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Specific features of African swine fever control activities in China

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SUMMARY

African swine fever is a highly contagious viral disease of pigs; however, no vaccines are available to control it. Currently the disease causes significant economic damage in many countries. The Republic of China is the first country in Southeast Asia, which officially reported the African swine fever outbreak in 2018. The disease further spread to all provinces of the country with 200 outbreaks in domestic pigs and 10 outbreaks in wild boar in total; herewith the overall population of pigs decreased dramatically, approximately by 180 million animals. Following the confirmation of the first African swine fever outbreak, the PRC Ministry of Agriculture and Rural Affairs launched the "African Swine Fever Contingency Plan and Emergency Response", which facilitated the disease eradication and already by 2023, no new infection outbreaks had been reported. The country with the largest swine population in the world achieved rather moderate spread rates if compared to Europe. In addition, the virus strains, which circulated in the Chinese territory, were genetically diverse and different in virulence, leading to a wide range of clinical signs manifested by diseased animals. Such aspects were supposed to complicate the eradication measures, but instead, they proved their effectiveness. The experience gained from the disease control in China is most certainly of interest for the Russian Federation, infected with African swine fever since 2008.

Keywords: African swine fever, infection spread, epidemic situation, disease control measures, Republic of China

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Особенности реализации противоэпизоотических мероприятий по африканской чуме свиней в Китае

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РЕЗЮМЕ

Африканская чума свиней – вирусная болезнь свиней, обладающая высокой скоростью распространения, против которой не разработано средств специфической профилактики. Китайская Народная Республика является первой страной в Юго-Восточной Азии, где в 2018 г. была официально зарегистрирована вспышка данного заболевания, наносящего в настоящее время значительный экономический ущерб многим странам мира. Болезнь в дальнейшем распространилась на все провинции страны, где общее количество очагов среди домашних свиней составило 200, а в популяции диких кабанов – 10, при этом общее поголовье свиней в стране катастрофически сократилось – примерно на 180 млн голов. С момента выявления первого очага африканской чумы свиней Министерством сельского хозяйства и сельских дел Китая был принят «План действий в чрезвычайных ситуациях по борьбе с африканской чумой свиней и уровень реагирования на чрезвычайные ситуации», выполнение которого обеспечило ликвидацию эпизоотии, и уже к 2023 г. выявление новых очагов инфекции в стране прекратилось. Страна с одной из самых объемных свиноводческих отраслей животноводства в мире добилась, в сравнении с Европой, показателей довольно среднего распространения эпизоотии. При этом на территории Китая циркулировали штаммы вируса африканской чумы свиней с высоким генетическим разнообразием и с различным уровнем вирулентности, что обусловливало широкий спектр клинических симптомов у заболевших животных. Подобные особенности должны были только усложнить проведение ликвидационных мероприятий, однако разработанные меры доказали свою эффективность. Опыт осуществления противоэпизоотических мероприятий в Китае, безусловно, представляет интерес и для нашей страны, неблагополучной по африканской чуме свиней с 2008 г.

Ключевые слова: африканская чума свиней, распространение инфекции, эпизоотическая ситуация, противоэпизоотические мероприятия, КНР

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INTRODUCTION

Due to the recent global political and socio-economic situation in the Russian Federation, there is a clear trend towards a significant increase in contacts with Southeast Asia countries. In the veterinary field, from our perspective, these are primarily contacts concerning prevention and control of highly dangerous animal diseases, potentially causing significant economic losses in the livestock industry. In this respect, China's experience in control of African swine fever (ASF) is most certainly of interest because this devastating pandemic causes enormous damage to pig production in many countries of the world with no effective ASF vaccines been developed yet.

Interest in the peculiarities of the ASF disease control measures in China is primarily explained by the fact that it is a country with one of the largest pig production industries in the world, but at the same time the nation managed to minimize the spread of the disease in a relatively short period of time, whereas most European countries with modern highly developed livestock management systems have not yet coped with ASF spread in their territories.

Moreover, up to the present time, the infection is gradually moving to the west of Europe. ASF was reported in Poland, Lithuania, Estonia in 2014; in Moldova in 2016; in the Czech Republic and Romania in 2017; in Hungary, Bulgaria and Belgium in 2018; in Serbia and Slovakia in 2019. Later ASF outbreaks were reported by Greece and Germany in 2020, by Northern Macedonia in 2021, by Italy in 2022 [1].

According to Bloomberg News ASF outbreaks have spread throughout the European Union since 2014, at a speed of about 200 km per year, which, according to estimates, causes annual losses of several billion euros [2].

The purpose of this work is to review the Chinese experience in ASF outbreak eradication to highlight the key components of disease control measures for the Russian regional veterinary services.

MATERIALS AND METHODS

Foreign scientific literature was reviewed and publications from Chinese into Russian concerning ASF spread in China were translated.

Data on the epidemic situation were taken from the World Animal Health Organization (WOAH) official reports [1], including the date and place of ASF outbreaks, and the coordinates of infected settlements/areas for mapping.

Information on pig population density in China was provided by the PRC Ministry of Agriculture and Rural Affairs and was used to calculate the relative risk of new ASF outbreak occurrence in China.

Using ArcGIS software (Esri, USA), maps were created demonstrating ASF-infected countries, the infected Chinese provinces and the geographical locations of outbreaks. The risk of the disease spread in Southeast Asia was analyzed.

RESULTS AND DISCUSSION

The first ASF case in China was reported on August 1, 2018 [3], long after the disease had escaped from its endemic area in 1957–1970 and had widely spread in Europe and other regions (Fig. 1).

ASF outbreak in China is considered to be the first occurrence of the disease in Southeast Asia countries, as the subsequent outbreaks were reported later in Mongolia in January 2019, in Cambodia in March 2019, in Hong Kong and the DPRK in May 2019, in Laos in June 2019, in the Philippines in July 2019, in Myanmar in August 2019, in South Korea in September 2019, in Indonesia in November 2019, in Papua New Guinea in March 2020, in India in May 2020. ASF was reported in Bhutan, Malaysia, Thailand in 2021, and in Nepal in 2022.

Southeast Asia countries have the largest number of pigs in the world (Fig. 2); only China accounts for about 50% of the world pig population. At the same time, most of the farms in the country (80–90%) are small farms and backyards that produce not more than 500 pigs per year and are at extreme risk of infection introduction due to the lack of biosecurity measures. In 2017, 688.61 million pigs were raised in China, which is approximately 48% of global pork production, and already in 2019, there was a drop in production volumes down to 310.4 million pigs due to ASF occurrence [4].

Since the first official ASF report in August 2018 in China's northeastern Liaoning province, the disease has been rapidly spreading across the country [5]. 33 ASF outbreaks were reported in 7 provinces out of 22 provinces, 5 autonomous regions and 4 municipalities of mainland China as of October 8, 2018 [5, 6]: Anhui, Heilongjiang, Henan, Jilin, Liaoning, Jiangxi, Zhejiang and in the Inner Mongolia Autonomous Region (Fig. 3), but as of December 7, 2018, the disease also spread to the provinces of Guangdong, Fujian, Hubei, Shanxi, Yunnan and Sichuan, where 50 facilities (farms/slaughterhouses) were infected.

At the end of 2018, 102 ASF outbreaks were reported among domestic pigs and 2 among wild boars in 23 provinces / autonomous regions / municipalities of the country (Fig. 4).

The spread of infection continued in 2019. The provinces of Hunan, Guizhou, Jiangxi, Qinghai, Gansu and Shandong, as well as the Ningxia-Hui and Guangxi Zhuang Autonomous Regions and the municipalities of Tianjin,

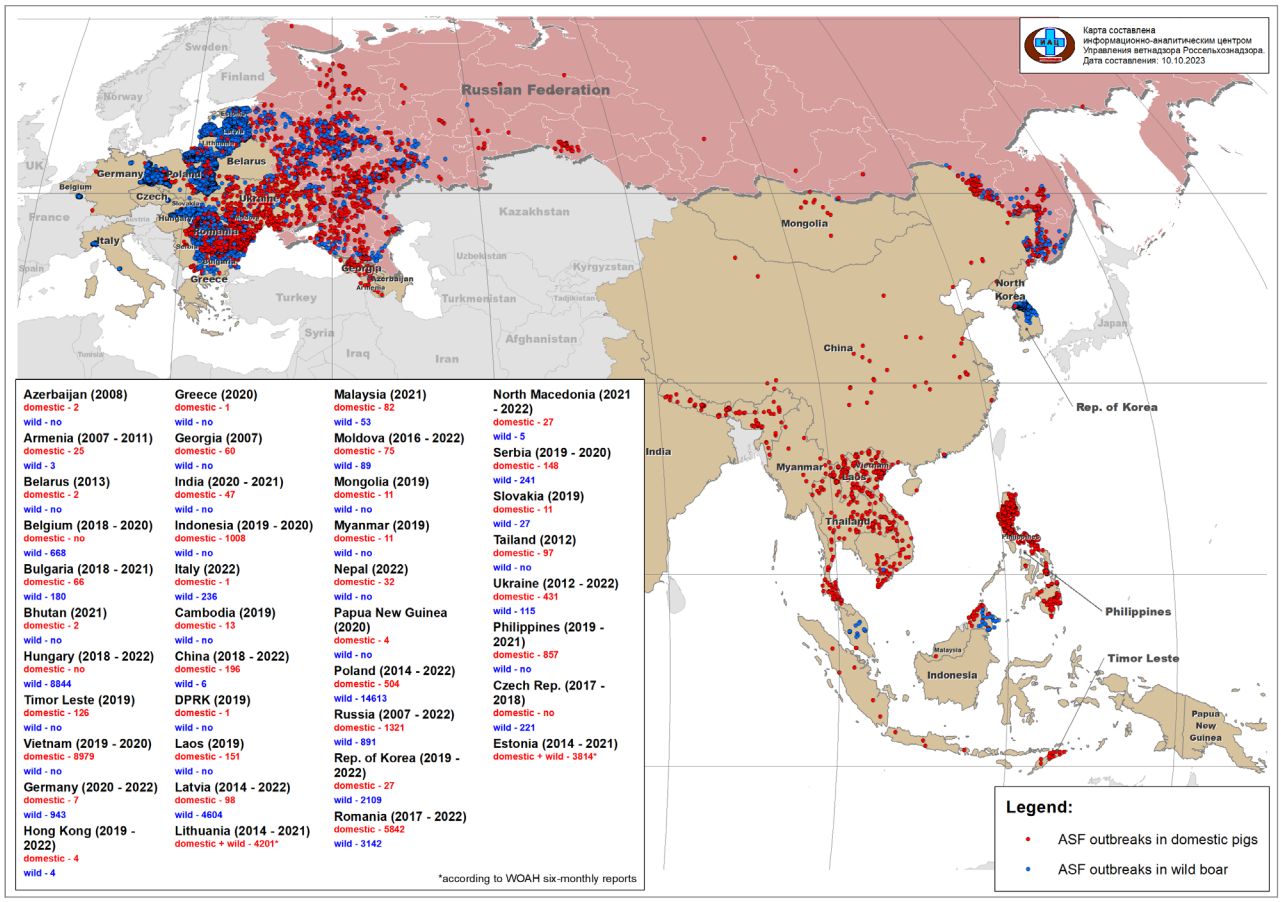

Fig. 1. ASF situation in the Russian Federation, European and Asian countries in 2007–2022 (based on urgent notifications to the WOAH as of November 30, 2022)

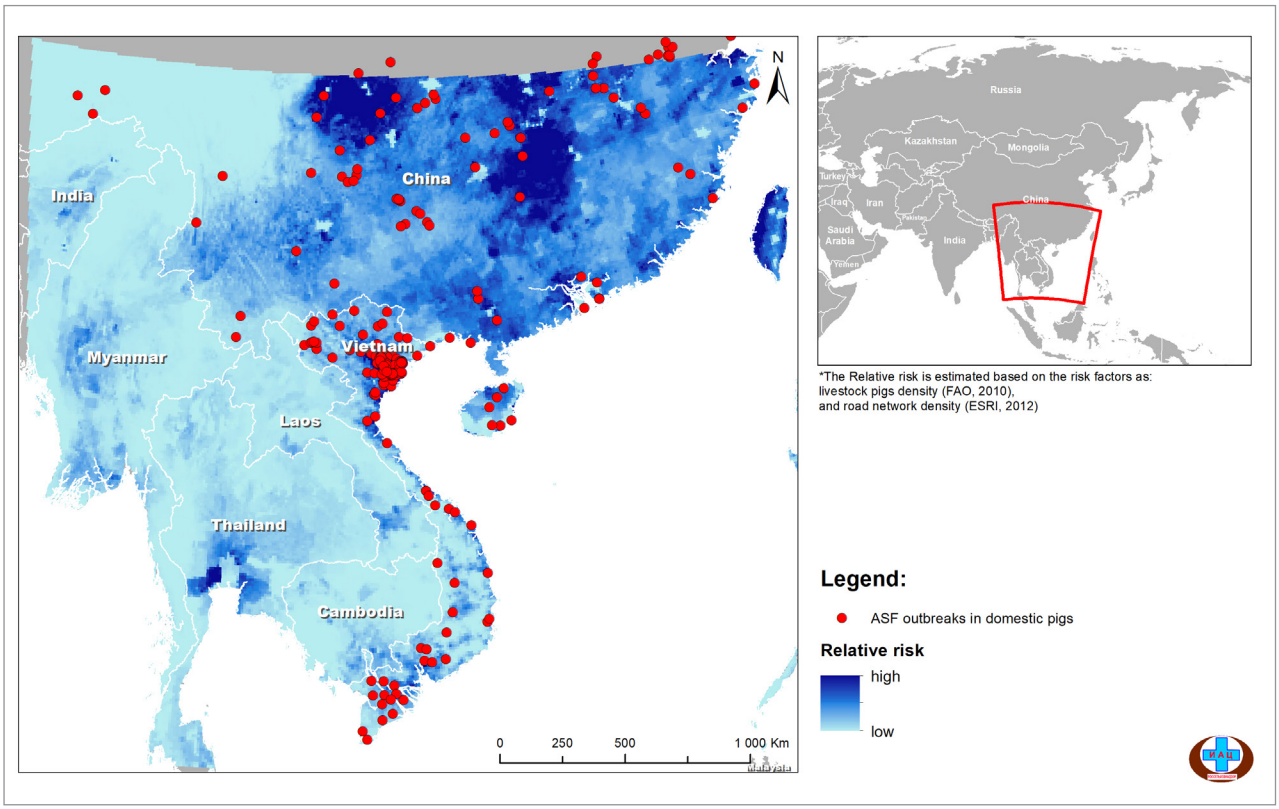

Fig. 2. Pig population density and relative risk of ASF spread in Southeast Asia countries

Chongqing, Shanghai and Beijing became also infected by ASF. In total, as of December 27, 2019, since the beginning of the ASF epidemic, the number of outbreaks reported in the country increased to 165; 4 of them among wild boars [7, 8].

In 2020, 33 outbreaks among domestic pigs and 2 among wild boars were detected in the same provinces as before, 4 cases of ASF among domestic pigs and 4 among wild boars were reported in 2021, and one ASF outbreak among domestic pigs in the Xinjiang Uygur Autonomous Region in 2022.

Thus, since the first occurrence of ASF in August 2018 and until 2023, the outbreaks were reported in almost all administrative regions of the country; the total number of outbreaks among domestic pigs was 200, and 10 outbreaks in the wild boar population (Fig. 5).

Compared with other, in particular European countries, the disease spread rate was fairly moderate, but, due to deaths of diseased animals in the outbreak areas and the policy of disease control measures adopted in China to prevent the infection spread by killing of pigs in the regions at risk, the total number of pigs in the country has catastrophically decreased by about 180 million animals.

One of the features of the epidemic in China was that highly genetically diverse ASFV strains with different levels of virulence circulated in the country, thus causing a wide range of clinical symptoms in diseased animals.

Studies by X. Wen et al. [9] demonstrated that the virus genome responsible for the outbreak in China in 2018 (China 2018/1) was mostly similar to the genome of the ASF virus isolated in Poland (GenBank: MG939588.1).

Based on the results of phylogenetic analysis of 66 strains isolated in 2019–2020 in the southern province of Guangxi, they were grouped into 8 different

Fig. 3. ASF infected regions of China in August – October 2018 [5]

variants, with 3 of them belonging to genotype 1; and 6 belonging to genotype 2 (p72), serogroup 8 (CD2v) [10]. Two non-haemadsorbing ASFV strains (HeN/ZZ-P1/21 and SD/DY-I/21), belonging to genotype 1 (with low virulence and causing chronic disease in pigs) were isolated in the provinces of Henan and Shandong [11–13].

The Chinese strains with reduced pathogenicity belonging to genotype 1 were identical to the strains isolated in the 60s of the last century in Portugal and Spain, and genotype 2 virus circulating in China since 2018 was similar to highly virulent ASFV isolates Georgia 2007/1, Krasnodar 2012, Estonia 2014 [10, 14, 15].

Fig. 4. ASF situation in China in 2018

Fig. 5. ASF situation in China from August 2018 to January 23, 2023

Since the identification of the first ASF outbreak, the PRC Ministry of Agriculture and Rural Affairs launched the African Swine Fever Contingency Plan and Emergency Response [16], providing for a set of the disease control measures. The Government established a 3-km protection zone and 10-km surveillance zone around the outbreak areas. Strict rules and measures, including quarantine, restrictions of pig and pig products movements within the country, surveillance outside the animal keeping facilities, mandatory culling of all diseased and contact pigs within a radius of 3 km from the infected area followed by carcass disposal.

An intersectoral interaction mechanism was created, which coordinated various agencies in ASF control and prevention; a multidisciplinary program of epidemiological monitoring was elaborated, covering the development of diagnostic tests for specific and early detection of animal cases, genetic analysis of isolated viral isolates, as well as monitoring among wild boar and tick collection. Compensation for case notifications, animal deaths and emergency slaughter of up to 1,200 yuan per animal (about 175 US dollars) was introduced everywhere.

The measures taken and, first of all, in our opinion, various restrictions, pig culling in infected and protection zones, a flexible system of compensation payments, etc., facilitated a significant improvement in the ASF situation in China, and already in February 2020, the Chinese authorities announced that the ASF situation in the country stabilized [16], and by 2023, no new ASF outbreaks in the country were reported, although, according to Krasnaya Vesna News Agency a single ASF outbreak was registered in Hong Kong and several outbreaks in the provinces of Shandong and Hebei in February – March 2023, where the disease in animals was clinically mild [17, 18].

Moreover, by the end of 2021 (Fig. 6) the number of pig population in the country almost recovered, amounting to 449.2 million animals [19].

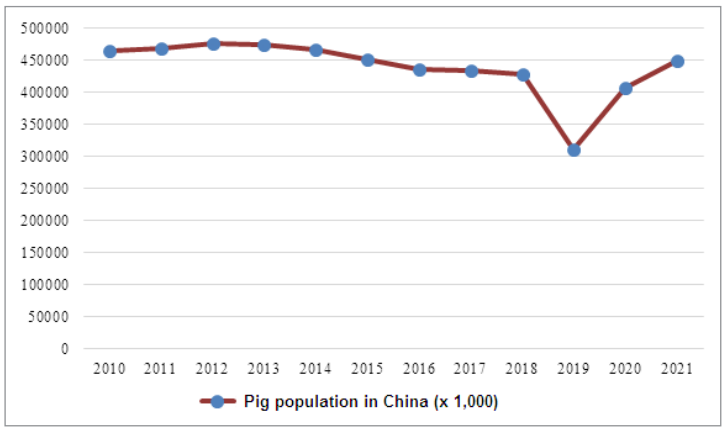

Fig. 6. Pig population numbers in China in 2010–2021 [19]

CONCLUSION

Experience of ASF eradication in China shows that the fight against this devastating pandemic can be successful throughout the country even without the vaccine use, but it must include strict sanitary restrictions associated with huge financial expenditures. At the same time, each country has developed its own control methods that can be applied in other countries too. We believe that the Chinese experience in ASF control measure implementation, taking into account the circulation of the ASFV 1 and 2 genotypes on its territory, should be thoroughly analyzed in Russia to be potentially used in such regions as,

for example, the Far East. First of all, in this regard, China's experience in implementation of a strict centralized strategy for ASF control and prevention throughout the country, significant enhancing of local authorities' role in arrangement and supervision of general and specific disease control measures, introduction of a well-arranged compensation system in case of pig culling to prevent the infection spread is of great interest.

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