Agrotechnology

Liu and Yang, Agrotechnol 2015, 4:1
http://dx.doi.org/10.4172/2168-9881.1000e114

Editorial Open Access

China Agriculture Dilemma under Haze Strike

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Rec date: Nov 05, 2014, **Acc date:** Nov 07, 2014, **Pub date:** Nov 09, 2014

Introduction

China is one of the rapidly developing countries. It had been the world's second largest economy entity after the United States. Unfortunately, China, especially the capital city Beijing, had encountered dozens of times haze since 2012. Outbreak of haze weather has been increasingly frequent and serious in Beijing. Sometimes, less half of the national territorial areas of China were on hit. Particular areas included areas of North China, Central China, East China and North-west China. Generally, spring and winter are the susceptible season for haze due to sharply increment of coal consumption. Excessive traffic exhausts plus weakened disposal ability of green plants. Therefore, the longest continuous haze called as 'haze week' happened two times in Beijing during late 2013 and early 2014. Nowadays, Beijing is frequently haunted with haze lasting one to seven days. Truly, sharp deterioration of air quality brought by haze heavily to affect overall aspects of urban dweller's life unprecedentedly. Some people felt physiologically and psychologically overwhelmed especially when coming up unpredictably and repeatedly. More badly, they are helpless except looking forward passively to the soon coming of windy weather.

Effects of Haze on Human Life and China Agriculture

Naturally, haze strikes arise more concerns on China food supply and security as well as public traffic and health. In essence, haze is a kind of manifestation of air pollution with PM2.5 particles which impact human health after being inhaled. According to the monitoring data, PM2.5 concentration ranged from 457 to 520 μg/m^3 across the urban and suburban area of Beijing during the 'haze week' occurred in 20 to 26 February, 2014. The highest record nationwide is 900 μg/m^3. Longevity of residents were supposed to be reduced when long-term exposure to high concentration PM2.5. As reported by New York Times, life expectancy of Chinese northerner was supposed to be lower at 5.5 years than the southerner.

Damage of heavy haze weather on China agriculture is noteworthy because plant-concerned sunlight traits changed drastically when it happened. It is well known that sunlight irradiation is the main energy source of plant photosynthesis and photo morphogenesis of agricultural production. Moreover, also the heat provider to keep the temperature in protected agricultural facilities (such as Chinese solar greenhouse) during cold night. Inevitably, haze are impacting agricultural productivity negatively to an uncertain degree by decreasing photosynthesis strength for discounted light intensity (estimated beyond 50%), changed light quality and shorter photoperiod (averagely beyond 1 hour) caused by absorption and refraction of air-borne micro particles. The delay growth and development of crops in protected facilities significantly. Additionally, concentrated air pollutants may exert negative chemical impacts on plant health. Almost simultaneous with haze high-incidence season, winter and spring are prime time for high-profit protected vegetable production. The commercial yield is determinant for annual total gains of Chinese vegetable farmers. So haze strike may be fatal sometimes, determining their destiny. As investigated by author in Shiny district, Beijing, some tomato plants in Chinese solar greenhouses tend to cease growth or die under dual stresses of low temperature and weak lighting given rise to long-term haze.

Totally, the cultivation area of protected agriculture in China was estimated up to 4 million hectares. However, most of acreage is unfortunately covered by haze influential area. But the actual loss caused by haze has not investigated systematically yet. Actually, Chinese protected agriculture is facing a dilemma under frequent haze strike. Traditionally, low input and low output with low income is the characteristic and operational principle for Chinese protected agricultural production. Therefore, most of investment was used to purchase the necessary and relatively cheap supplies (e.g. seed, fertilizer, pesticide and plastic film) rather than the expensive machines or devices to control environmental factors(such as temperature, CO_2 concentration and irradiation). Although Chinese solar greenhouse was invented in Liaoning province at 1980s.It is still primitive with poor environmental control capacity, highlighted contrast to well-equipped multi-span greenhouse of some developed countries, such as Netherlands and Japan etc. Furthermore, soilless cultivation is far from popularity, and soil culture accounts for over 95% at the end of 2013. So, it is inevitable and unsurprising for protected vegetables to suffer low temperature, weak light and reduced CO_2 concentration stresses in China. No feasible practical strategy has been established up to now even knowing large loss paid every year for social and technological factors. That situation gets rapidly worsened intervened by haze, for further discounted light condition in agricultural facility. That means entire lifetime of Chinese protected vegetables was malnourished, striving to survive without sufficient 'food and cloth' conditions.

Recommendations for Food Production in Controlled Environment

Food security and effective supply is a national strategy to support 1.3 billion populations. This apparently relies fundamentally on both quantity and productivity of arable land resources directly. Chinese government urged repeatedly that a minimum 120 million hectares of arable land must be protected to feed its people in the future. Some non-arable land in Northwest China, ecological vulnerable zones, and lack of water resource exploit protected agriculture. We think it is not an optimal national practical strategy to pursue merely for quantity instead of quality. Low level construction and expansion of protected agriculture has over occupied high-quality arable land. Furthermore, low productivity and loss caused by climatic adversity due to poor

defensive capacity is insurmountable. Here, we must highlight that Chinese protected agriculture is facing a strategic choice, either abandoning traditional operational idea and adopting new technology, or struggling as usual under haze strike. Fundamental changes are needed for China agriculture to ensure food security. To make a choice is becoming more urgent than ever for China under increasing haze hit.

More feasibly, we think the farmer should be recommended to develop well-equipped protected agriculture with high productivity on relatively small arable land. Some developed countries have set some successful examples. If advanced countries examples are followed, a large part of arable land will be saved to plant other crops. Money and intelligence should be appointed to develop novel facility structures and environmental control technology to improve vegetable yield and quality. To be specific, the problem of weak light caused by long-time haze can be successfully solved by supplemental lighting with electrical lamps (e.g. high pressure sodium lamps). Preferably, light-emitting diode (LED) lamps and the fourth generation electrical light source with many advantages over traditional ones. The light intensity, quality and photoperiod of LED supplemental lighting can be well controlled by computer responding to plant behaviors. Sunlight trait changes of sunlight irradiation properties under haze weather to meet plant growth and development. Certainly, based on barrel theory, other control equipments should be adopted to provide crop with sufficient temperature, CO_2 concentration besides light, by which is eliminating natural climatic change influence, like haze. In conclusion, henceforward, there is less available sunlight irradiation onto China agro ecosystems in winter and spring seasons. That means that haze affects agricultural production somehow. We should fight and overcome the disastrous strike with modern scientific technology, mainly supplemental lighting. Maybe, this is an opportunity for China officials and farmer to make up their minds to propel modernization process in environmentally-controlled agriculture.