UDC 619: 616.98: 578.842.1: 616-036.22

AFRICAN SWINE FEVER: ANALYSIS OF MODERN CHALLENGES IN IT'S EURASIAN NOSOAREAL

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The outbreak of African swine fever (ASF) in the Caucasian Region in 2007 led to a form at 2008–2012 of Eurasian nosoareal that cover of the large territories of Russian Federation and Caucasian countries. The article contains analytical data on key factors of the modern epidemic process around Ukrainian border and its trends in neighboring countries. Epizootological forecasting that made by the authors in 2010, was refined for prediction of ASF epidemic at the nearest future. The compartmentalization of risks on the northern, eastern and southern areal-sectoral threats are described. The system of ongoing monitoring and forecasting ASF advisable to deploy primarily risks at the most dangerous areas of cross-border movement of epidemics from East to West of Eurasian Continent has been implemented in NSC IECVM.

Keywords: African swine fever, nosoareal.

Now we come to general acceptance that the problem penetration of the African swine fever (ASF) in Georgia since 2007, after well-known events 2008, dissemination in the Eurasian nosoareal in 2008–2009 [1, 2, 8]. It had demonstrated of huge enlargement till size which the comparable with the African Natural ASF Focus (Nosoareal) of ASF in 2010–2013. Almost all of Eastern European countries are covered by the Eurasian nosoareal of ASF now. To understanding of key powers of this complicated process important significance is because affected countries (Georgia, Armenia, and Russian Federation) produces only 50–65 % of the consumption of pork: the rest are imported from other countries. It is one of the essential preconditions for delay of the rooting ASF, because the economics of these countries does not depend on exports of pig products and modern international countermeasures regarding the ASF for these countries is almost not affected [2]. This pattern is confirmed by the example of Spain, which suffered from ASF for several decades: the only ban of Spanish export by newly forming EU at middle of 1980s forced the Spanish authorities to active eradication the ASF at begin of 1990s. Nationwide comprehensive measures with the use of biodefense technologies (that count as traditional for today) have allowed to completely eradicating all of ASF nidi during 3–5 years. This example demonstrates the importance of nationwide motivating of the meat producers and veterinary service to elimination of the ASF and at the same time show to us the significant role of motivation factor in the epizootology of this disease.

Retrospectives of events demonstrate that the problem of ASF eradication in Russia almost have no chances to be solved now and in near future without deep changes on the level of administrative management strategy. The export items are invulnerable to quarantine sanction against ASF in Russia. Moreover, the lack of sufficient motivation for eradicating the ASF on the public common level is confirmed in Russia and official sources (OIE Document # 178) say that «in the Russian Federation have not economic motivation for fighting against ASF and its eradication» [2]. So, we can predict with certainty that the threat of continuous cross-border introduction of ASF on the territory of Ukraine will be the permanent threat for national security. Therefore Eurasian nosoareal of ASF will be very dangerous and constant threat for Ukrainian economy that tries to enhance of own export potential – especially in agricultural sector on the nearest and in far perspectives.

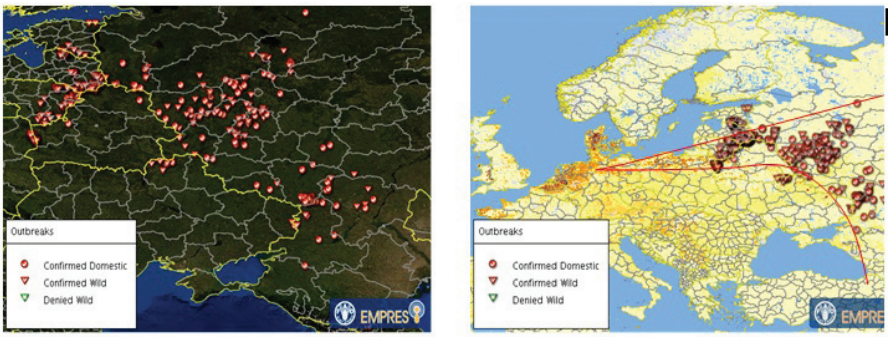
At 2012 the map of spatial-graphical forecast risk of transborder invasion of ASF in Ukraine has been produced by us [3]. In accordance with our forecast (fig. 1), the ASF threats in cases of the «natural process» are realized most likely through the pathogen ASF hidden entry (by introduction of low virulent variants of ASF virus – presumably like to patterns of ASF spread in Georgia) on the borderlands of Northern and Eastern regions of Ukraine by cross-border migration of wild boars and associated with the traffic of breeding material/domestic pigs in the Central and Southern parts of Ukraine. If the global warming will be continued, on the Southern and then Western Ukrainian territories will be enhanced of threat of the vector-borne ASF spread – by soft ticks (Ornithodoros spp.) and/or other biological vectors. Besides, the threats of virus entry and it spreading through international traffic and nets of recreation are very actual on entire motherland territory – especially at areas with a large international hubs [1, 3].

This prediction came true in terms of the permanent threats of the cross-border spreading ASF on the territories of Ukraine on today. Two outbreaks of ASF on the Eastern territories of Ukraine were localized before the start of the Antiterroristic Operation (ATO) in April 2014. However, the current situation in these areas, as well as in the area of Chongar, which belong to the Southern territory of Ukraine and was visited by Russian "green mans", does not allows us to exclude concealed the spread of the pathogen ASF amongst the wild boar of local populations. As was forecasted in 2010, ASF was spread by wild boars on Northern part of Ukraine: 9 cases of ASF were registered along the State border in Chernigiv and Sumy Regions during 2014. These outbreaks registered among homestead piggeries and small holdings (n=3) and in the forest holdings (n=9) in Korukìvs's'kiy, Nezhins'kiy, Ŝorsìvs's'kiy, Gorodyans'kiy, Kulikìvs'kiy Districts of Chernigiv Region and in Rìpkins'kiy District of Sumy Region. For preventing the spread of ASF on 10.01.2015 the State VetPhytoSanitary Service of Ukraine conducted a surveys of more than 31200 different farms with 63900 pigs. 2502 samples from wild boars and domestic pigs were checked for ASF, 6696 inspections of 25102 farms it were checked: imposed 807 fines on violators of veterinary legislation totaling was more than $130,000. Along the entire line of the Northern border of Ukraine the Security Strip in width of 20 km, free of wild boar and domestic pigs, was created. By results of control trials Chernigiv and Sumy Regions on date are free from ASF.

Figure 1. Map of presumably threats likelihood for ASF' spreading on territory of Ukraine in nearest future

As we can understand there are three zones of permanent threats of direct cross-border spreading of ASF in Ukraine on today (fig. 2): 1 – the northern State border of UA, "North zone of risk" (with of infected wild boars as main threat); 2 – the area of anti-terrorist operations (ATO), «Eastern area of risk" (with of infected wild boars & of absence of the adequate checking of meat products from RF and its residues in porcine rations as main threats), and 3 – the territory adjacent to the administrative boundary of the Kherson region and AR Crimea "South zone at risk» (with the same items of risk as 2nd zone but plus the arthropodborn transmission factors).

Beyond the borders of Ukraine (fig. 2) the epidemic of ASF develops no less dramatic. There are all main signs of panzootic scenario of ASF in European countries to where the disease rapidly moving in directions from East to West. This canvas is clearly emerges from registration data of Committee EMPRES FAO (fig. 3). We can see that at previous period («phase of germination & development») of the Eurasian nosoareal of ASF in 2007–2013 registered 89.3 % of ASF outbreaks only in the Russian Federation: the disease had sharp spreading in directions from South to North only. But since 2014 ASF spread scenario has been changed. Data analysis EMPRES-1 shows that even two years ago, 89 of 95 cases of ASF (or 93.7 %) of the registered in the world on the date of 27.01.2014 were occurred in Russia. Approximately at the same level of the "world ASF morbidity index" was maintained during 2009–2013. The statistical data on 10.01.2015 demonstrates that of 290 cases of ASF in the Russia registered only 34 outbreaks, i.e. 11.7 % of all new cases of ASF in the world, and the rest (of 08.07.2014) – along the borders with Russia and Belarus, 7 cases (2.4 %) were occurred in Ukraine and in the Central European countries (EU) – 249 cases (85.9 %). Other words, from date of 08.07.2014 index changes dramatically: begin of the disease invasion strictly along the lines of the Interstate borders of Central Region of RF and Belarus with Ukraine and then (as if after «of short training») – along borders of EU. The infected populations of wild boars are suspected in ASF transborder invading now. Also such a conclusion is self-imposed suggest from official data of a site «Rossel'hoznadzor» on end of 2014: as active 11 outbreaks of disease were registered in Russia and all of them were occurred among the wild boar populations.



A B

Figure 2. Current data of EMPRES-1 on 04.03.2015, about outbreaks of ASF for the 2013–2015 on different maps (A – administrative, B – industrial porcine density) Learn – by text

There are features of ASF spread along state borders between RF and Poland, or Lithuania, Latvia and/or Estonia is hardly noticeable at first glance feature. The frequency of registration of the new ASF outbreaks at the internal territories of Baltic countries is much less than along their borders. At the same time they penetrate deeper ahead in directions of the European genetic centers of pig breeding – to Denmark, Germany and The Netherlands. Of course, this pattern of spread it can to be explained by effects of the adequate nationalwide measures against ASF. But if we suggest of wild boars as «beneficiaries» of the ASF spreading we should take into account of possibility of discrete animals being which is adapted to life within frontier lines – on the «no man's land». Such wild boars populations are very

small, inconspicuous, but they are and they not can to be covered by national measures against ASF because migrate only within «no man's land» and can play important roles in the covert spreading of ASF agent between of borders of the countries. Presumably the similar events were able to happen and during of ASF by Georgian scenario-2007 and certainly its precursory to epizooty on Caucasian republics of Russia and Kuban Region, because the massive outbreaks of disease have covered of entire these territories with start of free pasture for pigs of homestead piggeries: as consequences of a covert distribution of the ASF agent in populations of wild boar of the previous winters [2].

About of certain artificiality of the situation with the rapid development of the Eurasian ASF nosoareal is evidenced the absence of any epizootic activity of the ASF virus 2nd genotype in Africa where situated the World Natural Reservoir of this agent. Moreover, during the period 2013–2014 is recorded only one case of the disease – and that is not associated with virus 2 genotype. Other words, epidemic activity of natural ASF focuses in Africa and on the borders of the Russia with Ukraine and EU-countries are situated in a clear anti-phase with each other.

Consideration of issues of the ASF epizootology features in its Eurasian nosoareal is distorted without the discussion of virulence of the pathogen. In data base that accumulated up today is absent the information about isolation of avirulent or low-virulent variants of agent in the ASF Eurasian nosoareal. This matter is very controversial and beyond comprehension because diversity of the 2nd genotype of ASF virus as well as all of other 21 genotypes of ASF agent is well-known for the all of natural outbreaks in African countries, Brasilia, Spain etc. [4, 5, 6]. Pattern of typical endemic situation of ASF in endemic nosoareal is described by terms of infection persisting from generation to generation in some parts of animal population: example for endemic area of South-Eastern Africa are aligned with the populations of two animal species – the warthogs and soft ticks of Ornithoduoros spp.; example for former Iberian ASF nosoareal – some populations of Ornithoduoros erraticus on South-West of Spain etc. But there are not revealed of any animal species which responsible for persisting of virus from generation to generation in the same populations in Eurasian ASF nosoareal till today [7].Therefore issues of the ASF virus diversity (being of the low virulence agent variants) is clue to understanding of the forces currently development of ASF epidemic situation. Without of resolution these issues, ASF eradication in endemic area is not impossible. Since 1993 become a knowledge that the ASF agent as this typically to bacteriophages or herpes viruses can to integrate with host genome [8]. At the same time all the sources that describe the properties of Georgian and Russian the agent' isolates indicate that there are only the high-virulent variants in the Eurasian nosoareal of ASF [9, 10]. Particularly active stance in this matter is occupied by the Russian scientists. This is not surprising since overwhelming number of new outbreaks last two years in the Russian Federation is linked to herds of wild boar. So, at last time from summer of 2014 in the almost of all cases the ASF was spread from East to West of Europa due to lethal infection of the wild boar [2, 11]. At last time from summer of 2014 the almost all cases the ASF was spread from East to West of Europe due to infection of the wild boars. But all of the known Russian data from research in 2008-2015 as well as other studies of Russians isolates are founded the exclusively clinically sick (of killed) or dead wild boars. As we know, such objects are not optimal for research of the virus variants with low virulence. From the other hand, the absence of diversity of the viral populations by virulence levels during a long epidemic period was not typical for the natural ASF cases of the past years epidemics [1, 5]. Conversely, absence of the virus agent diversity in its population is the evidence of viral cloning [12]. In this context the expected results were received by team of Prof. C. Gallardo (CISA-INIA, Spain), when was performed the genetic comparison of the different ASF virus isolates from different places of the ASF nosoareal at all epidemic phases. They are objectively showed that on the same epidemic phase (2012) in Russia the agent hadn't of transcription-regulating sequences (TRS) insertion between 173R and 1329L genes of the ASF virus (Tver0312/Novo, Tver0312-Torjo, Tver0712/Les, Tver0812/Bolo, Tver1112/Zavi), but exclusively in the Ukrainian isolate (Ukr12/Zapo) this insert was presented. This marker (TRS insertion that is responsible for effective virus reproduction in organism of porcine species) then registered in Belorussian (2013) and other Central European (2014) isolates of this agent, but not in the isolates from RF or Caucasian countries at any epidemic phase [13]. Also this team has summarized of results of the trials of the Lithuanian ASF virus isolate LT14/1490 by contact bioassay on pigs at spring of 2015. Like to scientists in RF [2], these authors found that not all pigs are killed by ASF: one of the 10 infected pigs (10 %) not was ill and thus survived infection after of contact infection [14].But huge level of mortality (94,5 %) give more points to the dose-aligned relationships but not to diversity of virus population by virulence.

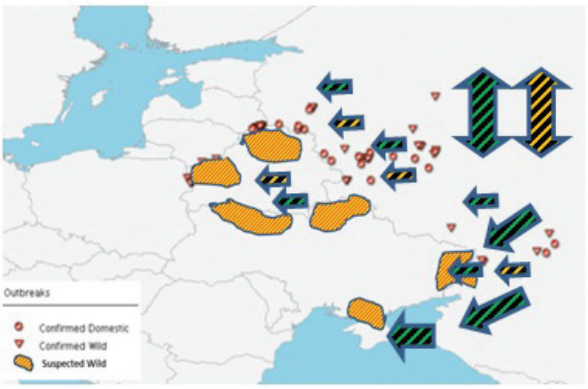


Figure 3. Analytical map of spread of ASF in Eastern Europe (by materials of the NSC «ÌECVM»): vectors of spread of the pathogen through the migration of wild boar (⇐) and through a network of food products (⇐); yellow stains – the high risk of the formation of natural foci of ASF. Learn the text

On our opinion, there are much more chances to find of the ASF virus variants with the low virulence or even no virulence in commercial products of Russian or Belarusian pork production as well as in environmental specimens of contaminated objects on some territory that contaminated by wild boars. This statement confirms by numerous of data about the ASF virus spread by contaminated with the ASF virus porky products (carcasses, sausage, pork stew etc.) in Russia [15]. Also is known about hypothesis of the Belarusian and Russian vets about spreading of the virus through food chains of the industrial pig production – through of contamination of forage crops (corn, beets, etc.) from infected wild boars during its pasture on crops fields [16]. In addition, these objects to the sampling have ability to provide more favorable conditions for the accumulation of the low virulence agent because it is more resilient to adverse environmental factors compared with the highly virulent variants of the ASF virus [17].

So, we can summarize the above data regarding ASF control by next formulation of the tasks for resolution as actual for NSC "IECVM": 1) monitoring not only by etiology, but much more a causative aspects of the ASF outbreaks (for ASF forecasting), as well as 2) study of the disease rooting mechanisms in the Eurasian ASF nosoareal, including the by sampling from wild boars, different arthropods species, the commercial porcine products and 3) development of the principles of evidence-based virology ASF for forensics, which in general will help to create of the system of the «early epizootic alert ASF». NSC «ÌECVM» should be equipped BSL-3 biosafety level to address these problems.

Acknowledgment. This work was supported by the STCU Grant P609, therefore authors very grateful for it to investors.

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АФРИКАНСЬКА ЧУМА СВИНЕЙ: АНАЛІЗ СУЧАСНОЇ СИТУАЦІЇ У ЇЇ ЄВРАЗІЙСЬКОМУ НОЗОАРЕАЛІ

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Обґрунтування. Африканська чума свиней (АЧС) становить наростаючу загрозу щодо транскордонного заносу АЧС на територію України, зокрема – за рахунок нелегального імпорту харчових продуктів, міграції дикого кабана та компетентних до трансмісії видів кліщів.

Результати досліджень та обговорення. У статті аналізуються особливості сучасного епізоотичного процесу АЧС в Світі та Україні. Розглянуто різні аспекти транскордонного поширення збудника та обґрунтовано ключову роль у ньому персистентно інфікованих диких кабанів, а також ризики від заносу контамінованих м'ясних продуктів, зокрема на Донбас та в АР Крим. Наголошується на необхідності розвитку наукових протиепізоотичних заходів (зокрема поточного моніторингу та прогнозування) проти АЧС на лабораторно-виробничих потужностях ННЦ «ІЕКВМ» НААН України, де на сьогодні зосереджено найбільш потужні вітчизняні науково-інноваційні ресурси галузі.

Висновки. Виходячи з отриманих аналітичних даних на найближчий період часу необхідно створити систему «Раннього Епізоотологічного Упередження АЧС»: 1 – розробити науковий супровід не лише етіологічних, але й каузативних (причинно-наслідкових) аспектів протиепізоотичної роботи для прогнозування АЧС; 2 – центральною проблемою експериментально-теоретичної епізоотології АЧС лишається вивчення природи укорінення хвороби у її євразійському нозоареалі; 3 – нагальним прикладним питанням постає удосконалення методологічних та методичних засад доказової вірусології АЧС для використання, зокрема, у судово-ветеринарній експертизі.

Ключові слова: Африканська чума свиней, нозоареал.

УДК 619:616.98:578.823.1:595.771(477.54)

АКТУАЛІЗАЦІЯ ДАНИХ ЩОДО ВИДОВОГО СКЛАДУ МОКРЕЦІВ РОДУ *CULICOIDES* – ПОТЕНЦІЙНИХ ПЕРЕНОСНИКІВ ВІРУСУ БЛЮТАНГУ В ХАРКІВСЬКІЙ ОБЛАСТІ

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За даними власних досліджень і за результатами аналізу літературних джерел складено список видів Culicoides зареєстрованих на території Харківської області. Новий список, який складено з урахуванням сучасних поглядів на систематику родини Ceratopogonidae, містить 36 видів, 3 з них вперше виявлено в регіоні. Також важливо підкреслити, що види які мають значення як потенційні переносники блютангу входять до категорії чисельних і звичайних, що становить небезпеку для епізоотичного благополуччя галузі скотарства регіону.

Ключові слова: *Culicoides*, моніторинг, видовий склад, систематика, блютанг.

У сучасних умовах однією з найбільш актуальних проблем наукового забезпечення епізоотичного благополуччя тваринництва в Україні є створення дієвих та економічно доцільних систем епізоотичного нагляду трансмісивних захворювань сільськогосподарських тварин. При цьому, зважаючи на складність і багатокомпонентність функціонування епісистем даних нозологічних одиниць, існує досить багато різноманітних методичних підходів проведення моніторингових досліджень.

Поряд із цілеспрямованим серологічним моніторингом сприйнятливого поголів'я усіх категорій, одним із важливіших напрямків досліджень в системі епізоотичного нагляду трансмісивних хвороб є ентомологічний моніторинг. Як показав проведений нами аналіз наукових публікацій з цього питання [1, 2], для більшості з груп кровосисних двокрилих, що мають значення як переносники трансмісивних захворювань, відомості щодо видового складу, поширення та фенології у різних природних зонах України є або застарілими, або неповними та уривчастими. Разом з тим, суттєвою перешкодою для проведення моніторингових досліджень переносників трансмісивних хвороб в Україні, можна вважати відчутний брак компетентних ентомологів медично-ветеринарного профілю. Також, варто відмітити, що проблема вірного визначення видової належності переносників є одним із ключових елементів, що визначають ефективність ентомологічного моніторингу і разом з тим (поряд із обмеженістю ресурсів, проблемами чутливості тестів та ін.) одним із основних факторів, що ускладнюють його проведення [3]. Зважаючи на вищезазначене, вважаємо, що вивчення видового складу та сезонної динаміки ентомокомплексу гнусу є актуальним завданням.

Так для території Харківської області сьогодні не існує докладної інформації щодо видового складу мокреців роду *Culicoides* – потенційних переносників таких небезпечних хвороб жуйних як блютанг і хвороба Шмалленберг. Єдиний перелік видів що були відмічені на території регіону наведено у роботі Прудкіної [4], проте він є неповним, а також положення деяких груп та наведені видові назви потребують актуалізації за сучасними уявленнями про систематику родини *Ceratopogonidae*. Отже, метою даної роботи є наведення актуальних даних щодо видового складу цієї важливої групи комах.

Матеріали та методи. В умовах тваринницьких господарств Харківської області протягом двох польових сезонів (квітень-жовтень 2013–14 р.) проводили збори комах за допомогою світлопастки CDC 1212. Згідно методики [5], пастки, що активуються щонайменше за годину до заходу сонця, розвішували на висоті 1,5–2 м, якомога ближче до тварин. Визначення проводили