Journal of Stress Physiology & Biochemistry, Vol. 16, No. 1, 2020, pp. 85-90 ISSN 1997-0838

REVIEW

OPEN ACCESS

Adaptation of Acupuncture and Traditional Chinese Herbal Medicines Models Because of Climate Change

Wenli Sun[1,2]#, Mohamad Hesam Shahrajabian[1,2,3]#,

Mehdi Khoshkharam[3], Qi Cheng[1,2]*

[1] *Biotechnology Research Institute, Chinese Academy of Agricultural Sciences, Beijing 100081, China*

[2] *Nitrogen Fixation Laboratory, Qi Institute, Building C4, No. 555 Chuangye Road, Jiaxing 314000, Zhejiang, China*

[3] *Department of Agronomy and Plant Breeding, Faculty of Agriculture, Islamic Azad University, Isfahan (Khorasgan) Branch, Isfahan, Iran*

 # Authors contributed equally to this research

**E-Mail: chenggi@caas.cn*

Received January 8, 2020

China is the vast country which has the highest population and providing enough and stable food is a challenge in China and climate change is expected to exacerbate problems, and agricultural systems models play significant roles in identify strategies to support global food security and protecting the environment. Literature search was conducted in Medline, Research gate, Scopus, Pubmed and Google scholar databases. The keywords were climate change, acupuncture and traditional Chinese medicine and health benefits. Climate Change will influence distribution of agricultural production, food supply and global markets in Asia and the world. The impact of climatic changes on agriculture can be divided into shift in climatic and agriculture zones, impact on plant growth and crop production, impact on agriculture soil such as soil organic matter, soil fertility, biological health of soil, soil erosion, soil water availability, and of course increase in number of pests, plant diseases and weeds. Traditional Chinese medicine uses five phase theory to describe the relationship between five zang and their physiological function, five zang and structure and function of various parts of the human body, and also the correlation between each part of human body and nature and society. Not only were the ancient Chinese scholars aware of Qi, the immaterial medium that connects between different parts of a body and speaks the intelligence of the body; they also recognized that nature, just like the human body, communicates between its different parts through its own Qi and the climate pattern. Farmers should adapt to climate change strategies which integrate traditional experience and indigenous knowledge with scientific researches and government polices as key factors. Because of climate change, China will be more vulnerable to droughts, heavy rains and heat waves. Climate change will extend growing seasons for some crops and make shorter growing seasons for other crops in North part of China and will bring less reliable rains, soils that retain less water, the spread of dangerous pests and unwanted weeds. To maintain or increase qualitative production of Chinese herbal crops, adaptation strategies, particularly to increasing temperatures affecting irrigated wheat, or expanding the cropping area will be required.

Key words: Climate Change, Stress, Model, Traditional Chinese Medicine, Sustainability, Agricultural Production

Climate Change and Chinese Herbal Medicine

Traditional Chinese medicine (TCM) has a history of thousands of years it is formed by summarizing the precious experience of understanding life, maintaining health, and fighting diseases accumulated in daily life, production and medical practice (Ge *et al.*, 2019; Ogbaji *et al.*, 2018; Shahrajabian *et al.*, 2019a,b). Acupuncture is also a technique in which practitioners stimulate specific points on the body. Acupuncture may help reduce pain. Both Acupuncture and Chinese herbal remedies date back at least 2200 years, although, the earliest known written record of Chinese medicine is related to 3rd century BCE. According to TCM, a person is healthy when harmony exists between two forces; illness is also result from a breakdown in the equilibrium of yin and yang. Western medicine focuses mainly on treating disease, but TCM looks at the entire well-being. It is both systematic theories and also has abundant preventative and therapeutic methods for diseases (Shahrajabian *et al.*, 2019c,d). Global warming has been an issue in many aspects and the impacts of future climate change on many sectors such as agriculture, forestry, water, energy, ecosystem, and health have been controversial (Monteiro *et al.*, 2018). Climate Chang has already caused significant impacts on water resources, food security, human health especially in Africa and Asia (Kang *et al.*, 2009). China encompasses various climate regimes from northern boreal to southern tropical and from western arid to eastern and southern humid climate zones. Three major issues about climate change in China can divided to: a) The effects of climate change on the inland aquaculture sector, b) The effects of climate change on grain and forage agricultural production, c) The development of the total factor productivity and its determinants on agriculture sector. Research on the social impacts of past climate change would not only prove that past climate change affected human society, but also explain the processes and mechanisms of these impacts, including their positive and negative implications for human society (Fang *et al.*, 2015).

Traditional Chinese medicine is indigenous to the Chinese and is therefore classified as a traditional medicine, and when it is used by non-Chinese ethnicities, it is called a complementary medicine. The five phases theory defines the nature of matters based on the related characteristics of wood, fire, earth, metal and water. The five phases maintain the generation and restriction relationship among them. Traditional Chinese medicine uses five phase theory to describe the relationship between five zang and their physiological function, five zang and structure and function of various parts of the human body, and also the correlation between each part of human body and nature and society.

Farmers are particularly vulnerable to extreme weather fluctuations brought by climate change. When unusual flooding, droughts, early frost, and late frosts occur, crop yields are affected which impact farm profit. Additionally, increased diseases in soil due to hotter days, and changes in insect patterns, which are at times unseen of before, all impact farm operations. With unpredictable weather patterns, farmers are often unable to respond proactively to these fluctuations. Other times, even a proactive approach cannot change nature's course. Chinese agricultural production has increased in recent past 30 years, although rising average temperature and declining land area sown has increased.

China has played a crucial role in advancing key elements of the foundations for future development and the global agenda by taken major steps to advance international cooperation, especially on climate change. China has also participated in forms of transnational governance such as the Gold Standard, a carbon credit certification scheme. China’s current goal is to maintain a food self-sufficiency rate of around 90-95%. China has already made progress by decreasing its reliance on coal, increasing investments in clean energy and shifting its economy away from heavy industry. China also needs to safeguarding the resource base, improving resource use efficiency, particularly fertilizer nutrients and water, reduce non-point pollution and other environmental impacts, mainstream agricultural climate change mitigation in low-carbon management through innovative mechanisms such as clean development mechanism and ecosystem service payments, reduce food waste in all stages of the food chain and promoting

sustainable food consumption, and integrated approaches to catchment management and manure management.

When it comes to climate change, improving education, training and public awareness on this issue is also an important parameter, which is why in recent years, Chinese government and Chinese Academic centres have strengthened the training and education on climate change with noticeable efforts in enhancing the general public awareness of climate change and of course promoting sustainable development inside mainland China. One of the most important efforts to strengthen scientific researches and technology innovation in China related to climate change are, to reach advanced levels in research on climate change in related fields, to make remarkable progress in technology on energy development, energy conservation and clean energy, and to improve adaptation technology in agriculture and forestry. The concept of restoring balance is an integral part of traditional Chinese medicine.

Chinese medicine's understanding of yin and yang allows us to see that personal health comes from balance and that if people are to address the destabilization of the climate, people need to address the condition of the internal environment. Not only were the ancient Chinese scholars aware of Qi, the immaterial medium that connects between different parts of a body and speaks the intelligence of the body; they also recognized that nature, just like the human body, communicates between its different parts through its own Qi and the climate pattern. Haque *et al.* (2014) reported that a systematic collection of knowledge on the use of traditional medicines to cope with climate-sensitive diseases can help the adaptation of communities vulnerable to climate change. They have also noted that it could increase the health coping capacity of people in a resource-poor setting and contribute to their adaptation capabilities. Dashtdar *et al.* (2012) explained the concepts of win in traditional medicine books and they have concluded that Chinese medicine is applicable for public health specialists, traditional and complementary medicine practitioners, and those who are interested in historical medicine and provides a theoretical basis for herbal drugs or acupuncture administration to eliminate wind in order to treat various diseases. Kelly (2012) noted that prevalent assumptions about climate change held in the industrialized West through the lens of Chinese medicine, an explore deep-reaching philosophical understandings from classic Chinese medical texts that have much to offer in discussions about- an action towards climate stabilization.

Adaptation New Models to Increase Qualitative Parameters in Chinese Herbal Crops in Response to Climate Change

Agricultural systems science is an interdisciplinary field that studies the behavior of complex agricultural systems (Shahrajabian *et al.*, 2019e; Sun *et al.*, 2019). Agricultural system models play significant roles in identify strategies to support global food security and protecting the environment (Qin *et al.*, 2018). Agricultural system simulation models also can capture current knowledge of agricultural science which have the potential to elucidate the effects of soil textures on crop productivity and water use (He *et al.*, 2014). The climate change scenarios considered in their study, agricultural net revenues would increase in most regions of China, except for the Northwest, the Southwest and parts of the Northeast, as a result of the projected increases in temperatures and precipitation levels (Wang *et al.*, 2012; Morgounov *et al.*, 2018).

Climate changes resulted in substantial changes in the dates of planting and harvesting normally leading to extension of growing season, and longer planting-harvesting period was positively associated with the grain yield for most of the locations (Li *et al.*, 2014). Li *et al.* (2014) found that the climate change has a universally negative effect on Chinese agriculture and implies that a higher flexibility of maize producing timing and a better regional adaptation to climate change in Southwest region could offset or even to outweigh the potential reduction of maize production in Northeast region. Chen *et al.* (2018) revealed that climate change would have major negative impacts on crop production, particularly for wheat in north China, rice in South China and maize across the major cultivation areas due to a decrease in crop growth duration and an increase in extreme events. Qin *et al.* (2018) have shown that grain yield and environmental impacts, such as soil organic

carbon, N leached and nitrous oxide emission are influenced by different climate change.

Qian *et al.* (2016) showed that climate scenarios based on climate change simulations by some models might be sufficient for projecting regional crop yield changes. Asseng *et al.* (2019) stated that grain and protein yields are expected to be lower and more variable in most low-rainfall regions, with nitrogen availability limiting growth stimulus from elevated CO_2. They have also noted that climate change adaptations that benefit grain yield are not always positive for grain quality, putting additional pressure on global wheat production. Qin *et al.* (2018) found that the appropriate N input could be 100-125 Kg N ha^{-1} in order to balance production and environmental impacts.

He *et al.* (2013) proved that a water and nitrogen management model can be used to simulate the water movement and N transport, as well as crop growth. Also, this model used to simulate water and nitrogen balance and crop yield for different soil profiles. He *et al.* (2012) have showed the importance of researches on climate change and he indicated that growers in Saskatchewan have the potential of earlier seeding. It is clear that climate change is putting pressure on wheat yields in several ways, such as lower annual, autumn and spring rainfall; later starts to the growing season; higher temperatures during growing season.

Hernandez-Ochoa *et al.* (2018) propose that to maintain or increase future wheat production, adaptation strategies, particularly to increasing temperatures affecting irrigated wheat, or expanding the cropping area will be necessary. With climate change the highest level of potential production will generally be attained with wheat varieties that have larger temperature sum requirements for grain filling and hence a longer period of grain filling (Paymard *et al.*, 2018). Paymard *et al.* (2018) showed that changing planting dates and densities can be beneficial for adaptation of wheat to climate change. Richter and Semenov (2015) concluded that changes in the variance of weather variables will have little effect on grain yields. However, they declared that the average wheat yields are likely to increase by 1.2 to 2 t/ha (15-23%) by the 2050s because of a CO_2-related increase in radiation use efficiency (RUE). Yang *et al.* (2019) after using a crop model (STICS) found that using earlier flowering cultivars reveals higher yield gains (26-38%) than that of early sowings (6-10%), which are cable to reverse the yield reductions.

CONCLUSION

In the Chinese philosophy, climate means the Qi of nature. It is reminding the world that nature is larger body, and human are each a cell of this body, and both the cell and the body have their own level of intelligence. If either the body or the cell claims the dominance of its intelligence without the awareness of the other, people have diseases. Global climate change is likely to change the frequency of extreme weather events: tropical cyclones may increase as sea surface waters warm; floods may increase as the hydrological cycle intensifies; and heat waves may increase in mid-continental locations.

Climate change represents an external influence on agricultural production, which is beyond the control of producers and hence only leaves them the possibility to react to changing conditions. Also, according to the theory of yin-yang, all opposite matters in the universe, which are interrelated with each other or two opposite aspects within one matter, can be defined as yin or yang. Rapid increase in levels of carbon dioxide in the atmosphere have significant impacts on agricultural systems and crop production due to increase carbon dioxide, ozone levels, changes in rainfall and seasonal temperature, and increase pest, weed and diseases in plant canopies.

Climate change and its effects will certainly increase in the near future, although the extent to which they do so can not presently be determined. The influence of climate change on medicinal plants, in particular, has not been well studied and of course it is not fully understood. Climate change may become a more pressing issue for the herbal community, potentially affecting so many people. Agricultural crop production systems are extremely sensitive to climate changes such as changes in temperature and precipitation which can lead to increase number of pests and disease, thereby reducing harvest index and finally affects the food security of Asian countries, especially China. Improving water productivity and keep sustainable

relations with environment, may decrease the adverse effect of climate change.

The global cooperation is important for China to cope with the adverse impacts of climate change on food security and safety. The future researches in China should be for a better understanding of the responses of crops to changes in climate and influence of climate change on agricultural products, diseases, pests, and atmospheric constituents.

CONFLICT OF INTEREST

The authors report no conflicts of interest.

REFERENCES

Asseng, S., Martre, P. and Maiorano, A, et al. (2019) Climate change impact and adaptation for wheat protein. *Glob Change Biol*. **25**: 155-173.

Chen, Y., Zhang, Z. and Tao, F. (2018). Impacts of climate change and climate extremes on major crops productivity in China at a global warming of 1.5 and 2.0 ^{o}C, *Earth System Dynamics*. **9**: 543-562.

Dashtdar, M., Dashtdar, M.R., Dashtdar, B., Kardi, K. and Shirazi, M.K. (2016). The concept of wind in traditional Chinese medicine. *Journal of Pharmacopuncture*. **19**: 293-302.

Ge, J., Hu, Y., Guo, L., Wang, C., Sun, W. and Shahrajabian, M.H. (2018). Effects of GA_3 and ABA on the germination of dormant oat seeds. *Cercetari Agronomice in Moldova*. **3**: 25-41.

Haque, Md.A., Louis, V.R., Phalkey, R. and Sauerborn, R. 2014. Use of traditional medicines to cope with climate-sensitive diseases in a resource poor setting in Bangladesh. *BMC Public Health*. **14**: 202.

He, Y., Wang, H., Qian, B., McConkey, B. and DePauw, R. (2012). How early can the seeding dates of spring wheat be under current and future climate in Saskatchewan, Canada? *PLoS ONE*. **7**: e45153.

He, Y., Hu, K.L., Wang, H., Huang, Y.F., Chen, D.L., Li, B.G. and Li, Y. (2013). Modeling of water and nitrogen utilization of layered soil profiles under a wheat-maize cropping system. *Mathematical and Computer Modelling*. **58**: 596-605.

He, Y., Hou, L., Wang, H., Hu, K. and McConkey, B. (2014). A modeling approach to evaluate the long-term effect of soil texture on spring wheat productivity under a rain-fed condition. *Scientific Reports*. **4**: 5736.

Hernandez-Ochoa, I., Asseng, S., Kassie, B.T., Xiong, W., Robertson, R., Luz Pequeno, D.N., Sonder, K., Reynolds, M., Babar, M.A., Milan, A.M. and Hoogenboom, G. (20180. Climate change impact on Mexico wheat production. *Agricultural and Forest Meteorology*. **263**: 373-387.

Kang, Y., Khan, S. and Ma, X. (2009). Climate change impacts on crop yield, crop water productivity and food security- A review. *Progress in Natural Science*. **19**: 1665-1674.

Kelly, B. (2012) The yin and yang of climate change: Chinese medicine and cultural transformation,. *Journal of Chinese Medicine*. **98**: 51-54.

Li, X., Takahashi, T., Suzuki, N. and Kaiser, H.M. (2014). Impact of climate change on maize production in Northeast and Southwest China and risk mitigation strategies. *APCBEE Procedia*. 8: 11-20.

Monteiro, A.L.G., Faro AMCD, Peres, M.T.P., Batista, R., Poli, C.H.E.C. and Villalba, J.J (2018). The role of small ruminants on global climate change, *Acta Scientiarum. Animal Sciences*. **40**: e43124.

Morgounov, A., Sonder, K., Abugalieva, A., Bhadauria, V., Cuthbert, R.D. and Shamanin, V., et al. (2018). Effect of climate change on spring wheat yields in North America and Eurasia in 1981-2015 and implications for breeding. *PLoS ONE*. **13**: e0204932.

Shahrajabian, M.H., Sun, W. and Cheng, Q. (2019a). The power of natural Chinese medicine, ginger and ginseng root in an organic life. *Middle-East Journal of Scientific Research*. **27**: 64-71.

Shahrajabian, M.H., Sun, W. and Cheng, Q. (2019b). Clinical aspects and health benefits of ginger (*Zingiber officinale*) in both traditional Chinese medicine and modern industry. *Acta Agriculturae*

Scandinavica, Section B-Soil & Plant Science. 1-11.

Shahrajabian, M.H., Sun, W. and Cheng, Q. (2019c). A review of ginseng species in different regions as a multipurpose herb in traditional Chinese medicine, modern herbology and pharmacological science. *Journal of Medicinal Plants Research*. **13**: 213-226.

Shahrajabian, M.H., Khoshkharam, M., Sun, W. and Cheng. Q. (2019d). The effect of pretreatment factors on seed germination and seedling growth of anise (*Pimpinella anisum L*.). Middle-*East Journal of Science*. **5**: 86-93.

Shahrajabian, M.H., Sun, W. and Cheng, Q. (2019e). A review of astragalus species as foodstuffs, dietary supplements, a traditional Chinese medicine and a part of modern pharmaceutical science. *Applied Ecology and Environmental Research*. **17**: 13371-13382.

Sun, W., Shahrajabian, M.H. and Cheng, Q. (2019). Anise (*Pimpinella anisum* l.) a dominant spice and traditional medicinal herb for both food and medicinal purposes. *Cogent Biology*. **5**: 1-25.

Ogbaji, P.O., Li, J., Xue, X., Shahrajabian, M.H. and Egrinya, E.A. (2018). Impact of bio-fertilizer or nutrient solution on Spinach (*Spinacea Oleracea*) growth and yield in some province soils of P.R. China. *Cercetari Agronomice in Moldova*. **2**: 43-52.

Paymard, P., Bannayan, M. and Sadrabadi Haghighi, R. (2018). Analysis of the climate change effect on wheat production systems and investigate the potential of management strategies. *Natural Hazadrs*. **91**: 1237-1255.

Qin, X., Wang, H., He, Y., Li, Y., Li, Z., Gao, Q., Wan, Y., Qian, B., McConkey, B., DePauw, R., Lemke, R. and Parton, W.J. 2018. Stimulated adaptation strategies for spring wheat to climate change in a northern high latitude environment by DAYCENT model. *European Journal of Agronomy*. **95**: 45-56.

Qian, B., Wang, H., He, Y., Liu, J. and Jong, R,D, (2016). Projecting spring wheat yield changes on the Canadian prairies: effects of resolutions of a regional climate model and statistical processing. *International Journal of Climatology*. **36**: 3429-3506.

Richter, G.M. and Semenov, M,A. (2015). Modelling impacts of climate change on wheat yields in England and Wales: assessing drought risks. *Agricultural Systems*. **84**: 77-97.

Wang, H., He, Y., Qian, B., McConkey, B., Cutforth, H., McCaig, T., McLeod, G., Zentner, R., DePauw, R., Lemke, R., Brandt, K., Liu, T., Qin, X., White, J. and Hunt, T. (2012). Hoogenboom G. Short communication: climate change and biofuel wheat: a case study of southern Saskatchewan. *Canadian Journal of Plant Science*. **92**: 421-425.