agro ecological condition of irrigated lands is a condition for their effective use. Therefore, the development and implementation of actions for improving agro-ecological conditions of irrigated lands are among the priority.

In the complex of actions to maintain the fertility of irrigated lands at the necessary level and to generate the highest possible agricultural crop yields of high quality, a fertilization program is very important. It should be a plan for the use of mineral and organic fertilizers in crop rotation with their doses, time and method of application [4].

One of the ways for intensification of the irrigated agriculture is the combination of irrigation with the use of chemicals, in particular the application of mineral fertilizers (which was called fertigation, from the English words irrigation and fertilizer), herbicides (herbigation), ameliorants and microelements.

Let us consider the results of our research about use of fertigation in the northern Steppe of Ukraine in the intensive cultivation technology of irrigated corn. Fertigation is a logical consequence of the development and improvement of irrigation techniques, increasing the level of use of chemicals and land reclamation, construction of technically advanced irrigation systems, use of modern wide-sprinkling machines [5].

Application of mineral fertilizers together with irrigation water fully meets the idea of multiple uses of irrigation systems and sprinkler equipment, increases the efficiency of water and fertilizers, favors the preservation of soil structure, and improves ecological conditions for growing maize. Fertigation allows to introduce the complex mechanization and automatization, ensuring corn yields at the level of 10 – 12 t/ha and reduce the energy resources cost [6,7].

The use of fertilizers with irrigation water solves the problem of even distribution of fertilizers in the active layer of soil to the level comparable with the even distribution of irrigation water. Very important advantage of this method is the possibility to apply fertilizers in small doses during the vegetative period without mechanical damage of plants and chemical burns [8].

The combination of fertilizers and irrigation in a single technological process causes the phenomenon of synergy. Two of the most important factors of corn yield – irrigation and fertilization mutually reinforce each other, resulting in

an additional factor – their interaction [7].

One third of the energy costs for growing corn in the Steppe of Ukraine is formed by fertilizers application. Traditional technology of mineral fertilizers application by surface method remains imperfect. Technological factors are dominated in it above biological ones, because soil is generally fertilized, not plants. When fertilizers apply with primary cultivation almost 6 month before they intensively use by maize, plants lose a lot of nutrients. In the result of mineralization, evaporating into the air and leaching into deeper soil layers these nutrients contaminate environment.

Technological possibilities of machines with centrifugal dispersive device are very low [7]. Allowable uneven distribution of solid mineral fertilizers within a field is ± 25%, but in practice fluctuations (deviations) during applying high doses may reach 50 – 75%. It is naturally that uneven applying, especially one of a large amount of fertilizers, leads to their irrational use and sometimes to the long-term negative consequences not only for the plants but also for the soil (nutrients surplus in some areas and their shortage in others, nitrate contamination, etc), which are often difficult to eliminate.

The use of heavy machine-tractor aggregate for application and fertilizers closing cause compaction of the upper layers of soil, decreasing of its physical characteristics, reducing yields and quality of maize. Mineral fertilizers are produced and supplied unevenly. So if producers purchase fertilizers in the period of maize vegetation they cannot use them. This is due to the fact that the use of row-crop cultivators for feeding is restricted at the moment of closing of maize crops in rows. Frequent small fertilizer tanks refilling on cultivators lead to considerable labor costs. Use of aircrafts for feeding have not been widely spread yet.

In view of the above, in recent years the system of intensive cropping includes the advanced method of applying mineral fertilizers with irrigation water.

Applying fertilizers at the same time with irrigation water provides the opportunity to optimize the supply of moisture to the plant over the whole vegetative period.

Fractional nitrogen fertilizers application with irrigation water provides more even nutrient availability, than their one-time application before seeding. In this case the terms and doses of fertilizers application for feeding are calculated by taking into account biological characteristics of crops, soil conditions and coordinated with irrigation schedule.

It is well known that the corn till the pinnacle injection phase consumes about 30% of nitrogen of the overall consumption of this element. Further the need of nitrogen increases especially in the period from pinnacle injection till milky ripeness of grain. At that time maize consumes the largest part of nitrogen. In the period from milky to full ripeness nitrogen consumption decrease to 13,7 – 26,6% [9].

Experiments, conducted at the Institute of Grain Farming, NAAS of Ukraine showed that under application of fertigation maize yields increase by 5 – 10% [6,7]. The best were the results of the nitrogen fertilization scheme, where the full amount of nitrogen was applied with irrigation water fractionally in equal doses after sowing, in 10 – 12 leaves phase, pinnacles ejection and at the beginning of milky ripeness phases. In conditions of experiment this phase provided the 11,2 – 12,3% of yield increasing [9]. The elements of this agricultural practice (terms, doses, methods of fertigation, ecological factor) are not thoroughly studied yet, that's why the further research is essential.

The aim of our research is to study the optimal norms, methods and timing of mineral fertilizers application in terms of intensive technology of growing maize for grain under irrigation.

Materials and research methods. Field experiments were conducted over the period of 1999 – 2001 on the educational-experimental farm of Dnipropetrovs'k State Agrarian University "Samarskiy". Soils are ordinary eroded loamy black earth. Thickness of humus layer is 65 – 70 cm, content of humus in topsoil is about 3,0%. Content of nitrogen after 7 days of composting (by Kravkov) in 100 gr. of tight soil is 1,4 – 3,8, phosphorus content (by Chirikov) is 11,9 – 15,5, potassium content (by Maslova) is 10,0 – 14,4 mg/100 gr. of soil. Subsoil water lies at the level more than 15 meters.

Weather conditions during the research years were generally favorable for growing maize under irrigation. During the vegetative period (May – September) of the year 1999 there were 128 mm of atmospheric precipitation, in 2000 – 216 mm, and in 2001 – 192 mm.

During the experiments the middle-early hybrid of maize Pioneer 3978 was sown. The norms of mineral fertilizers calculated for 8 and 10 t/ha, grain yield were studied. The technology of maize growing has been accepted as common use for this crop in the northern Steppe zone of Ukraine. Sprinkler irrigation was performed with unit DDA-100MA. Mineral fertilizers were dosed into irrigation water with a special fertilizer injector, manufactured in the laboratory of the Institute of Grain Farming NAAS of Ukraine. Irrigation schedule provided moisture level in the active soil layer not less than 70 – 80% MWC (minimum water capacity). Irrigation rate norm was 1800 – 2100 m^3/ha.

Sowing area of the experimental fields was 630, and researched one was 150 m^2. Repetition was fourfold.

Statistical processing of the results was performed with the help of analysis-of-variance method according to the known procedure [10].

As fertilizers carbamide, granulated superphosphate and potassium salt were used. Phosphoric and potassium fertilizers were added in calculated doses to the working plots for cultivation, carbamide – in accordance with the research program for cultivation and with irrigation water.

Doses of mineral fertilizers for planned maize grain yield were calculated with the help of balanced method due to the content of major nutrients in the soil.

To study the efficiency of nitrogen fertilizers with irrigation water compare to the traditional surface method and defining optimal parameters of fertigation the following options were developed.

Technological schemes of applying nitrogen fertilizers are the next:

1- full norm under fall-plowed land cultivation (control);
2- fractionally: 40% of norm with cultivation, and 20% with irrigation water in the phases of 10 – 12 leaves, pinnacle ejection and milky ripeness of the grain;
3- fractionally: 40% of norm with cultivation, and 40% with irrigation water in the phase of 10 – 12 leaves and 20% in the phase of pinnacle ejection;
4- full norm of nitrogen with irrigation water fractionally in doses of 20% in the phases of 10 – 12 leaves, pinnacle ejection and milky ripeness of grain, and 40% in the phase of pinnacle blooming stage;
5- full nitrogen norm with irrigation water fractionally in doses, 40% after sowing in the phase of 10 – 12 leaves, 40% in the phase of pinnacle ejection and 20% in the phase of milky ripeness of grain.

The results of research. The study has shown that the nitrogen content in soil, which plays an important part in plant fertility under irrigation, depends on method and terms of fertilizers application (table 1).

Table 1 – Nitrate concentration in the soil layer of 0 – 60 cm, depending on nitrogen fertilizers application for programmed yield 8 t/ha (average 1999 – 2001) mg/kg of soil

Variant	Phase of Development		
	5-6 leaves	10-12 leaves	milky ripeness of grain
1 - N_{150} P_0 K_{60} (at random for cultivation)	30,8	26,1	15,3
5 - N_{150} P_0 K_{60} (with irrigation water)	20,5	25	18,8

In autumn under using mineral fertilizers randomly nitrates migrate from root soil layer, and according to the received data it gets exhausted. Before the period when maize plants need nitrogen intensively (10 – 12 leaves) there were less nitrates in the soil than during the period of 5 –6 leave on 15,3% and in the phase of milky ripeness of grain – on 50,3%. At the same time under numerous nitrogen applications with irrigation water the content of nitrates in soil in that period was less, furthermore there was much more of them, especially in a milky ripeness phase that positively affected yields.

The results of research have shown that the use of nitrogen fertilizers with irrigation water increase maize yields more than under surface application method (table 2).

Table 2 – The yield maize hybrid Pioneer 3978, depending on the dose and method of mineral fertilizers application, t/ha

Calculated dose of mineral fertilizers for yield	Nitrogen fertilizers application scheme	Year			Average	± to control	
		1999	2000	2001		t/ha	%
Without fertilizers		5,16	5,96	5,48	5,53	-	-
8,0 t/ha	1 (control)	7,86	7,75	8,01	7,87	-	-
	3	8,14	8,46	8,54	8,38	0,51	6,6
	5	8,28	8,65	8,58	8,51	0,63	8,1
	Average	8,09	8,28	8,37	8,25	-	-
10,0 t/ha	1 (control)	9,28	9,34	9,46	9,36	-	-
	3	9,87	10,20	10,06	10,04	0,62	6,7
	5	10,14	10,32	10,42	10,29	0,93	10,0
	Average	9,76	9,95	9,98	9,89	-	-
$HCP_{0,5}$ t/ha for schemes		0,03	0,47	0,21	-	-	-
$HCP_{0,5}$ t/ha for doses		0,24	0,32	0,13	-	-	-

With increasing of mineral fertilizers dose corn yield was increasing in average by 2,72 – 4,36 t/ha (6,6 – 10%) comparing to the option without fertilizers.

Evaluating any technological method it is important to take into account not only its impact on the amount of yield but also on its consumer qualities. Under irrigation with yield increasing, the deterioration of the grain quality is often observed, exactly the reduction of protein content. Our research had shown that with the increasing of mineral fertilizers norm the protein content increases too.

In hotter conditions of the given period in years 1999 – 2001 the content was 34,85 – 55,73 and 44,7 – 52,6 mg/kg respectively. At all studied soil fertility nitrate content was lower than admissible concentration limit (MPC nitrate content in maize corn is 300 mg/kg). Applying of high norms of mineral fertilizers as well as applying nitrogen fertilizers along with irrigation water didn't increase the nitrate content in maize grain.

Conclusions

Nowadays it is very important to implement new, effective and ecologically safe agricultural technologies, that stipulates the decrease of mineral fertilizers doses and increase of their rate of return in 1,5 – 2 times by means of optimization of terms and methods of application. Under the intensive technology of maize growing on irrigated soils in northern steppe of Ukraine it is reasonable to apply nitrogen fertilizers along with irrigation water in proportions as follows: 40% of the overall dose in the period of 10 – 12 leaves, 40% – in the phase of pinnacle ejection and 20% in the

phase of milky ripeness of grain. Under these conditions of nitrogen application maize grain yield in average had been increased on 2,72 – 4,36 t/ha, than without fertilizers application.

The tendency of protein rising in maize grain under nitrogen fertilizers with irrigation water application was observed. High norms of mineral fertilizers application and fractional application of nitrogen fertilizers with irrigation water didn't affect the nitrate content in grain and didn't deteriorate its quality.

The results of research indicate that combining irrigation with mineral fertilizers application (fertigation) is an effective method of decreasing energy and material resources, increasing yields and quality of maize grain and protect soil from degradation.

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ВЛИЯНИЕ ЭКОЛОГИЧЕСКИХ, ЭКОНОМИЧЕСКИХ И СОЦИАЛЬНЫХ ИЗМЕНЕНИЙ НА ЛЕПТОСПИРОЗ В КРЫМУ

Введение: Деятельность человека направленная на создание оптимальных условий для его существования и удовлетворения социально-экономических потребностей воздействует на природную среду и тем самым может влиять на природные очаги инфекционных заболеваний и повлечь непредсказуемые изменения в их активности.

Крымский полуостров подвергается значительному антропогенному воздействию, приводящему к новым экологическим и социальным условиям. В Крыму расположены природные очаги инфекционных заболеваний (лептоспироз, туляремия, Крымская-Конго геморрагическая лихорадка, клещевой энцефалит и др.) имеющие выраженную приуроченность к определенным территориям и биотопам [1, 2].

Одним из наиболее распространенных природно-очаговых заболеваний в Крыму является лептоспироз. Заболевания людей регистрируются в 17 административных районах, что имеет не только медицинское, но и экономическое значение.

Цель: определить значение экологических, экономических и социальных изменений на заболеваемость людей лептоспирозом в Крыму.

Материалы и методы: проанализирована заболеваемость лептоспирозом за период с 1946 по 2010 гг. по архивным материалам Республиканской санитарно-эпидемиологической станции АР Крым, проведен ретроспективный эпидемиологический анализ лептоспироза в АР Крым и г. Севастополе на основании 195 карт эпидемиологического обследования за период с 1981 по 2010 гг. Визуальное отображение и проведение пространственного анализа выполнено с использованием ГИС-технологии, программа ArcGIS 9.2 (лицензия E300 3/02, ESRI, США).

Результаты и их обсуждение

Экологические изменения: Одним из определяющих условий для поддержания существования природных очагов лептоспироза является наличие водных источников. Степные районы Крыма и Керченский полуостров не являлись оптимальными для существования природных очагов, но ввод в строй Северо-Крымского канала в 1965 году привел к созданию новых экологических условий: площадь орошаемых земель быстро увеличивалась, внедрили рисосеяние. Не учтенные особенности Крымского полуострова при проектировании,