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## Modelling environmentally suitable areas for the potential introduction and cultivation of the emerging oil crop *Paeonia ostii* in China

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*Paeonia ostii* is a traditional ornamental and medicinal species that has attracted considerable interest for its high oil value. To facilitate the effective and rational cultivation and application of *P. ostii* in China, it is necessary to determine its potential spatial habitat distribution and environmental requirements. Using high-resolution environmental data for current and future climate scenarios, the potential suitable area and climatic requirements of *P. ostii* were modelled. Among the 11 environmental variables investigated, growing degree days, precipitation of the wettest month, mean temperature of the coldest quarter, global UV-B radiation, annual precipitation, and soil pH played major roles in determining the suitability of a habitat for the cultivation of *P. ostii*. Under the current environmental conditions in China, a total area of  $20.31 \times 10^5$  km<sup>2</sup> is suitable for growing *P. ostii*, accounting for 21.16% of the country's total land area. Under the two future climate scenario/year combinations (i.e., representative concentration pathways [RCPs], RCP2.6 and RCP8.5 in 2050), this species would increase its suitable area at high latitudes while decrease at low latitudes. These results present valuable information and a theoretical reference point for identifying the suitable cultivation areas of *P. ostii*.

*Paeonia ostii*, a species of tree peony (Sect. *Moutan*, *Paeonia*, Paeoniaceae;  $2n = 10$ )<sup>1,2</sup>, has been traditionally cultivated for medicinal purposes throughout Asia for more than 1,600 years because of its antispasmodic value<sup>3,4</sup>. Recently, the seeds of this species have been shown to be rich in unsaturated fatty acids, especially  $\alpha$ -linolenic acid<sup>5–8</sup>, which indicates that oil from its seeds can be used as a novel source of high-quality edible oils. Due to its great potential for producing edible oils, *P. ostii* has been recognized in the national project to relieve the perpetual oil crisis in China<sup>9</sup>, and the cultivated area of this species has rapidly increased to over  $33.3 \times 10^4$  ha since 2013<sup>10</sup>.

*P. ostii* native to China is a deciduous, multi-stemmed, woody shrub with a preference for sun and suitability for both dry-cold and wet-warm climate conditions. It is widely cultivated in Bozhou and Tongling Cities in Anhui province, and sporadically in Hubei, Shaanxi, and Sichuan provinces in China as a traditional medicine<sup>3</sup>. In recent years, *P. ostii* has been cultivated for multiple purposes in many new regions, including Hebei, Yunnan, Sichuan, Xinjiang, Inner Mongolia, and Gansu Provinces, among others. The growth and development of *P. ostii* are affected by various environmental variables such as temperature, moisture, light, soil conditions, and landscape properties<sup>8,11–14</sup>. Previous research showed that the oil content,  $\alpha$ -linolenic acid content and seed yield vary with geographical environment and changes in climatic conditions: the  $\alpha$ -linolenic acid content in Xunyang (Shaanxi Province) is significantly higher than that in Tongling (Anhui Province)<sup>8</sup>, and the seed yield per plant in Bozhou (Anhui Province) is about four times that of Shaoyang (Hunan Province)<sup>15</sup>. Temperatures were reported to affect the vegetative growth<sup>16</sup>, flower bud differentiation<sup>17</sup>, photosynthetic characteristics<sup>13</sup> and seed dormancy and germination<sup>18</sup> of *P. ostii*. Although *P. ostii* is comparably resistant to cool temperatures, heat, wet conditions,

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