

# **Research on the Technique of Conservation Tillage in Various Areas in Shanxi Province**

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## **ABSTRACT**

This paper introduces the techniques of conservation tillage (CT) in various areas of Shanxi Province. With the results of research on CT, it is proposed that the technology be promoted and advanced.

**Key words:** Conservation tillage, technique, equipment, research

Shanxi Province is located in the eastern part of the Loess Plateau of Northwest China. It experiences temperate and warm temperate zones, and continental monsoon climate. Population is about 33 million; cultivated land covers an area of 4.4 million hm<sup>2</sup>; dry land covers an area of 3.335 million hm<sup>2</sup>, and accounts for 75.8 per cent of the general cultivated areas. Annual natural rainfall is 400-650mm. Shanxi Province is one of the dry areas of North China and experiences water shortage.

Since the area is mountainous, it has low vegetation coverage rate, and experiences loss of soil and water. Shanxi has become one of the fragile agro-ecology provinces in China. The landform and climate conditions of Shanxi are varied such as flat areas, hilly areas, and mountainous areas.

The northern area has higher heights and lower air temperature. These areas usually cultivate maize, millet, sorghum, soybean, tuber crops, naked oats, benne and sunflower, etc. The middle and southern parts of Shanxi has plenty of resources such as light, cultivate crops such as maize, wheat, soybean etc., cropping pattern is usually one crop a year and three crops for two years in many districts. In irrigated places, such as in some basins of Linfen, Yuncheng and Jincheng, they carry out plant modes of two crops per year for wheat, maize or soybean.

Considering its natural agricultural conditions, Shanxi Province can produce various crops. The technique of CT is a sustainable development producing technique, with its application of minimal-tillage; zero-tillage; crop stubble management and weeding keeps the crop stubble suitable for covering the soil surface, and reducing water erosion. The techniques of CT for various areas in the province have been established.

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## 1. TECHNIQUES OF CT FOR ONE WHEAT A YEAR

The cropping pattern of one wheat a year is practiced in the hilly areas in the middle and southern parts of Shanxi, most of which do not have irrigation and carry out dry farming. In general, cropping schedule is as follow: seeding on 10-22 September; harvest on 25 May to 1 June of the following year; and fallow period in June to September.

The essential techniques of wheat CT covers weeding, min-tillage/zero tillage during the fallow period, keeping the crop stubble cover as much soil surface as possible to reduce runoff and prevent soil moisture evaporation, increase soil pond age, and increase soil fertility. CT technology consists of six key measures: harvest, depths loose, straw handles, soil surface cultivation, chemistry weeding, and sowing with mini-tillage/zero tillage.

Harvesting is the first technique in CT. After combine harvesting, the straw is not thrown away or burned. In small farmlands in the mountainous areas, harvesting is done by using a cutter-harvester, keeping the stubbles as high as possible. Harvesting can also be done manually.

The depth loose is one technique for resolving soil compaction. Land cultivation, natural rains, etc., lead to soil sinkage, and gradually to compaction. While traditional farming depends on ploughing the soil to avoid soil compaction, CT depends on the crop stubble root system to restore soil structure, grow earthworms, and eventually, bring back the soil nutrients and soil agglomerate structure. To break the bottom of the soil, depth loose should be done during the same year before CT is adopted. Depending on the soil compaction situation, depth loose could be done every three to five years later. Working period is determined based on the condition of soil moisture.

Straw handles could be used in wheat fields with higher straw outputs so that smooth sowing with homogeneous cover could be attained. Usually, straw handles used in the wheat field have harvests of more than 200 kg/mu. Application is synchronized with weeding. When wheat yields are higher than 300 kg/mu, there is more straw and the pass ability of the seeder is affected. In this case, soil surface handles are necessary.

Weed control is one key technique for CT. Chemistry weeding does not churn the soil. In wheat fields with lower outputs, straw handles and soil surface tillage are not carried out. Therefore, during the fallow period, herbicides are used to exterminate weeds. While straw handle and soil surface tillage is carried out in wheat fields with higher yields, it is still important to control the weeds.

Sowing with zero-tillage is the most important technique for CT. The capability and usage of the seeder affects sowing quality. The seeder should be able to handle

stubble covering and zero-tillage, sowing, fertilization, soil press, etc. With the stubbles, enough seeds should be sowed to ensure wheat seeding.

## **2. TECHNIQUES OF CT FOR ONE MAIZE A YEAR**

Maize is the staple food crop in Shanxi Province, cultivated in 1-1.15 million hm<sup>2</sup> a year. About 75 per cent of this area is cultivated to one maize crop per year.

Maize seeding time is from 10 April to 1 May; harvest time is from 25 September to 10 October, following a growth period of 120 days. Maize cobs are picked manually or harvested mechanically. Manual harvesting keeps the straw upright. Mechanical harvesting using a straw-chopper cuts up the maize straw. A rotary-cultivator cultivates the land surface.

In areas with lower maize outputs, straws are intertwined and stored upright to be used for feeding livestock in winter. During the next cropping season, maize is sown using seeders with minimum or zero tillage. Multi-purpose seeders or rotary tillage seeders are also used. Weeding is done manually in combination with the use of herbicides.

## **3. TECHNIQUES OF CT FOR WHEAT, MAIZE, OR SOYBEAN TWO CROPS A YEAR**

The southern parts of Shanxi Province enjoy a good amount of sunlight, abundant rainfall, and fertile soil. Wheat, maize, or soybean is planted twice a year.

After wheat harvest during 28 May to 15 June, sowing of maize or soybean immediately follows between 25 September to 5 October. After wheat harvest, two kinds of sowing may be done: manpower dibble sowing or mechanized sowing. In the period of maize growth, weeding is done manually in combination with the use of herbicides.

During the harvesting period of maize and soybean, manual picking of maize cobs is employed or the use of combine machinery. After harvesting the cobs, the maize stalks are stored upright; a straw-chopper is used to cut the maize straw then wheat sowing is done using a multi-purpose seeder or rotary tillage seeder.

Usually after soybean harvest, minimum or zero tillage is done; wheat sowing follows using a seeder.

## **4. TECHNIQUES OF CT FOR WHEAT, MAIZE AND SOYBEAN THREE CROPS TWO YEARS**

In the middle and southern parts of Shanxi Province, there are ample heat

resources and rainfall conditions suitable for a triple-cropping system for two years. After the maize harvest, wheat sowing is done in October; soybean sowing is done after the wheat harvest in June the following year; winter fallow period after the soybean harvest in September; maize sowing in April of the third year. This cropping pattern totals a production cycle of two years.

Due to the soil's fertility and higher yields in these areas, crop stubbles are excessive. Fertilizer is scattered in the field manually; then wheat sowing follows using a rotary-seeder. After the soybean harvest, maize sowing follows using a seeder in the minimum and zero tillage fields.

## **5. TECHNIQUES OF CT FOR COARSE FOOD GRAIN AND TOMATO**

Shanxi is a big province producing coarse food grains and tomatoes. The average area cultivated for the crops per year is 1.35 million  $\text{hm}^2$ . Sowing crops such as millet, soybean, sunflower, naked oats, potato is done in April to June; harvesting is done in September to October.

The main aspects of CT includes the following: sowing of the grains, millet, soybean, sunflower, and naked oats manually or using a machine; keeping the stubbles on the land surface through winter; planting of the second rotation crops; sowing using multi-purpose seeder, rotary tillage seeder; manual weeding combined with chemical weeding using herbicides.

### **Summary**

To solve the problems related to CT in Shanxi Province, it is important to pay attention to the following: (1) Cropping pattern which could be one wheat a year, one maize a year, wheat maize or soybean two crops a year, wheat maize and soybean three crops in two years. These cropping systems where CT techniques are applied can be popularized in Shanxi Province. (2) The use of crop stubbles can protect the soil during autumn and in the higher and colder areas of the province. The crop stubble covers the soil surface, reduces the ground temperature, and creates an environment for crop growth.

Field tests for one maize a year with zero-tillage was done in five years. Results showed that the ground temperature decreased by 1.4 to 2°C compared to traditional tillage which had seeding time of 2-12 days and a one-day maize maturity period. Therefore, in maize areas with lower air temperature, shorter frost-free, zero-tillage mode is not suitable. (3) Crop stubble cover affects sowing quality, therefore, in the areas of higher crop stubble amounts; minimal TC technique should be popularized. (4) There should be a good timing for grain sowing and weeding. (5) Fifthly, with the high cost of available seeders with zero-tillage, low availability factor, and worsening economy, there is a need to develop low-cost multiple seeders.

With the above factors considered, it is expected that families of farmers could improve their economic status while at the same time, promote CT.

## **6. REFERENCES**

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