IN THE PAPER ARE ANALYZED FOLLOWING BLOOD COUNT PARAMETERS: ERYTHROCYTES, HEMOGLOBIN, LEUCOCYTES AND THROMBOCYTES.

THE AIM OF THE PAPER IS TO INVESTIGATE WHETHER PESTICIDES INFLUENCE CHANGED BLOOD COUNT OF TRACTOR DRIVERS EXPOSED TO PESTICIDES DURING THEIR WORK.

ANALYSIS OF OBTAINED RESULTS INDICATES THAT EXPOSURE TO PESTICIDES, LIKE IN EXAMINED GROUP OF WORKERS, HAS NOT INFLUENCED DAMAGE IN ANY OF INVESTIGATED BLOOD COUNT PARAMETER.

KEY WORDS: BLOOD, BLOOD ELEMENTS, PESTICIDES, TRACTOR DRIVERS.
Apart from previously mentioned facts, influence of pesticides to exposed workers extremely depends on technology of pesticide application. It is significant to emphasize that technology of pesticide application in our country develops much slowly than other agro-technical measures. Technical solutions of equipment for pesticide application very often lag behind the new knowledge in achieving necessary efficiency of newly made compounds/preparations. Each preparation requires certain way of application and in order to increase efficiency control of their application is necessary to be made. Controlled application of pesticides is achieved with modern equipment that is increasingly improved in developed countries day by day. However, in our circumstances this improving of protective equipment is very slow. We are now in the second phase of development while developed countries are in the fifth phase (Đukić et al., 2001).

Pesticides, like all poisons, which reach in human body at the location of their metabolism, extraction or accumulation, have to come there through blood. In addition, circulating cells of peripheral blood and bone marrow, except cells of some lymphocyte lines are relatively short-living and quickly renewed, so even slightly changed length of living or rate of their production result in significant disorders in peripheral blood (Jocić and Savić, 2002).

Having in mind these facts, pesticide influence to blood can be manifested as follows:

— In the direction of provoked disorders in reproductive cells that imperil reproduction ability of those cells and results in decreased number of red blood cells, white blood cells and thrombocytes in peripheral blood (carbamates, organo-chlorine compounds, substituted phenols, and rodenticides (Savić, 1997; Fait et al., 1994).

— In the direction of diseases that are characterized by abnormality in maturation and production of certain types of blood elements which consequently result in their increased sensitivity (carbonic herbicides, dipiridiles (paraquat), copper-sulphate) (Savić, 1997; Fait et al., 1994), and

— In the direction of diseases with main characteristics of exceeded production of cells of all or some of blood lines (Savić, 1997; Fait et al., 1994).

In addition, of influence to reproductive cells in bone marrow and maturation process of blood elements, pesticides can also imperil mature blood cells in peripheral blood. Accordingly, copper-sulphate can cause insufficiency of one enzyme (glucose-6-phosphate dehydrogenase) which results in rapid decay and decomposition of red blood cells; due to production of unnatural blood color (methemoglobin) in red blood cells, dinitrophenol and paraquat can cause anemia; organic solvent tetrachlorinecarbone and organic nitro and amino compounds cause disease called porphyria etc.

These are reasons why accurate interpretation even of a slight and/or atypical disorder in peripheral blood can indicate to professional poisoning with pesticides.
MATERIAL AND METHODS

The sample included 142 tractor drivers employed in government agricultural organizations who were exposed to pesticides during their agricultural activities.

Blood for analysis of certain parameters of blood count was taken in the period from October 2007 to the end of January 2008. During this period selected tractor drivers had regular periodical check-ups.

Regarding to annual and daily exposure to pesticides of tested persons it was determined that daily length ranged from 3—12 hours and annual from 5—125 days, in average 60.93 days.

During the year was applied great number of preparations with more than 20 various active substances. Mostly were used organo-phosphorous compounds, then triazines and carbamates and fewer phenoacetic acid and urea derivatives, piretroides, anilides, imidazolines, phtalimides etc. Organo-chlorine compounds were rarely used.

During work with pesticides each of tested tractor drivers had certain personal protective devices (in accordance to internal regulations of the firm).

The control group encompassed 70 doormen and workers who were exposed neither to pesticides nor to any other substances with poisoning effect to blood and blood elements.

All persons in sample and control group were males.

In this paper were monitored the following parameters of blood count: red blood cells (erythrocytes), blood color (hemoglobin), white blood cells (leucocytes) and blood platelets (thrombocytes).

Counting of observed blood elements, concentration of blood color (hemoglobin) is performed by automatic counter AVL AUTOLYZER AL 818 after usual procedure of preparation of blood samples.

Borderline values of described method are erythrocytes from 3.90—6.50x10^{12}/L, hemoglobin from 120.00—175.00 g/L, leucocytes from 4.00—11.00x10^{9}/L and thrombocytes from 15.00—400.00x10^{9}/L.

Blood count and other laboratory analyses are performed 5—6 months after exposure.

In statistical data processing are used the following methods: average value (\bar{x}), minimal value (Min) and maximal value (Max), standard deviation (SD), coefficient of variation (CV) and Student’s t-test (p).

The aim of the paper was to investigate whether pesticides influence changed blood count of tractor drivers who were exposed to pesticides during their work.

RESULTS

The sample encompassed 142 tractor drivers who were exposed to pesticides during their work.

The average age of tractor drivers was 38.16 and average age in the control group was 39.98 years. Age of living in both groups was homogenous — CV at tractor drivers and control group was identical: 18.14% (Table 1).
### Tab. 1. — Age of tractor drivers and the control group

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Tractor drivers (N = 142)</th>
<th>Control group (N = 70)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average (x)</td>
<td>38.16*</td>
<td>39.98*</td>
</tr>
<tr>
<td>Minimum</td>
<td>25</td>
<td>22</td>
</tr>
<tr>
<td>Maximum</td>
<td>57</td>
<td>55</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>6.92</td>
<td>7.25</td>
</tr>
<tr>
<td>Coefficient of variation %</td>
<td>18.14</td>
<td>18.14</td>
</tr>
</tbody>
</table>

* There is no statistically significant difference between groups (p > 0.05)

Difference of average age of tractor drivers and control group was not statistically significant (p > 0.05) (Table 1).

Average length of service spent at the post of tractor driver (exposed length of service — ELS) was 11.18 years, while for control group this data was not statistically significant because they were selected regarding to non-exposure to pesticides.

### Tab. 2. — Hematological parameters of the tractor drivers and the control group

<table>
<thead>
<tr>
<th>Statistics</th>
<th>Red blood cells (x10^{12}/L)</th>
<th>Hemoglobin (g/L)</th>
<th>White blood cells (x10^9/L)</th>
<th>Platelets (x10^9/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>T</td>
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<td>T</td>
<td>C</td>
</tr>
<tr>
<td>Average (x)</td>
<td>4.94</td>
<td>4.99</td>
<td>154.1</td>
<td>154.4</td>
</tr>
<tr>
<td>Minimum</td>
<td>4.16</td>
<td>4.11</td>
<td>133</td>
<td>112</td>
</tr>
<tr>
<td>Maximum</td>
<td>6.94</td>
<td>5.79</td>
<td>182</td>
<td>178</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>0.4</td>
<td>0.32</td>
<td>8.56</td>
<td>9.92</td>
</tr>
<tr>
<td>Coefficient of variation %</td>
<td>8.23</td>
<td>5.55</td>
<td>6.42</td>
<td>26.43</td>
</tr>
</tbody>
</table>

T = tractor drivers C = Control group * p < 0.05 (t-test)

Average number of red blood cells registered at tractor drivers was 4.94x10^{12}/L and at their control group it was 4.99x10^{12}/L. In both groups was registered very low coefficient of variation (CV) of the number of red blood cells. Difference of the average number of red blood cells between tractor drivers and control group was not statistically significant (p > 0.05) (Table 2).

Average concentration of blood color (hemoglobin) at tractor drivers was 154.17 g/L while in their control group it was 154.40 g/L. In both groups was also registered very low coefficient of variation (CV) of blood color (hemoglobin) concentration in blood. Difference of average blood color (hemoglobin) concentration between tractor drivers and control group was not statistically significant (p > 0.05) (Table 2).

Average number of white blood cells registered at tractor drivers was 7.12x10^9/L, while at their control group it was 7.29x10^9/L. In both groups was registered coefficient of variation (CV) of the number of white blood cells above 20%. Difference of average number of white blood cells between tractor drivers and control group was not statistically significant (p < 0.05) (Table 2).
Average number of blood platelets (thrombocytes) at tractor drivers (246.11x10⁹/L) was higher than at their control group (208.55x10⁹/L). Coefficient of variation of the number of blood platelets (thrombocytes) in both examined groups also ranged around 20%. Difference of the average number of blood platelets (thrombocytes) between tractor drivers and control group was statistically significant (p<Table 2).

Analysis of the range of examined hematological parameters at tractor drivers was carried out within the group, after their classification according to age (6 sub-groups), length of service with exposure to pesticides (4 sub-groups) and according to the number of days of work with pesticides during the year (4 sub-groups).

Obtained statistical analyses indicated that there is not any statistically significant difference of the average values of hematological parameters between groups classified in this way. Therefore mentioned analyses are not presented in this paper.

DISCUSSION

Before analysis of the mentioned blood count parameters it was determined that tractor drivers, although in average younger, were not statistically significantly different from their control group.

Statistical analysis of the length of service of tractor drivers regarding to their control group was not carried out because they were selected regarding to non-exposure to pesticides or some other blood poisons.

Average number of red blood cells registered at tractor drivers and their control group was very similar and within normal limits. In both groups were registered minimal values and they indicated that in the group of tractor drivers was not noticed decreased number of red blood cells under the lowest limit of normal values in any of examinees.

In any of tractor drivers was not registered concentration of blood color (hemoglobin) under the lowest allowed limit, which is opposite to the result of Parron and collaborators (1996) who had confirmed decreased concentration of blood color (hemoglobin) at 38% of exposed tractor drivers.

Statistical analysis of difference of average number of red blood cells and average concentration of blood color (hemoglobin) between tractor drivers and their control group confirmed that, in this case, exposure of tractor drivers to pesticides have not resulted in significant disorder of the number of red blood cells and quantity of blood color (hemoglobin) in peripheral blood of examinees.

Average number of white blood cells is registered in tractor drivers only to some extent lower (p<0.05) than average number of white blood cells in their control group. In the group of tractor drivers are registered just two cases of the number of white blood cells under normal limit. In the first case the tractor driver was exposed to pesticides around 100 days per year, and in the second case tractor driver had the exposure of 30 days per year.
Very interesting is data that average number of blood platelets (thrombocytes) at tractor drivers is statistically significant higher (p,ically their control group. However, it is well known that toxic influence of pesticides at blood platelets (thrombocytes) is characterized by their decreased but not increased number. In the group of tractor drivers are registered only four cases (2.82%) with values lower than normal, which would indicate to toxic influence of pesticides to produce blood platelets (thrombocytes). These cases include two examiners exposed to pesticides around 30 days per year, one around 70 days and one around 100 days per year.

These data on the number of blood platelets (thrombocytes) at tractor drivers also indicate that exposure to pesticides haven’t resulted in significant disorder in function of this blood line as Savic et al. have determined (1993).

Previous discussion indicates that exposure to pesticides which is registered in analyzed group have not resulted in disorder of any of monitored blood count parameters.

Statistical analyses of average levels of monitored blood count parameters in the analyzed group of tractor drivers are classified according to exposed length of service to four sub-groups and according to the number of days of exposure to pesticides during the year (4 sub-groups). It indicates that there is no significant difference in those levels between mentioned groups established in described way.

Concerning the length of time passed from exposition and performed laboratory analyses, at the very end of discussion should be also mentioned option that immediately after exposition there still happens certain aberrations in some parameters of blood count but also that these damages are already recovered by the moment of taking the blood samples. This hypothesis could not be confirmed by the analysis of monitored parameters of blood count.

In order to exclude similar confusions in further researches, it is necessary to examine parameters of blood count at exposed persons immediately after their exposure to pesticides.

Based on obtained results the following conclusions can be assumed:
— Although statistically insignificant, tractor drivers were younger than their control group (\( \bar{x} = 38.16 \) years and \( \bar{x} = 39.98 \) respectively).
— Daily length of exposure to pesticides ranged from 3—12 hours and from 5—125 days annually, in average 60.93 days.
— Within work of tractor drivers in the fields during the year great number of preparations with more than 20 various active substances are applied. Mostly are used organophosphorous compounds, then triazines and carbamates, in a smaller amount derivates of phenoxy-acetic acid and urea, pyrethroids, anilides, imidazolines, taliloides etc. Organo-chlorine compounds are rarely applied.

Analysis of monitored parameters of blood count of tractor drivers regarding to control group as well as regarding to length of exposed years of service and the number of days of exposition to pesticides per year, indicates that exposition to pesticides, like that which is registered in analyzed group of tractor drivers, have not resulted in significant disorders in their blood count. Laboratory analyses of selected blood count parameters at exposed persons...
should be carried out immediately after their exposure to pesticides. Use of all available technical, technological, and organizational protective measures is necessary, as well as necessary use of adequate personal protective measures. Regular follow-up of health condition of exposed tractor drivers is also necessary through periodical/systematic checkups according to the program included in the Regulations on previous and periodical check-ups of employed workers at work places with increased risk (2007).

REFERENCES


Pravilnik o prethodnim i periodičnim lekarskim pregledima zaposlenih na radnim mestima sa povećanim rizikom (Službeni glasnik RS br 120/07).

НЕКИ ЛАБОРАТОРИЈСКИ ПОКАЗАТЕЉИ КРВНЕ СЛИКЕ КОД ТРАКТОРИСТА ИЗЛОЖЕНИХ ПЕСТИЦИДИМА

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Резиме

Пестициди представљају групу веома различитих једињења или смеша једињења. Произведе се у виду праха за директну употребу, праха за припремање суспензије, концентроване суспензије, концентрата за емулзију и у другим облицима.

Утицај пестицида на изложене запослене раднике умногоме зависи од технологије примењене пестицида.

Сви огрови, па и пестициди, који на било који начин доспеју у организам, до места свог метаболизма, излучивања или складиштења у телу, морају доћи путем крви.
Пестициди делују на матичне ћелије у коштаној срји, процес сазревања крвних елемената, и могу да оштећују и зреле крвне ћелије у периферној крви. За узорак је узето 142 возача трактора запослених у државним пољопри-веденим добрима који су при обављању пољоприведенних послова били изложен-ни пестицидима.
У погледу годишње и дневне изложености пестицидима испитиваних особа утврђено је да се дневна дужина кретала од 3 до 12 часова, а годишња од 5 до 125 дана, просечно 60,93 дана.
У раду су праћени следећи параметри крвне слике: црвена крвна зрна (еритроцити), крвна боја (хемоглобин), бела крвна зрна (леукоцити) и крвне плочице (тромбоцити).
Циљ рада је био да се испита да ли пестициди доводе до промена у крвној слици тракториста који су приликом обављања свог послала изложен деловању пестицида.
Анализа добијених резултата указује да изложеност пестицидима какву је имала испитивана група није довела до оштећења ни једног од посматраних па-раметара крвне слике.