玉米宽窄行留高茬交互种植技术研究

1996——2005

吉林省农业科学院

Jilin Academy of Agricultural Sciences

刘武仁　　研究员

Professor Liu Wuren

一、研究依据及目的意义

Evidence , goal and significance

- 针对生产上存在问题
- The existing problem in the production

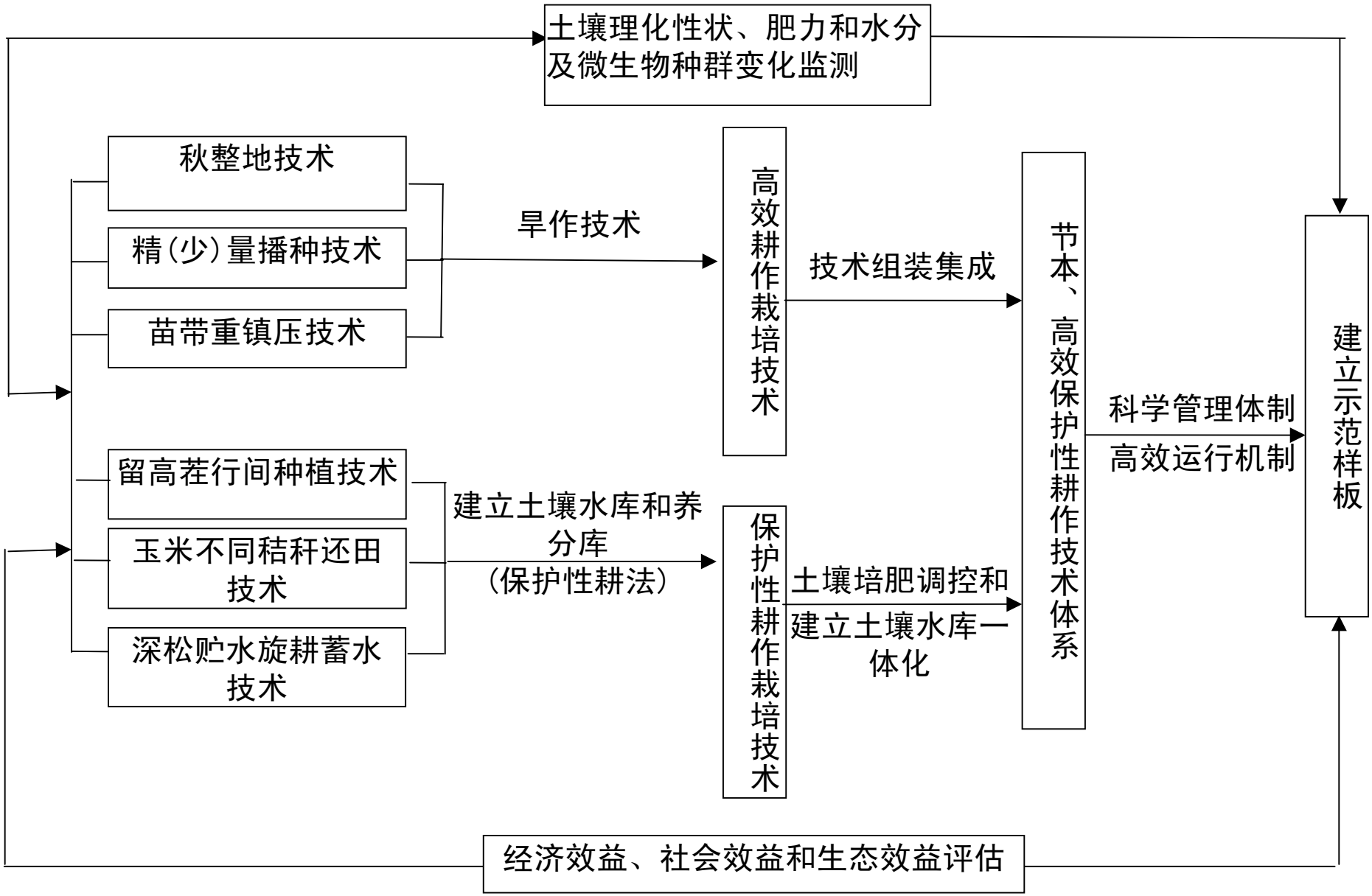
① 春旱严重，自然降水利用效率低；②地力下降、物理性状变差、耕层变浅、犁底层加厚、有机质降低；③土壤风蚀和水蚀严重；④ 田间作业环节多，成本高。

The utilization rate of the rainfall is low because of the draught.
The soil fertility is decreased , the physical property is low , the plow layers
is thin , the plow pan layer is deep and the organic matter is low.
The wind erosion and water erosion of soil is serious
The working procedure is much and the cost is high.

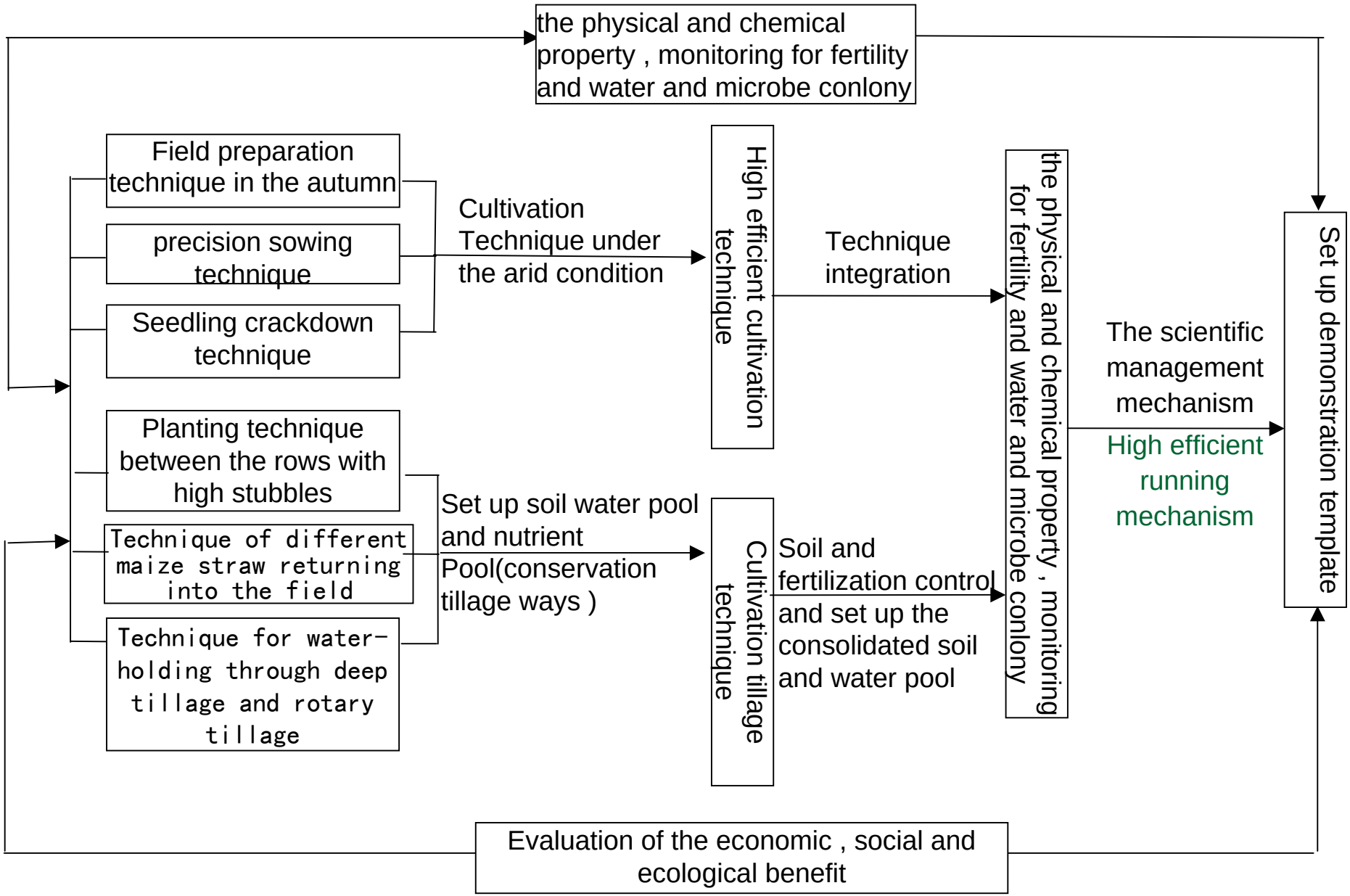
- 实行保护性耕作是保护农业生态环境的需要;
- 实行保护性耕作是提高农业生产效益的需要;
- 实行保护性耕作是农业可持续发展的需要;
- 实行保护性耕作是保证国家粮食安全的需要;

- The conservation tillage is the need for protecting the environment.
- The conservation tillage is the need for increasing the agricultural production benefit.
- The conservation tillage is the need for the sustainable agriculture
- The conservation tillage is the need for the safety of the national grain

二、研究思路（Research ideas）



二、研究思路（Research ideas）



三、成果的主要内容
The main content of the achievements

- 建立了玉米宽窄行留高茬交替休闲种植技术体系

Planting technique system of wide/narrow row alternation was set up

1.玉米宽窄行交互种植；

2.窄行精密播种；

3.宽行中耕深松蓄墒；

4.留高茬秸秆还田；

5.旋耕整地保竖年春墒；

6.种植带、耕作带互作休闲。

1. wide/narrow row alternation Planting for maize
2. Precision planting of narrow row for maize
3. Middle tillage of wide row for keeping soil moisture
4. High stubble was remained for returning the straw into the soil
5. Rotary tillage and preparation for keeping the soil moisture of the next spring
6. fallow/tillage with planting zone / cultivation zone alternation

新耕法田间图 **filed picture for new tillage way**

图1 现行耕法（均匀垄）示意图

Chart 1 Sketch map for conventional tillage way(average row)

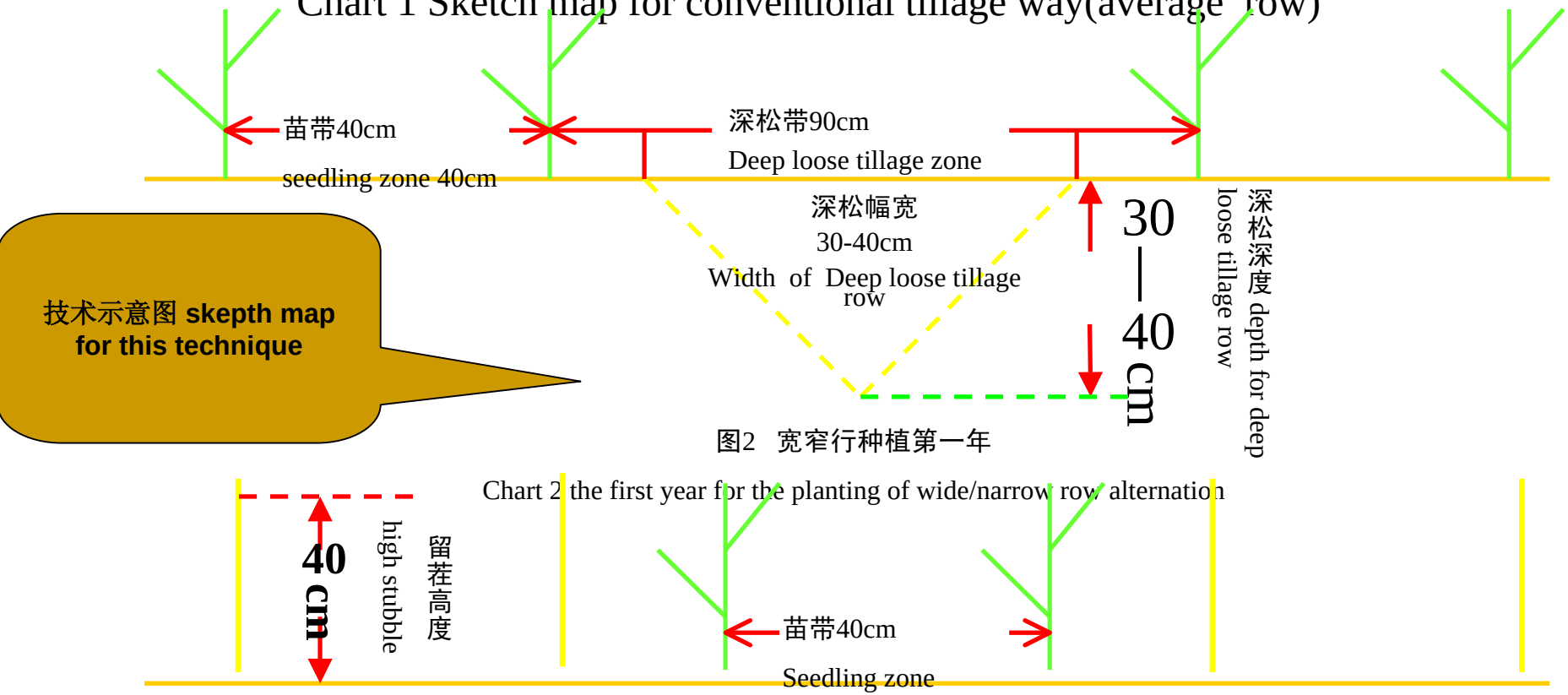


图2 宽窄行种植第一年

Chart 2 the first year for the planting of wide/narrow row alternation

图3 宽窄行种植第二年 chart 3 the second year for the planting of wide/narrow row alternation

- 新技术体系配套的农机设备 **agricultural mechanism matching for new technique system**

3ZSF-1.86T2深松追肥机

(3ZSF-1.86T2 deep tillage machine for top dressing)

（专利产品 patent products）

BJ系列精密播种机

precision seeding machine for BJ series

1GQN320T3条带旋耕机

1GQN320T3 stripe zone rotary machine

保护耕作新体系的技术经济效果

Economic effect for the new technique system of conservation tillage

✓ 宽窄行交替休闲种植留高茬增加土壤有机物料

Increasing the organic substance for the planting of wide/narrow alternation with high stubble

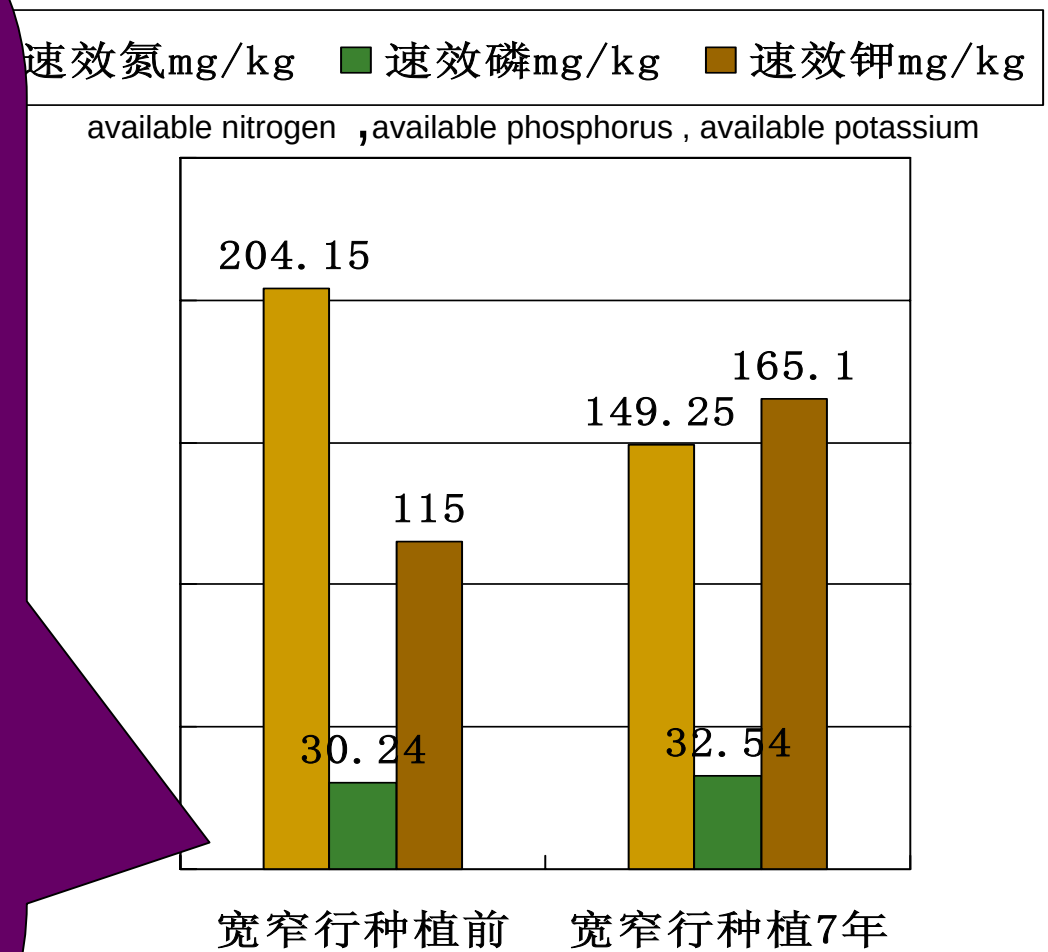
品种 Variety	平均单株秸秆风干重(g) the average air-drying weight of single straw			40cm茬占全株% % of Stubble of 40cm length accounting for the total plant	公顷还田有机物料(吨) The organic substance of returning to the soil per hectare
	全株 Total plant	10cm茬 Stubble of 10cm length	40cm茬 Stubble of 40cm length		
四密25 simi25	206	10.9	46	22.23	2.78
吉单209 Jidan209	199	12.5	52.8	26.53	2.90
银河101 Yenhe101	218	11.7	51.3	23.53	2.82

✓ 新体系的土壤速效养分变化情况

change of the available nutrients for the new technique system

七年的宽窄行种植定位试验,土壤有机质提高6.73g/kg，速效磷提高2.3mg/kg，速效钾提高50.1mg/kg，速效氮降低了54.9mg/kg,速效氮有所降低，主要原因是宽窄行种植实行半秸杆还田，七年的秸杆还田，秸杆在分解过程中要消耗一些N素，没有特殊的增施N肥，调解C、N比。

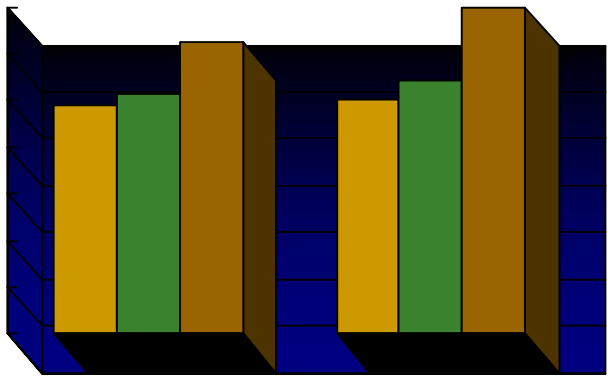
Through the fixed place experiment of wind/narrow alternation planting for seven years , the soil organic matter was increased by 6.73g/kg, the soil available phosphorus was increased 2.3mg/kg, the soil available potassium was increased 50.1mg/kg, the soil available nitrogen was decreased 54.9mg/kg.the main reason for nitrogen decreasing was that nitrogen was used up during the straw decomposing , and no additional nitrogen was applied , the proportion of carbon and nitrogen was not regulated.



土壤速效养分变化情况

✓ 土壤容重降低

Decreasing of soil bulk density

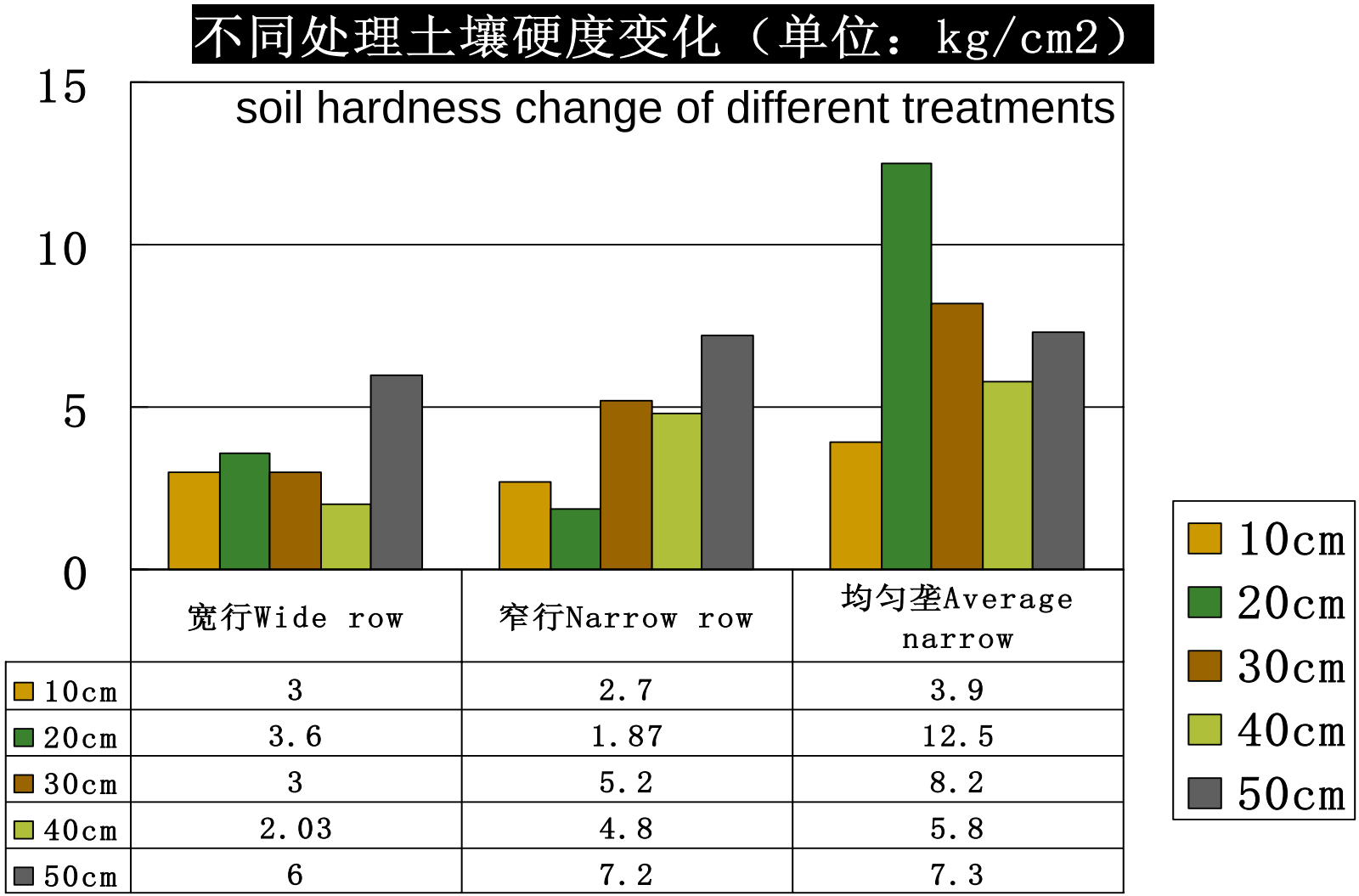


		0－20cm	20-40cm
Wide row	宽行	0.98	0.999
Narrow row	窄行	1.024	1.082
Average row	均匀垄	1.25	1.4

(g/cm^3)

✓ 土壤硬度下降

Decreasing of soil hardness



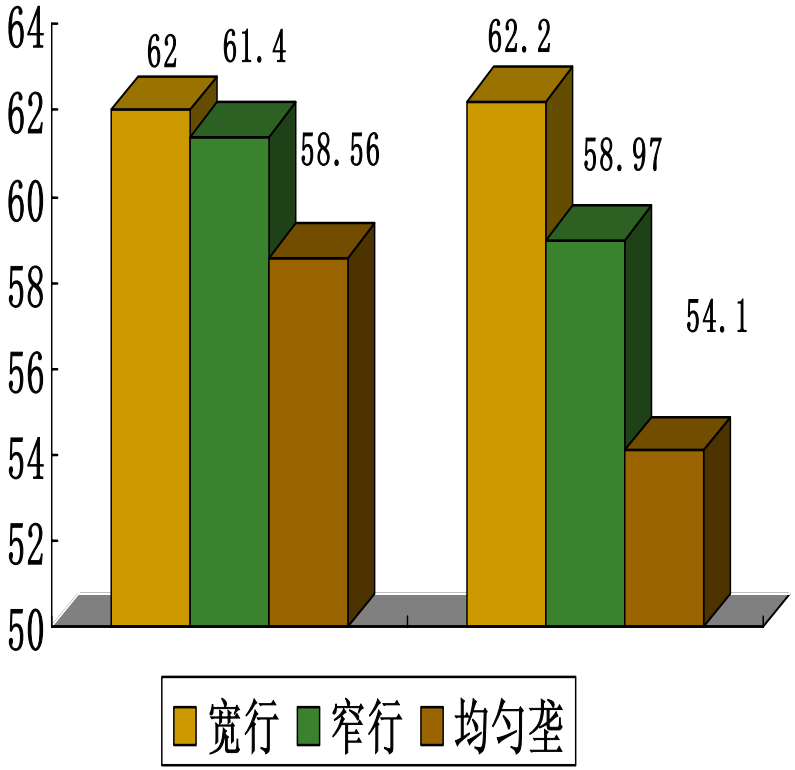
	宽行Wide row	窄行Narrow row	均匀垄Average narrow
10cm	3	2.7	3.9
20cm	3.6	1.87	12.5
30cm	3	5.2	8.2
40cm	2.03	4.8	5.8
50cm	6	7.2	7.3

✓ 土壤通透性增强

The soil permeability was strengthened

不同处理土壤总孔隙变化情况(%)

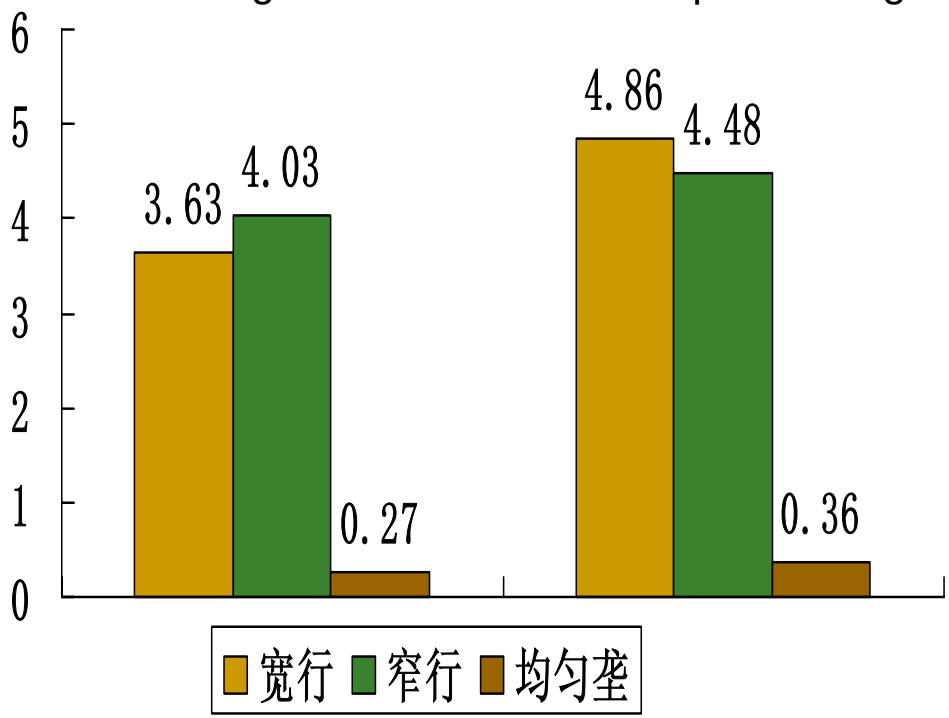
Change of the total soil porosity of different treatments



Wide row; Narrow row; Average row

土壤渗透系数变化情况（mm/min）

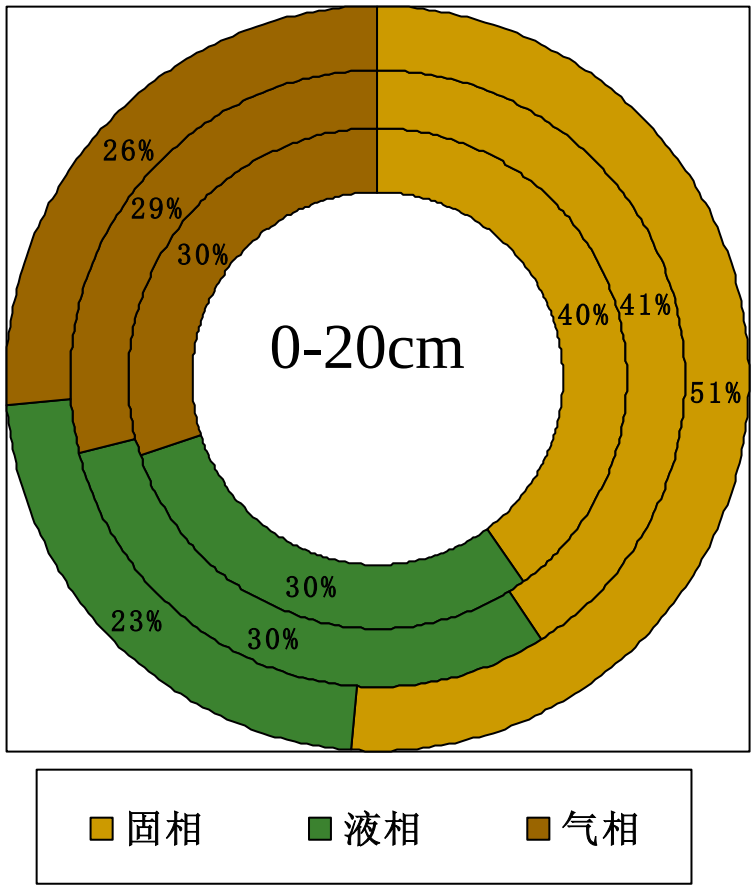
Change of the coefficient of permeating

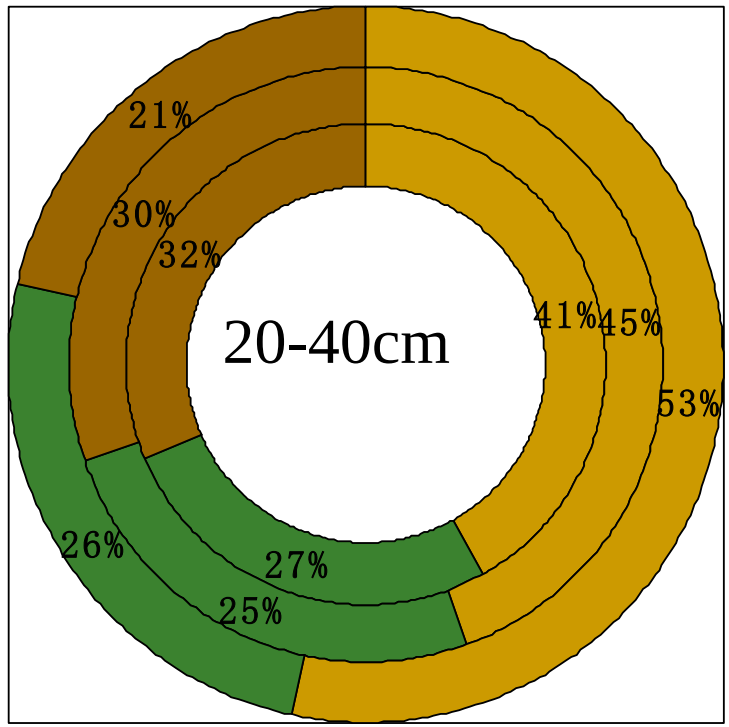


Wide row; Narrow row; Average row

✓ 土壤三相比例趋于合理

The rate of the soil solid phase ,liquid phase and gas phase was more reasonable





Solid phase ;Liquid phase; Gas phase

✓ 深松后蓄水能力增强

Water holding capacity was strengthened after deep tillage

年份 Year	1999	2000	2001	2002	2003	2004	2005	平均 AVERAGE
春播前 Before spring seeding	+2. 7	+0. 7	+0. 5	+0. 9	+2. 0	+1. 3	+3. 0	+1. 59
全生产育期 The total growth	+2. 4	+1. 2	+0. 9	+0. 5	+0. 9	+1. 2	+1. 1	+1. 17

✓ 增产效果明显 the significant yield increase effect

项目 treatments 处理	年份 year	单产(kg/hm²) Per unit yield (kg/ha)	增产幅度 (%) Yield increase (%)	经济系数(%) Economic coefficient
宽窄行 Wide/narrow row	1997	11869.1	115.5	53.6
	1998	11796.0	117.2	54.1
	1999	12693.0	115.2	53.9
	2000	9122.0	114.4	—
	2001	8363.4	110.8	53.2
	2002	9731.1	116.4	—
	2003	9977.0	117.5	52.1
	2004	8959.0	104.9	—
	2005	8928.6	110.9	50.8
	平均	10159.9	113.6	53.0
现行耕法（CK） Conventional tillage (CK)	1997	10276.3	100	51.1
	1998	10064.8	100	50.2
	1999	11018.2	100	51.0
	2000	7973.8	100	—
	2001	7548.2	100	51.3
	2002	8360.1	100	—
	2003	8489.6	100	51.8
	2004	8539.2	100	—
	2005	8053.8	100	48.2
	平均	8053.8	100	48.2
宽窄行与CK比较		+1235.0	+13.6	+2.4

四、创新点 Innovation

1、留高茬育土培肥，防止土壤风蚀；

2、宽幅深松打破犁底层，建立土壤水库，防止水蚀；

3、宽窄行种植，苗带与深松带轮换；

4、2BJ播种机,**3ZSF-1.86T2条带深松追肥机的研制**；

5、农机与农艺相结合.

1 soil and fertiltzer was improved and the wind erosion was prevented through high stubble

2 the plow pan was broke down, soil water pool was set up and water erosion was prevented through deep tillage.

3 alternation between seedling zone and deep tillage zone through wide/narrow alternation planting

4 Research on 2BJ seeding machine and **3ZSF-1.86T2 3ZSF-1.86T2 deep tillage machine for top dressing**

5 combine agricultural mechanism and agriculture technique.

留高茬自然腐烂还田
培肥土壤
Soil was fertilized through high stubble decomposing

宽幅深松
打破犁底层
蓄水保墒
Water holding capacity was strengthened through deed tillage breaking down the plow pan

秋旋耕整地
春墒秋保
Keeping spring soil moisture in the autumn through the field rotary tillage and preparation in the autumn

五、应用效果及产生的综合效益
using **effect** and economic benefit

应用效果(Using effect):

1. 提高自然降水利用效率——节约水资源；

Increasing the utilization rate of the rainfall- saving resource

2. 实现秸秆还田，育土培肥——保护土地资源；

Realizing to return the straw into the soil and improve the soil –protecting land resource

3. 改善土壤理化性状——改善土壤生态环境；

The physical and chemical condition was improved- improving ecological environment.

4. 提高光合效率——创造良好的作物生长条件；

Increasing photosynthesis efficiency – buildinga good growing condition for crop

5. 减少作业环节——节本增效；

Decreasing working procedure- saving cost and increasing benefit

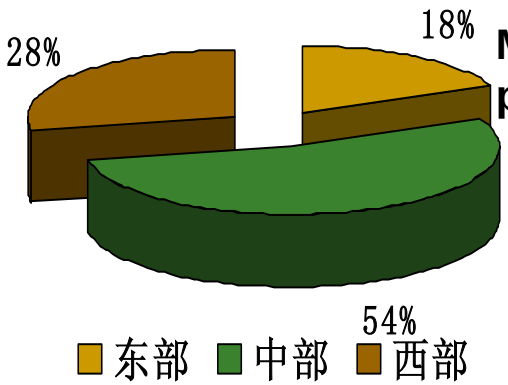
6. 增产效果明显——提高农民收入水平。

Increasing yield significantly-increasing farmer income.

新技术适用区域广(Using area for the new technique)：

该技术体系多年来一直在吉林省中、西部地区进行技术熟化与推广 **(The technique was popularized in the middle and west part in jilin Province for many years)** 。

Crop	应用作物	玉米	maize
Cultivated land type	适用耕地类型	平原区	Plain area
Climate	适用气候区	雨养农业区	Rain- fed agricultural area



East part；middle part； west part

Most maize in Jilin province was planted in middle and west part

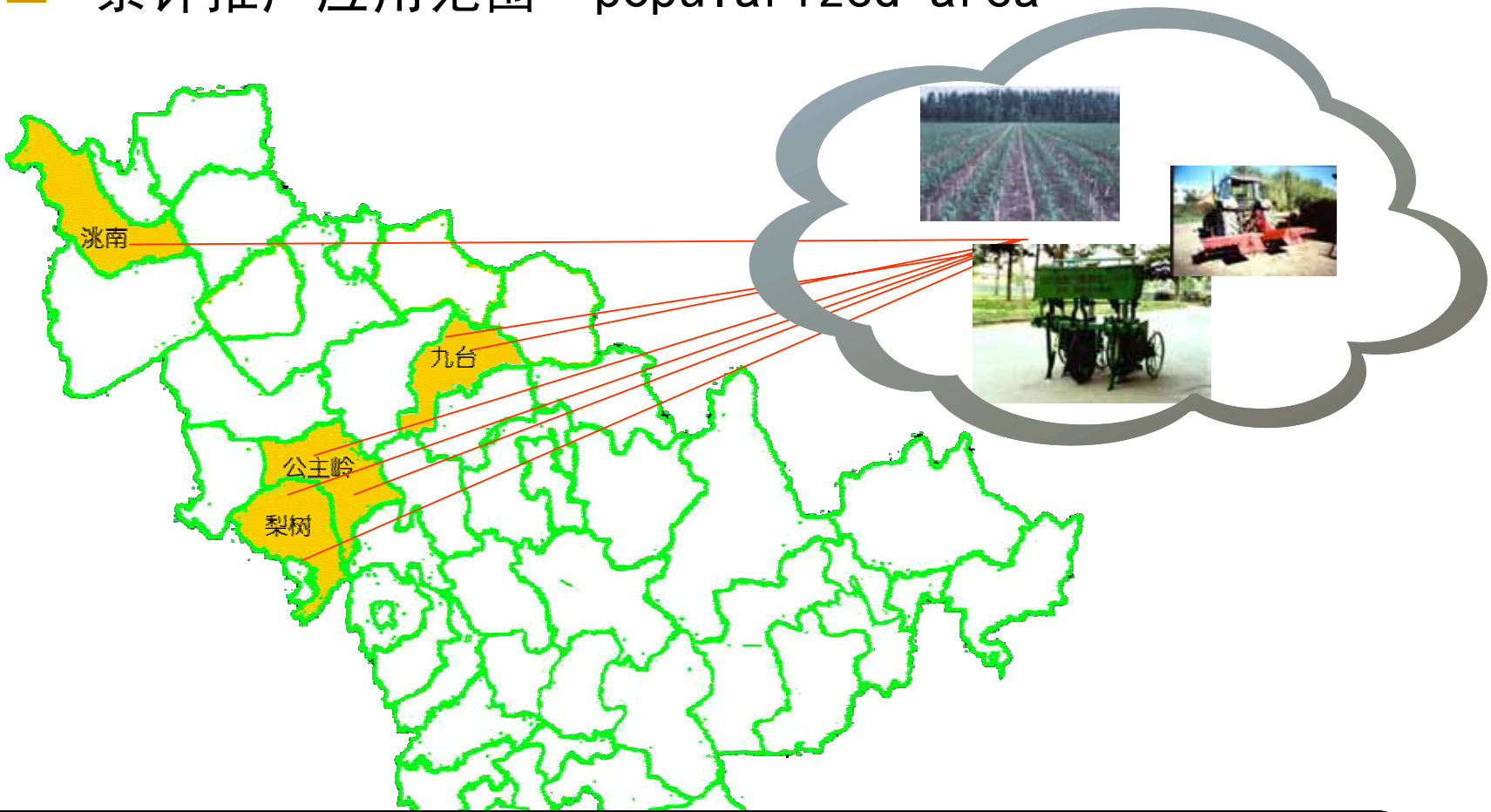
吉林省玉米集中于中西部平原区

该技术在我省适用区域广阔

This technique is used in a broad area in our province

广泛适用于东北雨养农区 widely used in the rain-fed area of northeast china

累计推广应用范围 popularized area



此项技术及其配套机具10年来累计推广应用1200万亩

this technique was popularized by 800 thousand hectares during the ten years

综合效益 comprehensive benefits

经济效益 economic benefit

1996—2005年，配套技术累计推广15万亩，取得经济效益1395万元；单项技术推广应用1200万亩，取得经济效益11.7亿元。 The corresponding technique was popularized by ten thousand hectares and got the economic benefit of 13.95 million yuan, the single technique was popularized by 8 thousand hectare and got the economic benefit of 1.17 billion yuan.

经济效益额核算依据
calculation evidence for economic benefit

应用技术亩增产65公斤，节约成本28元；
Yield was increase 65 kilogram pe mu , the cost was save by 28yuan
按目前市场玉米价1.0元/公斤计算，亩增收65元；
The price of maize is 1.0yuan per kilogram, the income was increased 65 yuan per mu.
节本增收合计为65+28=93元；
The total benefit pe mu is 65+28=93yuan
总效益为93元/亩×1200万亩=117000万元。
The toal benefit is 93yuan/mu×12 million mu=**1.17 billion yuan.**

生态效益 the ecological benefit

- 保护性耕作技术，防止土壤风蚀、水蚀，保土保水、育土培肥，调解土壤的理化性质，改善农业生态环境，土地用养结合，粮食产量大幅度提高，降低了生产成本，增加经济效益，使黑土地的农业生产向持续高效的方向发展。

- **Conservation tillage could prevent the soil from wind erosion, protect soil and water, fertilize the soil , regulate the physical and chemical property of soil ,improve the ecological environment , obviously increase the grain yield , decease the production cost , increase economic benefit and realize the sustainable development of the agricultural production on the black soil**

社会效益 social benefit

- 由于玉米保护性耕作新技术研究水平的提高，为玉米提高品质、增加产量、降低成本提供了强大的技术支撑，为提高我国玉米国际竞争力提供了技术储备。
- **The increment of the new technique of conservation tillage give the technique support for increasing maize quality , increasing yield, decreasing maize production cost and provide the technique for increasing the international competition of maize**
- 由于新技术的推广应用，项目区取得了巨大的经济效益，带动了东北平原相邻省及地区的保护性耕作的实施与推广。
- **Because of he new technique using, the experimental area got the great economic benefit , which pushed the popularization of the conservation tillage in the northeast plain and the near provinces.**


Thanks