The development and extension of subsoiling technology in China

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Introduction

Subsoiling is a typical mechanized tillage method used in conservation fields in China. Due to long-term conventional tillage, soil bulk density and hardness are increased while soil porosity is decreased, which is unfavorable to crop growth. Current studies in China show that subsoiling can break the compacted soil hardpans, increase aeration and permeability of the soil, and improve physical and chemical properties of the soil, without disrupting the original soil structure. Because of these obtained effects, this technology makes the root elongation into deeper soil, benefits to the absorption and utilization of water and nutrients by crop roots, and then increases the crop yields. In recent years, more and more attention has been paying to the development and extension of the subsoiling technology. In this paper, the national policy and financial support for the promotion and application of the subsoiling technology was summarized, changes of subsoiling area and possessive quantity of subsoilers in China in recent years was generalized, different kinds of subsoiling machine researched and applied in China was introduced, and measures for further development and extension of subsoiling technology in China were proposed.

National policy and financial support

Attributing to a series of regulations associated to promote subsoiling technology, such as policy, plan, measure and subsidy, the subsoiling technology has been rapidly adopted in suitable provinces in China since 2009. In 2018, the national subsoiling area was 10.6 M ha, which was 1.93 M ha more than that in 2008. Especially by the end of the 12th Five-Year Plan period in China, the possessive quantity of large tractors(> 80 hp) and subsoilers was 414 thousands and 95 thousands more than at the end of the 11th Five-Year Plan period, respectively. Over these five years, the cultivated land in the suitable areas of northern China had almost all been subsoiled. And suitable subsoiling operation model for seven regions had been formed. Monitoring data of some provinces showed that the subsoiled lands, whose subsoiling depth reaching 30 cm, could store about 400 mm^3 more water per hectare than those unsubsoiled lands. And then the average moisture content increased by about 7% during the summer drought. Besides, the drought-tolerance time of crops was extended by about 10 days. And thus, the average yield of wheat, corn and other crops increased by about 10%. The national policy and financial support is a significant action for the development and extension of subsoiling technology.

Table 1. Some relevant development regulations of subsoiling technology in China

Year	Regulation
2009	Ministry of Finance: Interim measures for the administration of the centralized use of the newly increased central funds for comprehensive agricultural subsidies for the building of basic grain capacity
2011	Ministry of Agriculture: National agricultural machinery subsoiling and land preparation operation implementation plan(2011-2015)
2016	Ministry of Agriculture: National agricultural machinery subsoiling and land preparation operation implementation plan (2016-2020)
2018	Ministry of Agriculture and Rural Affairs: The maximum subsidy amount of national general agricultural machinery central financial funds (2018-2020)

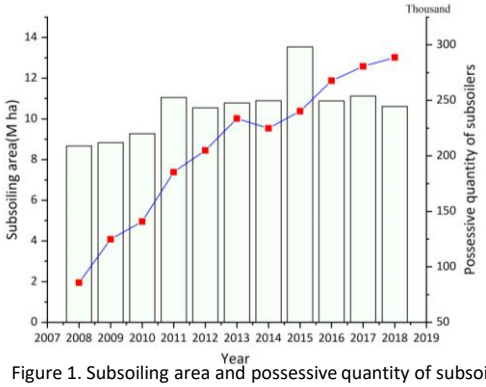

Figure 1. Subsoiling area and possessive quantity of subsoilers in China (2008-2018)

Classification of subsoiling machines

The subsoiling technology started to be studied in 1960s in China. In recent years, more and more attention has been paying to the research and development of subsoiling shovels and subsoiling machines. According to the operation function, subsoiling machines can be divided into two types. The one is machines, which are capable of subsoiling only, and another one is machines, which are able to complete several operation processes at one time, including stubble breaking, rotary tillage, subsoiling, fertilization, sowing, covering soil and other operations. In addition, the machines, which only have subsoiling function, are further divided into vibrating subsoilers and non-vibrating subsoilers. And the latter mainly includes chisel subsoilers and omni-directional subsoilers. Different kinds of subsoiling machines can be selected according to the specific soil condition and farming system in different regions in China.

Table 2. Some maximum subsidies from the central government for subsoilers(2018-2020)

Class name	Maximum subsidies from the central government(RMB)
Non-vibrating subsoiler with three or less subsoiling shovels	1400
Non-vibrating subsoiler with six or more subsoiling shovels	3400
Vibrating subsoiler with three or less subsoiling shovels	2800
Vibrating subsoiler with six or more subsoiling shovels	4900

Figure 2. Different kinds of subsoiling machine in China

Conclusion

The development and extension of subsoiling technology in Chine has improved the efficiency and quality of agricultural production, and increased the economic benefits of farmers. More importantly, it has promoted the sustainable development of agriculture. Some measures, such as the national policy and financial support, locally applicable scientific research, better extension and training for farmers, and international cooperation and communication, will further accelerate the extension and adopation of subsoiling technology in China.