



Research Progress and Prospect on the Production of Oats in China

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Outline

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1. Oat production, requirement and international trade

Oat production in China (2001–2009)

Region	2001		2002		2009	
	Area (10 ⁴ ha)	Output(10 ⁴ t)	Area (10 ⁴ ha)	Output(10 ⁴ t)	Area (10 ⁴ ha)	Output(10 ⁴ t)
Inner Mongolia	3.27	1.3	4.51	3.9	15	15
Hebei	-	-	-	-	13	22
Shanxi	5.3	0.99	6.12	4.4	10	10
Qinghai	-	-	-	-	0.4	2
Gansu	0.15	0.3	-	-	8	12
Jinlin	-	-	-	-	1.1	3
Ningxia	-	-	-	-	1.2	1
Yunnan	0.71	0.9	0.53	0.7	2.7	2
Sichuan	1.3	2.1	1.26	2.4	1.3	1
Guizhou	-	-	-	-	1	1
other region	0.224	0.33	0.07	0.2	7.6	16
Total	10.95	5.92	12.49	11.6	61.3	85

Resource: 《Chinese oat industry development report 2010》, Shanxi science and technology press, 2011.



Oat production trend in the world (Unit:10⁴t)

The country	2006/2007	2007/2008	2008/2009	2009/2010
Argentina	40	47.2	29.1	50
Australia	74.8	150.2	116	126
Canada	385.2	469.6	427.3	280
European Union	776.8	863.4	897.5	851.7
Russia	490	540	580	540
USA	135.7	131.3	129.4	135.1
The world	2304.3	2592.3	2613.5	2415.6

Resource: 《Chinese oats industry development report 2010》, Shanxi science and technology press, 2011.



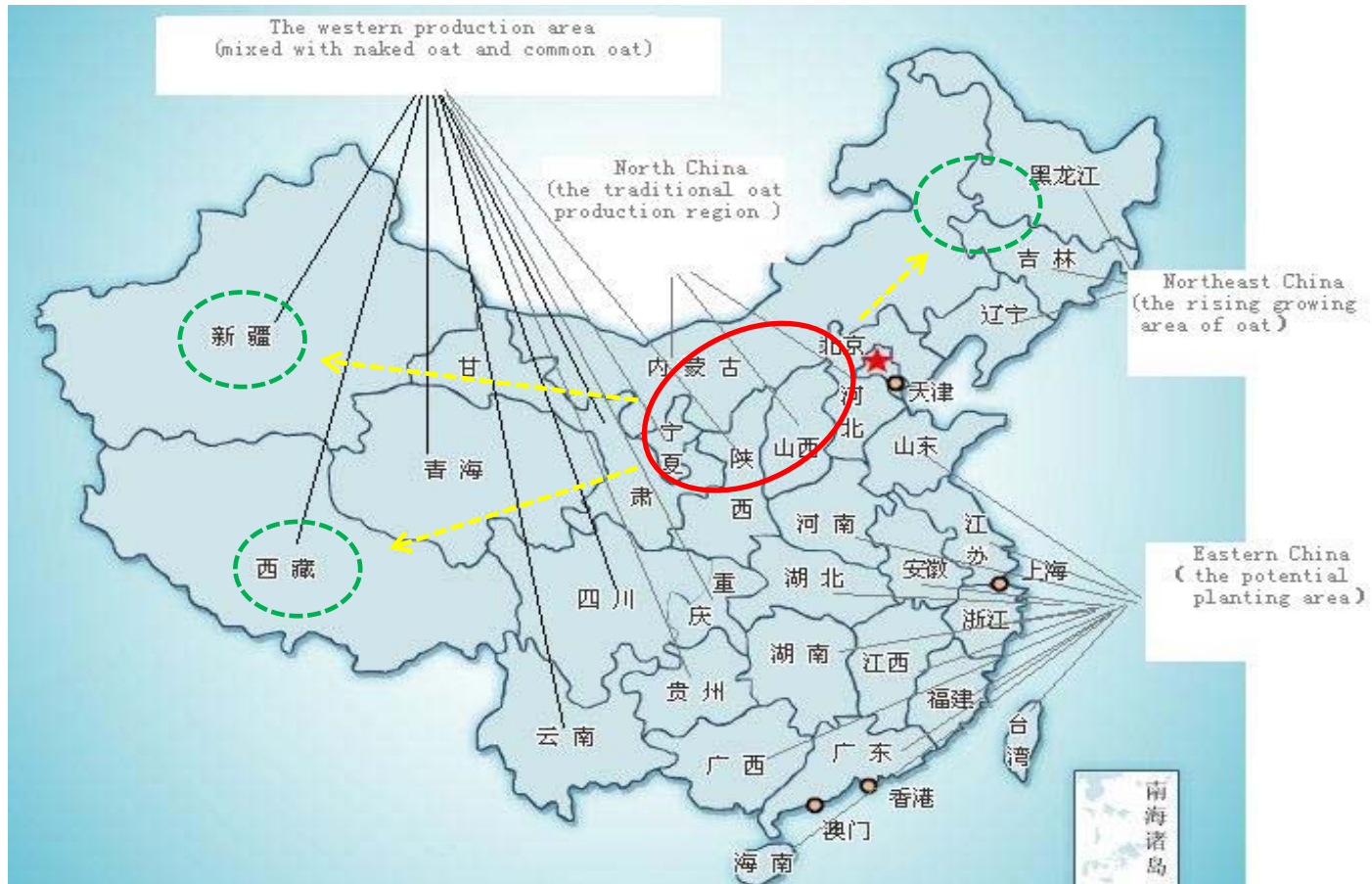
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Oat Import to China during 2004-2010

Year	2004	2005	2006	2007	2010
Total (t)	6214	10643	14295	15624	50000

Resource: 《Chinese oats industry development report 2010》, Shanxi science and technology press, 2011.

2、Oat producing regions in China



Main Oat Producing Areas in China

Region	2001	2002		2009	
	Area	Area	Output	Area	Output
Inner Mongolia	33.42%	36.11%	33.62%	24.47%	17.65%
Hebei	--	--	--	21.21%	25.88%
Shanxi	54.17%	49.00%	37.93%	16.31%	11.76%
Total	78.23%	85.11%	71.55%	61.99%	55.29%

Resource: 《Chinese oats industry development report 2010》, Shanxi science and technology press, 2011.



3、 Oat Productivity (Unit: t/ha)

Oat productivity in different regions during 2001-2009

Region	2001	2002	2009
Inner Mongolia	0.4	0.86	1.00
Hebei	--	--	1.69
Shanxi	0.91	0.72	1.00
Qinghai	--	--	5.00
Gansu	2.00	--	1.50
Jilin	--	--	2.73
Ningxia	--	--	0.83
Yunnan	1.27	1.32	0.74
Sichuan	1.62	1.90	0.77
Guizhou	--	--	1.00
Total	0.61	0.93	1.27

Resource: 《Chinese oats industry development report 2010》, Shanxi science and technology press, 2011.



Records of Oat Yield

Region	Grain yield (t/ha)		Forage yield (t/ha)		Reference
	Naked oat	covered oat	Naked oat	Covered oat	
Shanxi	2.25	--	--	--	Han M S,2010
Inner Mongolia	1.92	2.39	8.93	12.96	Zhao B P,2007
Hebei	--	--	10.90	--	Lv A Z,2006
Qinghai	3.40	6.78	--	6.34	Wang J P,2009 Zhou Q P,2008
Gansu	--	4.90	--	9.86	Bao G S,2008
Jilin	2.72	3.73	5.72	5.62	Zhou C J,2009



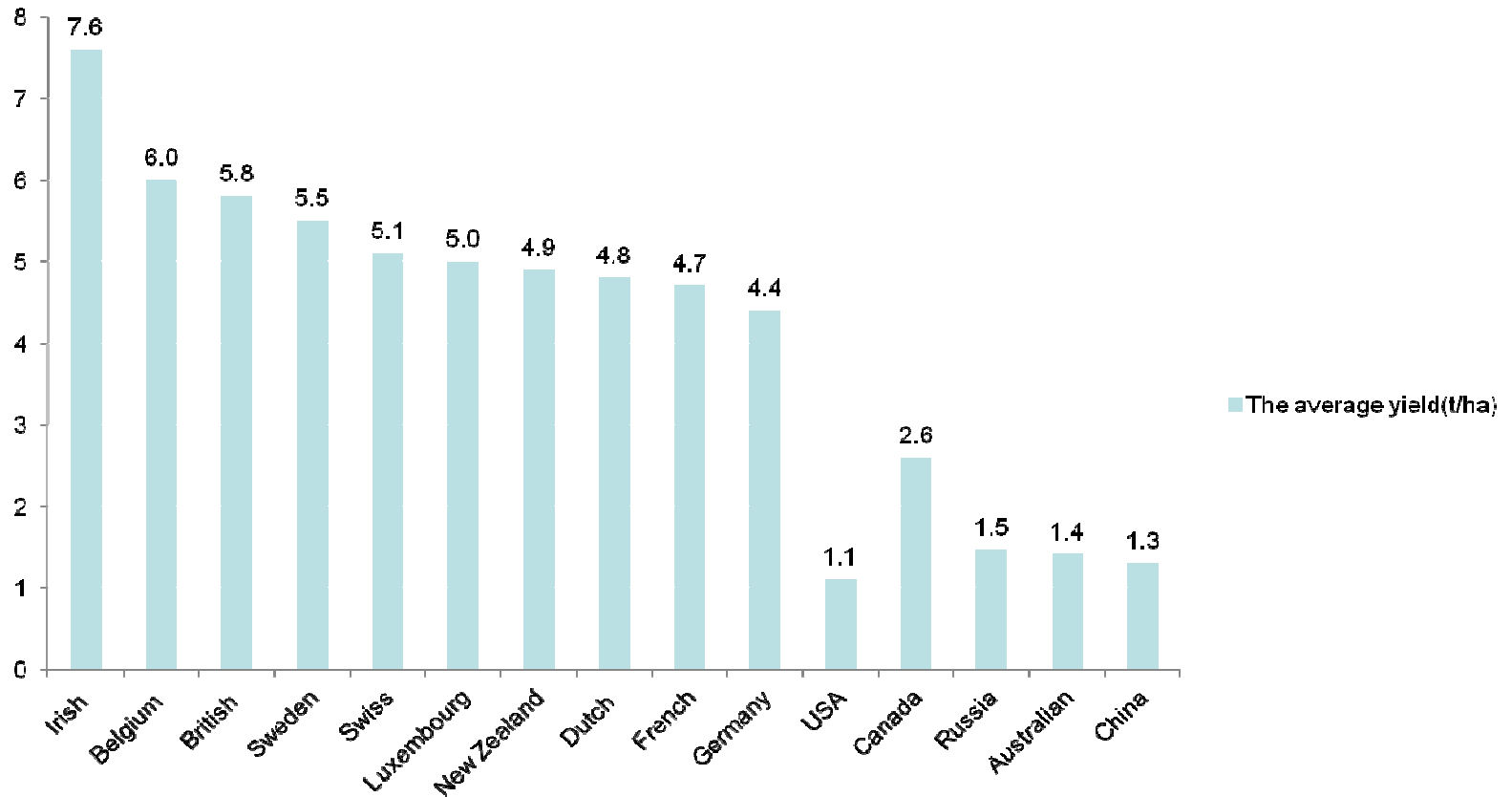
Oat productivity (t/ha) by region

The region or country	2004	2005	2006	2007	2008	2009	2010
Europe	--	--	--	--	3.00	--	--
USA	1.12	1.09	1.03	1.05	1.10	1.16	--
Canada	--	--	--	--	2.59	2.95	--
Russia	--	--	--		1.46	1.57	--
Australian	--	--	--	--	--	1.41	--
China	--	--	--	--	1.3	1.27	--
The world	--	--	--	--	--	--	1.87

Resource: 《Chinese oats industry development report 2010》, Shanxi science and technology press, 2011.



Several countries oat average yield in 2008



Resource: 《Chinese oats industry development report 2010》, Shanxi science and technology press, 2011.



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4、Oat Quality

β -glucan content

β -glucan content (%)	Number of genotypes	Proportion of Total (%)	Number of improved varieties	Number of Local varieties
<3.00	67	6.61	0	67
3.00–4.99	877	86.49	96	781
5.00–5.99	58	5.72	26	32
≥ 6.00	12	1.18	9	3

Zhou D S, 《 Oats lipid-lowering research 》 , China's agricultural science and technology press,2010.



Crude protein and beta-glucan content in oats under different N rates in 2008-2010

年度 Year	处理 Treatment	白燕 7 号 Baiyan 7 (%)		白燕 2 号 Baiyan 2 (%)	
		粗蛋白 Crude Protein	β -葡聚糖 Beta-Glucan	粗蛋白 Crude Protein	β -葡聚糖 Beta-Glucan
2008 [*]	N ₀	10.83b	3.10a	16.57a	4.32ab
	N ₃₀	11.23ab	3.04a	16.68a	4.55a
	N ₆₀	11.55ab	3.23a	16.84a	4.17b
	N ₉₀	11.56ab	3.07a	16.63a	4.67a
	N ₁₂₀	<u>11.89a</u>	3.38a	<u>17.43a</u>	4.48ab
2009					
	N ₀	11.02c	3.42c	14.53b	4.40a
	N ₃₀	11.07c	3.46bc	14.06b	4.64a
	N ₆₀	12.01b	3.76ab	14.05b	4.57a
	N ₉₀	12.45ab	3.61abc	14.98b	4.67a
	N ₁₂₀	<u>13.06a</u>	3.80a	<u>15.95a</u>	4.91a
2010 [*]					
	N ₀	10.96c	3.51b	15.05ab	4.22ab
	N ₃₀	11.83bc	3.67ab	15.2ab	4.44ab
	N ₆₀	12.5ab	4.06a	14.23b	4.69a
	N ₉₀	12.3abc	3.66ab	15.54ab	4.66a
	N ₁₂₀	<u>13.43a</u>	3.73ab	<u>16.27a</u>	5.06a

(Xiao X F, 2010)



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Effects of irrigation methods on yield and quality of naked oat (Baiyan 8)

The type of irrigation	Irrigation quota (mm)	Tri-leaf stage (mm)	Jointing stage (mm)	Heading stage (mm)	Grain-Filling stage (mm)	Yield (kg/ha)	Crude protein content (%)	β -glucan content (%)
W1 (drip-irrigation)	60	6	9	18	27	1137.8 c	16.03 c	3.80 c
W2 (drip-irrigation)	90	9	13.5	27	40.5	1251.5 c	16.35 bc	4.30 b
W3 (drip-irrigation)	120	12	18	36	54	1328.5 bc	16.84 a	4.85 a
W4 (drip-irrigation)	150	15	22.5	45	67.5	1593.8 a	16.57 ab	4.54 ab
W5 (drip-irrigation)	180	18	27	54	81	1516.9 a	16.46 b	4.17 bc
CK (flood irrigation)	200	40	40	60	60	1413.8 b	16.11 c	4.10 bc

(Wu N, 2010)



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5、 Soil and water



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Oat cultivated in sandy soil experiment



15cm line spacing



25cm line spacing



35cm line spacing

Water-saving cultivation



In experiment



Used in production

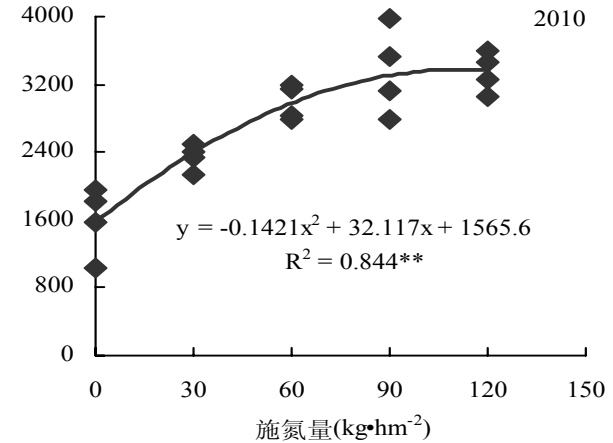
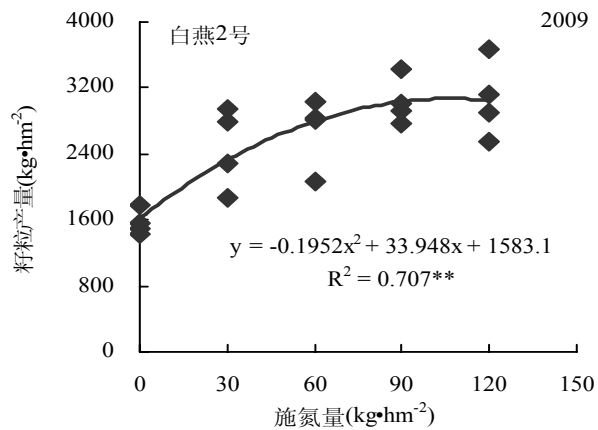
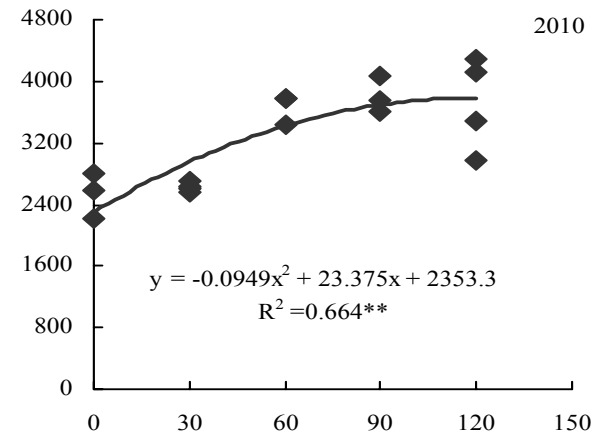
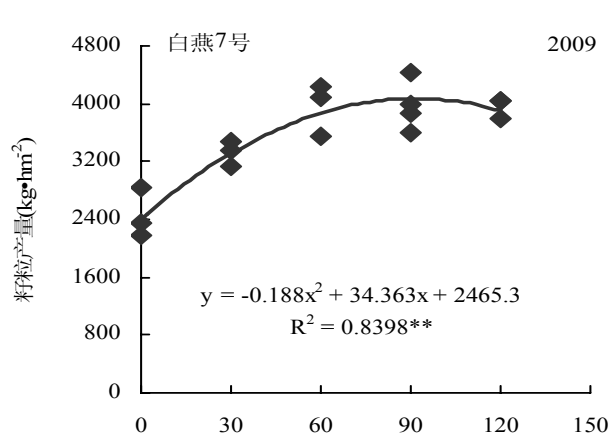


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6、Fertilizer use





Relationship between grain yield and nitrogen application rate in Jilin in 2009 and 2010

(Xiao X F, 2010)



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Yield and its components of covered oat cultivar **Baiyan No.7** under different N-fertilizer levels

Treatment	穗数 Panicle No. 10 ⁴ /hm ²	小穗数 Spikelet number	穗粒数 Grain No. per Panicle	穗粒重 Grain Weight/ Panicle (g)	千粒重 1000-grain Weight (g)	籽粒产量 Grain yield (kg/ha)	干草产量 Hay Yield (kg/ha)
N ₀	356	11b	19 b	0.56b	26.4 b	1945.4 b	2996.7 d
N ₃₀	409	14b	28 b	0.74 ab	26.5 ab	3168.2 a	4754.6 c
N ₆₀	327	22a	40 a	1.06 a	28.2 a	3460.1 a	5163.7 b
N₉₀	359	19a	37 a	0.91 a	28.4 a	3731.0 a	5621.2 a
N ₁₂₀	345	20 a	39 a	1.02 a	28.3 a	3522.6 a	5279.4 b
平均	359	17	32	0.86	27.6	3165.5	4634.1

(Zhou C J, 2008)



Yield and its components of naked oat cultivar

Baiyan No.2 under different N-fertilizer levels

氮肥 处理	穗数 Panicle No. 10 ⁴ /hm ²		穗粒数 Grain No. per Panicle	穗粒重 Grain Weight/ panicle (g)	千粒重 1000-grain Weight (g)	籽粒产量 Grain yield (kg/hm ²)	干草产量 Hay Yield (kg/hm ²)
N ₀	320	13 c	26 b	0.54 b	20.3 b	1757.8 c	3733.5 c
N ₃₀	336	15 bc	27 b	0.61 b	21.8 a	2355.3 b	4750.9 b
N ₆₀	290	22 a	40 a	0.91 a	22.4 a	2459.6 ab	5114.0 b
N ₉₀	296	20 ab	42 a	0.92 a	22.7 a	2723.6 a	5584.7 a
N ₁₂₀	302	23a	48 a	0.97 a	22.7 a	2549.9 ab	5715.8 a
平均	309	19	37	0.79	22.0	2369.2	4979.8

(Zhou C J, 2008)



Effects of different potassium application on grain and hay yield in naked oat In Qinghai

Variety	Experiment site	K ₂ O (kg/ha)	Grain yield (kg/ha)	Forage yield (kg/ha)
Baiyan 7	Minhe city in Qinghai province	0	4340 b	8350 b
		75	4790 a	8860 b
		105	4900 a	9860 a
		135	4890 a	9110 a
Qingyin 1	Huangzhong city in Qinghai province	0	6280 b	52488 b
		75	6475 a	53768 b
		105	6778 a	58813 a
		135	6532 a	59181 a

(Pao G S, 2008; Wang J P, 2009)



7、 Pesticide and herbicide application

- Weeds control : rotation system+herbicide
- Insect control : rotation system+insecticide
- Disease control : rotation system+pesticide

To establish a **healthy production system**
(including organic products production system)

8、 Rotation system

Regions	Traditional rotation system
Traditional regions (North China)	Potatoes, buckwheat, flax or continuous cropping
The western production area	Spring wheat, naked barley, or continuous cropping
Northeast China	Soybean, mungbean, maize, spring wheat, or continuous cropping

9、 Other factors

- China ranks the second in the world in the number of diabetic patients, the incidence of diabetes being 9.6%, about 128 million people (2011)
- At present, there are about 230 million people suffering from coronary heart disease, stroke, heart failure and hypertension, and other cardiovascular diseases (2010)
- 70% of the Chinese people are in the “sub-healthy state”

Other factors affecting crop production

A diagram on the left side of the slide features a large green circle and a light blue circle. A grey arc connects these circles to a series of six horizontal, rounded rectangular boxes. Each box is preceded by a small, colorful sphere (yellow, green, blue, orange, and dark blue respectively).

- economy development

- population increase

- resource problem

- climate change

- globalization

- all other Socio-economic-ecological issues



Historical Trend of Agriculture Production Technology

ITEM	RADITIONAL PERIOD	Present time	TECHNICAL DENSITY
crops	++	+++	↑ ↑ ↑
soil	++	+++	↑ ↑ ↑
water	+	+++	↑ ↑ ↑
climate	+	+++	↑ ↑ ↑
fertilizer	++	+++	↑ ↑ ↑
others		+++	↑ ↑ ↑
Socio-economic	++	+++	↑ ↑ ↑

High density--

Potential market of oat products

	Number (million)	Estimated annual consumption (10 ⁴ t)
Diabetic patients	128	234.77
Cardiovascular disease patients	230	419.75
Sub-healthy population	980	178.85
Whole national population	1340	2445.50
Finland standard statistics	1340	433.19

The consumption in the table were estimated according to 50g/d per person, except the last one was estimated by consumption quantity in Finland 1984, 62g/week per person in (from OECD)

10、Conclusions and suggestions

10.1 The oat worker's duty

We have 280 participants in this conference, from 24 countries, including scientists, entrepreneurs, managers, and graduate students. As oatmen, we are the future of the oat industry.

A hero is only made by his time. The oat industry has a decisive role to play in the sublimation of the human civilization. Which decides oat people's bright future. Thus, all of us should work together and assume our respective roles to move this great cause forward.

10.2 Pay attention to the connections between various disciplines

Scientific research is conducted by discipline; the whole oat industry, on the other hand, demands cooperation. All of us oatmen should keep in mind the healthy development of oat industry as the highest target while striving to excel in their respective disciplines.

This is an era of information, an era of global agriculture, and an era of omni-agriculture where agriculture has penetrated into all aspects of human life, not just confined to a specific piece of land. We oatmen should work hard and work together to achieve what matches this great era.

10.3 Constructing the oat raw material production base seriously

Market is the key to the oat industry, however, which depends on a reliable production base. We need to establish a comprehensive technology system with components of variety improvement, fertilizer application, sowing date and seeding rate optimization, optimal and economic irrigation, disease, insect, and weed control, optimal timing of harvest, rotation system establishment, storage technology development, and socio-economy system organization.

In addition, we should introduce futures system to stabilize the oat production, and establish a complete management system of the oat industry.

10.4 Exploring the means of Chinese oat production cooperative society

China has a huge rural population, but a limited amount of tillable farmland. This demands that the commercialization of the oat industry and the raw material production are in the form of associations or alliances. The producers and the buyers should progressively build a stable relationship. We should work out a system in which all stakeholders in the oat value chain, including the producers, the processors, the marketers, and the consumers are all benefited, and a stable and modern oat production system could be formed in China.

10.5 Preserve specialty oat products of the regional ethnic

North China is the traditional oat producing area. For thousands of years, the local people have created a great deal of distinctive oat products with lovely culture related. In this new period of industrialization, we should explore the possibility of manufacturing and commercializing such products. We should also try to innovate the oat products to add value to the coming oat industry.

Thanks for your attention!



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