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RESEARCH ARTICLE

Using a process-oriented methodology to precisely evaluate temperature suitability for potato growth in China using GIS

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Abstract

A process-oriented methodology to conduct precise evaluation temporally and spatially on temperature suitability for potato growth was applied in China. Arable lands in China were gridded with 1 km×1 km geographic units, and potential potato phenology in each unit was automatically identified in terms of the potato planting initial temperature and effective accumulated temperature. A temperature thermal response coefficient model was used to compute a temperature suitability value for each day of potato phenology in each geographic unit. In addition, five temperature suitability ranking methods were applied to define suitable areas: (1) upper fourth quantile, (2) median, (3) expected value+1/4 standard deviation, (4) expected value+1/2 standard deviation, (5) expected value+1 standard deviation. A validation indicator was innovated to test the effectiveness of the five ranking methods. The results showed that from a strict degree point of view, the five methods sequence was as follows: 1=3>4>2>5, with a and c determined as the two best ranking methods. For methods 1 and 3, the suitable potato growing area was 1 of 57.76×10^4 km^2. In addition, the suitable areas were spatially coincident with the main potato producing counties. The study output technically supports the proposal from China's government that there is a large potential area to grow winter-ploughed potato in South China because the potential suitable area for growing potato is approximately 2×10^7 ha. In southeast Heilongjiang and east Jilin, where it is hilly and mountainous, there are still some potentially suitable areas for potato growing accounting for nearly 2.32×10^6 ha. The authors suggest to optimize the agricultural regionalization and layout in China and to adjust the cropping pattern structure.

Keywords: potato, temperature suitability, temperature thermal response coefficient model, ranking method, validation

1. Introduction

The potato was listed as the fourth most important food crop in China after rice, wheat and maize in 2014. Due to the merits of the potato in cultivation (Soltani *et al*. 2013), it has been increasingly grown and widely spread across China over recent decades to improve farmers' income and ensure food security (Gao *et al*. 2013). At present, there are approximately 5 million hectares of potato cultivation in

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