# The Major Recessive Calamities Affecting the Wheat Production in Chuxiong Prefecture and Control Countermeasures

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**Abstract** The impact of recessive calamities was analyzed, including seasonal drought, cold injury, dry hot wind and aphid in the wheat production of Chuxiong Prefecture, and the countermeasures that prevented and controlled the recessive calamities in a target-oriented way were proposed, including the improvement of basic farmland, the application of organic manure, the promotion of the breed with high stress resistance, the seedling at suitable date, the improvement of control on fertilizing and watering, the enhancement of management on cultivating and controlling disease in time, and the breeding new variety adaptive to local ecosystem, in order to advance the wheat production in a sustainable way.

**Key words** Recessive calamity, Wheat production, Control countermeasures, Chuxiong Prefecture

Chuxiong locates in the west Yunnan - Guizhou Plateau and central region of Yunnan Province. Influenced by East Asian monsoon, South Asia monsoon and Qinghai - Tibet Plateau, Chuxiong enjoys special plateau subtropical monsoon of lower latitude. Such peculiar landscape and climate contribute to the worsening distinctive and recessive calamity[1] to agriculture in Chuxiong, especially the outstanding effects of recessive calamity on the production of wheat. As one of the stable crops in Chuxiong, wheat plays a significant role in the economic and social development as well as crops safety in Chuxiong. The plantation of wheat in Chuxiong reached 59200 $hm^2$, about 148771 t in total. It decreases gradually year after year, and the average annual planation area was around 33 333 $hm^2$ in recent decade, with a total production of 9000 t, and an average output of 2700 kg/$hm^2$. Based on previous studies and field observation as well as comparison analysis, it is believed that the major reason for the low yield of wheat and stagnant growth is the impacts of recessive calamities on wheat production.

## 1 Primary recessive calamity that affect wheat production

**1.1 Seasonal drought** Chuxiong enjoys subtropical monsoon climate with distinctive four seasons and little precipitation as the annual average precipitation is 850 mm, which is 1258 mm lower than the average precipitation in Yunnan. The precipitation generally concentrates between June and October. There is distinctive drought in different seasons[2]. Wheat grows from November to April when the average precipitation was only 99 mm. The average precipitation in Chuxiong in ten years was about 92.1 mm, Yao'an County 76.1 mm in ten years, and average 110.4 mm in Wuding County. Studies suggest that during the entire growth period, there must be a precipitation between 450 and 500 mm to meet the demand of water[3]. The precipitation from November to the next April in Chuxiong was only 99 mm, which was far less than what the wheat demanded. The wheat in Chuxiong, which was irrigated without water, was mostly planted in spring. Mid-January witnessed spike differentiation, which meant there should be adequate water supply. If the moisture is inadequate, the spike differentiation would accelerate, and the nature of spike would deteriorate. Most wheat in Chuxiong were in the booting stage from the last ten days of January to the mid-February when its demand for water was especially sensitive. Therefore, drought and lack of irrigation were the responsible for the low-yield of wheat. There was continuous drought from the autumn in 2012 to the summer in 2013, which brought about disastrous impacts on wheat in Chuxiong, with a total output of 93 142 t, 11.8% lower than previous time.

**1.2 Low temperature and heavy frost** The annual mean temperature in Chuxiong was 14.8 ℃, as the mean temperature in January was 7.4 ℃ and the mean temperature in July was 21.4 ℃. The extreme highest temperature was 42 ℃ (May 31, 1963) and the extreme lowest temperature was minus 8.4 ℃ (January 1, 1974). There was a period of frost from November to April when the wheat was shooting and jointing. However, the period from the last ten days of January to mid February witnessed dramatic cooling of temperature as the wheat was in the earing stage when its capacity to resist low temperature weakened. The daily mean temperature should be between 10 and 15 ℃ from shooting to earing stage[4]. The coldness in Chuxiong may change with the height of elevation. There was coldness in most years in Chuxiong, causing a reduction of 5% to 10%. Influenced by the cold air on February 25, 1989, the temperature there decreased to lower 0 ℃, and the yield per unit dropped from 1590 kg/$hm^2$ in 1987 to 990 kg/$hm^2$ in 1989.

**1.3 Dry hot wind** Dry hot wind refers to the weather with high temperature, low-humidity and certain wind power, which would

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give rise to reduction of output of wheat. The dry hot wind occurred usually when the daily highest temperature was above and equal to 30 ℃, the relative humidity at 14:00 was lower than and equal to 30%, and the wind speed at 14:00 was larger than and equal to 3 m/s[5]. The temperature rose back quickly from March 20th when the daily mean temperature could reach 20 ℃, the daily highest temperature could be larger than or equal to 30 ℃, and the daily lowest relative humidity often lower than or equal to 30%. Dry hot wind mostly took place when the wheat was blooming or grouting. The dry hot wind would quicken the transpiration of leaves, result in shortage of supply of water, and weaken the effect of photosynthesis, which would result in early maturation[6]. Dry hot wind occurred in Chuxiong every year, which more or less brought about certain influences on the output of wheat.

**1.4 Rust disease of wheat** Rust disease is the major disaster that affects the serious reduction of output in wheat[7]. Nearly 13333 $hm^2$ of land is under the influence of rust disease. There are three kinds of such disease, namely twig rust, leave rust and stalk rust. The reason why rust disease occurs is the elevation differs greatly in Chuxiong, the dimensional climate is distinctive and the wheat species cannot resist diseases, etc. Such disaster is related to the rainfall in winter and spring. Generally speaking, the heavier the precipitation in spring and winter, and the more serious the disease. For example, the precipitation in Chuxiong was much heavier than that from November to December in 2008, and vice verse. There was heavy precipitation in the winter of 2010 in Chuxiong, and the rust disease became popular in the spring of 2011.

**1.5 Aphid in wheat** Because of the complicated dimensional climate in Chuxiong, aphid survives in the wheat throughout the year. There have been aphids since the seedling of wheat grew, especially from February to March each year. The temperature and precipitation in winter and spring is the major factor that affects the timing of aphid. If the weather is extremely cold in winter and early spring, the aphid would be controlled, otherwise there would be much more aphides in wheat. The aphid in wheat would suck the juice in the stalk, leaves and ears of wheat until it withered to death.

## 2 Prevention and control measures

**2.1 Strengthening the infrastructure control of farmland** The governments at all levels are strengthening investment and building reservoirs, raising water conservation, and increasing the use of water for wheat production. Besides, large areas of farmland are being constructed by improving the soil, fertilizing, and strengthening the soil's capacity to conserve water and fertilizers. Such infrastructure construction exerts significant effects on promoting the wheat growth.

**2.2 Promotion of the breed with high stress resistance, the seedling at suitable date** Wheat seedlings such as Yunmai 42, Chumai 10, Yunmai 56 and Chuanmai 107 are promoted at this stage. From the mid October to early November when the rainy season is going to end, and the soil is moist, the time to sow seedlings depends on land quota, elevation height and species, which lays solid foundation for the resistance of various potential disasters. The low temperature makes it necessary for people to choose species that can survive from coldness. Dry hot wind should be avoided when plants are blooming and earing.

**2.3 Strengthening the adjustment of fertilizer and water** To enhance the soil fertility, there should be a balance among nitrogen, phosphorus, and potash fertilizer. Irrigation should be conducted before the low temperature disasters and dry hot wind come.

**2.4 Strengthening cultivation management** The appropriate ways to plant wheat are intertillage weeding and soil ridge, which are essential ways to prevent drought. Furthermore, fertilizers should be sprayed during the blooming stage when the frost occurred.

**2.5 Timely prevention control of diseases** The disease prevention mostly refers to rust disease and aphid in wheat. The best way to prevent rust disease is to plant species that are immune to rust disease, which is the most economic and environmental-friendly method[8]. Therefore, new species should be developed now and then. What's more, fertilizers should be used appropriately. The medicine and fertilizer should be monitored closely to reduce the dangers of aphid to the largest degree, and to ensure the output of wheat.

**2.6 Breeding new variety adaptive to local ecosystem** In order to ensure the sustainable production of wheat, species with high yield and strong ability to resist drought and coldness are one of the crucial measures. The administrative departments and agricultural scientific promotion departments reinforced scientific and technological investment. New species with peculiar features can be tried and promoted to replace the old species, which laid solid foundation for the sustainable development of wheat.

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