INTRODUCTION
Over the past 25 years, the agriculture of Ukraine is characterized by a radical reform of the agroindustrial complex (AIC). Elimination of collective and state farms, and change of the forms of ownership is at the base of these reforms. As land shares, the majority of the lands passed into the ownership of former collective farmers and state farm workers. In recent years, land shares are actively leased or bought up by the private farms and large farming enterprises. Unfortunately, small-scale land users and private farms of the AIC still function without proper sanitary control over the transportation, storage and use of pesticides (P), and they are characterized by unfavourable working conditions for workers. Unfavourable working conditions of agricultural workers (mostly hired workers to perform certain seasonal jobs) are characterized by imperfect technological process, extensive use of outdated equipment and machines, a large amount of poorly mechanized labour operations and manual labour, especially when growing sugar beet, tobacco, gardens, and vinelands [1-3]. At the same time, there is a deterioration in the provision of workers with individual protective equipment against the exposure of adverse production factors, as well as health care services due to closing-down of medical and obstetric centres and district hospitals, deterioration in the quality of preliminary and regular medical examinations, and almost complete disruption of medical examination system [1-4].

Due to introduction of new forms of agriculture and transformation of the treatment and preventive service in recent years, there has been a false impression of a sharp decrease in the level of occupational morbidity among agricultural workers 30 % to 25 % in the structure of general occupational morbidity in the 80–90s down to 0.2-0.4 %. The decrease in occupational morbidity among agricultural workers has occurred dozens of times, despite the increase in the volume of work and production of grains, vegetable crops, sunflower, etc. [5]. Misinterpretation of the low level of occupational morbidity among agricultural workers is associated not only with the deterioration of the quality of regular medical examinations, but also with the fact that farmers often use seasonal hired workers without legal registration to work, and therefore they have no registered work experience, that does not allow to trace a...
connection between the developed diseases and profession. Unfortunately, the problems of social security of small-scale land users, farmers, private machine operators, who are employed, have not been solved so far. In addition, the system of deduction of contribution amounts to the social insurance fund requires improvement.

In recent decades, the structure of occupational diseases in agricultural workers has been formally represented mainly by group cases of acute pesticide poisoning [1–4]. Acute pesticide poisoning is still quite widespread, and in most cases occurs due to gross violations of hygienic regulations, mainly among people of working age, causing a long-term loss of professional working ability and often persistent disability, and is accompanied by significant social and economic damage [1–6].

THE AIM
Objective: summarize data on the prevalence, causes, structure of acute pesticide poisoning in agricultural workers at the current stages of its reform in order to improve preventive measures.

MATERIALS AND METHODS
Data on the causes of development, prevalence and structure of acute pesticide poisoning in agricultural workers were summarized depending on profession and work experience. Only those cases of intoxication with pesticides among agricultural workers over the past 25 years have been analyzed, in which the staff of the Scientific Center took part in the sanitary-hygienic and clinical-laboratory study of the aetiology of poisoning and clarification of the diagnosis. Unfortunately, it is not possible to summarize all cases of acute pesticide poisoning in the country, since all poisonings are still recorded in the “Other” column of the statistical reporting forms.

This paper analyses the results of sanitary-hygienic and clinical-laboratory examination of 647 cases of acute occupational pesticide poisoning among agricultural workers, with predominance of acute poisoning with 2,4-dichlorophenoxyacetic acid-based herbicides (2,4-D) — 522 patients (80.7 %) and organophosphorus compounds — 60 patients (9.3 %). Victims also included 36 patients with acute poisoning with sulphonylurea-based herbicides (Rimsulfuron), 14 patients poisoned with synthetic pyrethroids (SPs), and isolated cases of intoxication with aluminium phosphate, dithiocarbamates (TMTD), oxatiine compounds (Vitavax), and phenylypyrazole derivatives (Fipronil).

After first aid, all the victims were transferred to the clinic of the Scientific Toxicological Center, where all patients underwent standard detoxification and antidote therapy [6–7], as well as general clinical and biochemical examination according to standardized methods [8]. Classification and general principles of diagnostics set out in the guidelines for physicians by Ye. A. Luzhnikov et al. were adopted as the basis for the diagnostics of clinical syndromes of intoxications and determination of their degrees of severity [9].

RESULTS AND DISCUSSION
The composition of the examined patients and the structure of acute pesticide poisoning are presented in Table I, which shows predominance of patients with 2,4-D-based (80.7 %), OPCs (9.3 %) and sulphonylurea-based herbicide poisoning (5.6 %).

In the professional composition of the examined patients, the field beet growers prevailed: out of them, 522 patients (80.7 %) with acute 2,4-D-based herbicide poisoning and 36 patients (5.6 %) with sulphonylurea-based herbicide poisoning. The professional composition of the main group of patients with acute pesticide poisoning is presented in Table II.

All 6 patients with TMTD poisoning and 4 with aluminium phosphate poisoning were workers of grain storages, who violated hygienic regulations during grain treatment. Three cases of Vitavax poisoning occurred in the workers of mixing units, two cases of Fipronil poisoning developed in workers during treatment of potatoes with a gross violation of hygiene requirements. The age of all examined patients ranged between 28 and 62 years (mean age — 36.4 ± 0.7 years). Out of the 647 cases of acute poisoning, 605 patients were females (93.5 %) — all field crop and fruit growers, winegrowers, disinfectors, and several general workers. Among 14 patients with acute SP poisoning, there were 8 females and 6 males.

Acute poisoning with 2,4-D-based herbicide in 522 field beet growers (8 cases of group poisoning, 24 to 153 victims) and sulphonylurea-based herbicides in 36 field beet growers, who performed the manual thinning of sugar beet sprouts, resulted from the driftage of herbicides from adjacent fields, sowed with cereals, which, without coordination with other land users, were treated at the same time with these pesticides. Also as a result of the driftage of pesticides from adjacent fields treated by OPC machinery operators, acute OPC (Dimethoate) poisoning also occurred in 36 female winegrowers who, at the same time, carried out manual work on a nearby vineyard in hot weather. The main cause of these poisonings was lack of consistency in plans for the use of pesticides among land users, whose lands border each other.

Out of 60 cases of OPC poisoning, in 13 cases (21.7 %) poisoning occurred under the action of karbofos, in 8 cases (13.3 %) – dichlofos, in 3 cases (5.0 %) – phosalone, and in 36 cases (60 %) – dimethoate.

Signs of OPC poisoning in the majority of victims appeared 2–3 hours after inhalation and percutaneous occupational exposure. The main complaints of the victims were increased tearing and salivation, headache, dizziness, heavy cough with profuse mucous sputum, paraesthesia in the hands and feet, cramps in the muscles of the extremities, nausea, and often vomiting and pain in the right hypochondrium or in the region of the heart. Depending on the severity of complaints and clinical-laboratory parameters, 51 out of 60 patients (85 %) had a mild degree (I) of intoxication, 6 (10 %) — moderate (II), and 3 (5 %) — severe degree (III). The test for blood serum cholinesterase (CE) and acetylcholinesterase in red blood cells showed that
while their levels decreased by an average of 20-40% in case of degree I of intoxication, then their levels decreased on average by 73.8% and 78.8%, respectively, and returned to normal only in 30-40 days in case of degree II-III.

Patients with acute 2,4-D-based and sulphonylurea-based herbicide poisoning complained of general weakness, headache, dizziness, paraesthesia in the face, tongue, lips, hands and feet.

Among 14 patients with acute SP poisoning, in nine cases poisoning developed upon exposure to 2.5% Decis (deltamethrin), in one — 2.5% Arrivo (cypermethrin), in three — 20% Sumicidin (fenvalerate), and in one case — 5% Karate (lambda cyhalothrin). All victims after exposure to SPs noted intense headache, dizziness, general weakness, burning sensation and hyperaemia of the face, visible mucous membranes and sclera, as well as severe paraesthesia in the face, especially in the nasolabial triangle, nausea and vomiting of varying degrees of intensity. Similar complaints were noted in patients with acute TMTD, Vitavax and Fipronil poisoning.

Thus, the reform of agriculture in Ukraine, unfortunately, is not accompanied by proper and effective sanitary control over the labour conditions of the workers. Due to this, hygienic requirements for the storage and use of pesticides are often grossly violated, which is accompanied by the development of acute poisonings with agrochemicals, including group ones.

The main reason for sanitary and hygienic violations is the lack of coordination of plans for the use of pesticides among both land users and the sanitary service. Within the structure of group acute pesticide poisoning, agricultural workers, beet growers are predominantly poisoned with 2,4-D-based and sulphonylurea-based herbicides, winegrowers are poisoned with OPCs as a result of the driftage of these pesticides from adjacent fields due to lack of coordination of plans for the use of agrochemicals between the land users whose lands border each other.

**CONCLUSIONS**

The strengthening of sanitary control over the implementation of hygienic regulations for individual and public safety in the purchase, storage, and use of pesticides is at the basis of the developed complex of preventive measures. The necessity for land users to annually draw up work plans for the use of agrochemicals in the fields and their mandatory coordination not only with the sanitary service, but also with adjacent land users whose lands border each other has been justified. At the same time, the complex of organizational and sanitary-hygienic-

---

Table I. The structure of acute pesticide poisoning in the examined patients

<table>
<thead>
<tr>
<th>Pesticides</th>
<th>Number of victims (n=647)</th>
<th>Proportion, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,4-dichlorophenoxyacetic acid-based herbicides (2,4-D)</td>
<td>522</td>
<td>80.7</td>
</tr>
<tr>
<td>Organophosphorous compounds (OPCs)</td>
<td>60</td>
<td>9.3</td>
</tr>
<tr>
<td>Sulphonylurea-based herbicides</td>
<td>36</td>
<td>5.6</td>
</tr>
<tr>
<td>Synthetic pyrethroids (SPs)</td>
<td>14</td>
<td>2.2</td>
</tr>
<tr>
<td>Aluminium phosphate</td>
<td>4</td>
<td>0.6</td>
</tr>
<tr>
<td>Dithiocarbamates (TMTD)</td>
<td>6</td>
<td>0.9</td>
</tr>
<tr>
<td>Oxatiine compounds (Vitavax)</td>
<td>3</td>
<td>0.5</td>
</tr>
<tr>
<td>Phenylpyrazole derivatives (Fipronil)</td>
<td>2</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Note: n — number of patients.

Table II. The professional composition of the main group of patients with acute pesticide poisoning

<table>
<thead>
<tr>
<th>Professional groups</th>
<th>2,4-D (n=522)</th>
<th>OPCs (n=60)</th>
<th>Sulphonylurea (n=36)</th>
<th>SPs (n=14)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field beet growers</td>
<td>522</td>
<td>–</td>
<td>36</td>
<td>–</td>
</tr>
<tr>
<td>Winegrowers</td>
<td>–</td>
<td>36</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Breeders</td>
<td>–</td>
<td>9</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Fruit growers</td>
<td>–</td>
<td>8</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Workers of toxic chemical warehouses</td>
<td>–</td>
<td>2</td>
<td>–</td>
<td>5</td>
</tr>
<tr>
<td>Disinfectors</td>
<td>–</td>
<td>2</td>
<td>–</td>
<td>3</td>
</tr>
<tr>
<td>General workers</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>6</td>
</tr>
<tr>
<td>Machinery operators</td>
<td>–</td>
<td>3</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

Note: n — number of patients.
ic measures for the prevention of acute pesticide poisoning, both on an individual and collective level, has been optimized.

REFERENCES

The work was done within the framework of the scientific-research work “Scientific substantiation of modern normative requirements for the use of pesticides and agrochemicals: forecasting of remote effects of action (carcinogenic, mutagenic, teratogenic activity, reproductive toxicity, chronic intoxication)" (state registration number 0108U007458).

Authors’ contributions:
According to the order of the Authorship

Conflict of interest:
The Authors declare no conflict of interest

CORRESPONDING AUTHOR
Galyna M. Balan
SE “L. I. Medved’s Research Center of Preventive Toxicology, Food and Chemical Safety of the Ministry of Health of Ukraine”
6, Heroiv Oborony Str., Kyiv 03127, Ukraine
tel: +380953182883

Received: 20.03.2019
Accepted: 02.05.2019