Effect of Rotational and Successional Cropping on Aphids, BYDV, Smut and Yield of Oats in Western Loess Plateau

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Gansu is located in northwest of China, it is the conjunction of Inner-Mongolian-Xinjiang Plateau, Loess Plateau and Tibet Plateau, which gave the province different kinds of climates and topographies.





Oat is mainly distributed in cool area with high altitude of Gansu, the total growing area is about 90,000ha, 82% is covered oats.



Covered oats mainly grow in alpine region for hay, such as Tianzhu, Gannan Tibet Autonomous prefecture and Sunan County

Naked oats mainly distributed in semi-arid area for grain, such as Dingxi, Huining and Huanxian



The main problems in oat production in Gansu:

- 1. Backward cultivation techniques without rotation;
- 2. Degraded varieties need to be replaced;
- 3. Disease and pest are serious in some oat growing area.



## Our research objectives

Study oat rotation and successional planting in typical oat growing area of Gansu province, compare their effects on oat grain yield, main diseases (BYDV, smut) and pest (aphids) incidence, provide reference to oat grower in Gansu.



#### **Experimental site**

Indicators	Hajialing Township
Altitude (m)	2342
Geographical coordinates	E105° 12′, N34° 55′
Annual Precipitation (mm)	500
$\geq 0^{0}$ C annual accumulative temperature	2530
Total soil nitrogen (%)	0.23
Available nitrogen (mg/kg)	141.39
Available phosphorus (mg/kg)	38.52
Available potassium (mg/kg)	136.92
Soil PH	7.92
Organic matter (%)	4.67

#### **Materials and Methods**

- Naked oat (*A nuda L*.): BaiYan No.2, seeded on April 28, 2008, April 20, 2009, April 17, 2010 and April 20, 2011, respectively, with seeding rate of 180 kg/hm<sup>2</sup>;
- Pea (*pisum sativum L*.) : DingWan No.3, sowed on March 17, 2009, with 285 kg/hm<sup>2</sup>
- Flax (*Sesamum indicum L.*) : DingYa No.18, sowed on April 21, 2010, the seeding rate was 67.5 kg/hm<sup>2</sup>.

#### **Experimental Design**

Treatment	<b>Rotational cropping</b>			Suc	cession	al crop	ping	
Year	2008	2009	2010	2011	2008	2009	2010	2011
Corp	Oat	Pea	Flax	Oat	Oat	Oat	Oat	Oat

all the materials were seeded in  $80m^2$  plots ( $8m \times 10m$ ) with 4 replicates. Harvest the whole plot at maturity, measure grain yield after air dry.

#### **Aphids Survey**

Aphids head per plant was surveyed every 7 days from seedling stage, with 10 points for each plot and 20 plants for each point. Grading was made according to Chen (1993).

Level 0: aphids free; Level 1: less than 5 heads per plant; Level 2: 5-20 heads per plant; Level 3: 21-40 heads per plant; Level 4: 41-80 heads per plant; Level 5: more than 80 heads per plant.

Aphids injury index =  $\frac{\sum (Severity \, level \times plant \, number \, of \, the \, level)}{total \, plant \, investigated \times the \, highest \, level} \times 100$ 

#### **BYDV** investigation

BYDV was investigated from stem elongation stage with 10 points for each plot and 20 plants for each point.

Grade 0: disease free;

Grade 1: disease area was less than 20% of total leaf area;

Grade 2: disease area was 20%-40% of total leaf area;

Grade 3: disease area was 40%-60% of total leaf area;

Grade 4: disease area was 40%-80% of total leaf area;

Grade 5: disease area was more than 80% of total leaf area;

Disease index =  $\frac{\sum (number of pants of each grade \times the grade)}{total plant investigat ed \times the highest grade} 100$ 

#### **Smut Survey**

Smut was investigated from heading stage with 10 points for each plot and 20 plants for each point. Classification standard on wheat was used (Zhang et *al*.1987):

Grade 1: the infected panicle <1%;

Grade 2: 1%  $\leq$  the infected panicle <3%;

Grade 3: 3% st the infected panicle <5%;

Grade 4: 5% sthe infected panicle <10%;

Grade 5: the infected panicle  $\geq 10\%$ .

Disease incidence(%)=  $\frac{The inf \ ected \ plant \ number}{total \ plant \ investigat \ ed} \times 100$ 

### **Results and Analysis**

 Effect of rotational and successional cropping on aphids

Aphids per plant increased with the increasing continuous oat planting. In the 4th year of the succession, 59.4% increase were observed compared to the 1st year. On the other hand, aphids per plant decreased 34.6% under rotation, compared with the succession.







#### The impact of rotational and successional cropping on aphid injury index



Under rotational cropping, aphids injury index was much lower than that of succession, 28.3% reduction was observed at the 4th year.

# **Correlation of meteorological factors to aphid injury index**

Factors	Average relative humidity (%)	Rainfall (mm)	Average daily Temperature(°C)	Aphid injury index
Average relative humidity (%)	1.000	0.793**	-0.843*	-0.608**
Annual Precipitation (mm)		1.000	-0.676**	-0.680**
Average daily temperature(℃)			1.000	0.605**
Aphid injury index				1.000

#### Effect of rotational and successional cropping on BYDV of oats



In the 4th year, BYDV disease index was 18.1% lower than that of continuous cropping





#### **Correlation of weather factors and aphids to BYDV disease index**

Factors	Average relative humidity (%)	Rainfall (mm)	Average daily Temperature (℃)	The number of aphid per plant	BYDV disease index
Average relative humidity (%)	1.000	0.851**	-0.707*	-0.754*	-0.763**
Annual precipitation (mm)		1.000	-0.662*	-0.867**	-0.777**
Average daily temperature(°C)			1.000	0.878**	0.879**
The number of aphid per plant				1.000	0.910**
BYDV disease index					1.000

#### Effect of rotational and successional cropping on smut of oats



In the 4th year, 59.4% reduction was observed under rotational cropping compared with the succession.

#### Smut





# Effect of rotational and successional cropping on oat grain viold



Under successional cropping, oat grain yield reduced 17.2%.



#### Effect of rotational and successional cropping on oat grain quality

1	Su	ccession	Rotation				
Year	CP(%)	CF(%)	ADF (%)	CP(%)	CF(%)	ADF(%)	
2008	16.01a	7.14a	0.12b	16.05a	7.15a	0.13a	
2009	15.65ab	7.10a	0.13ab				
2010	15.22ab	7.06a	0.14a				
2011	14.42b	6.90a	0.14a	16.03a	7.17a	0.12a	

### Effect of rotational and successional cropping on soil fertility



#### Effect of rotational and successional cropping on soil fertility



#### Effect of rotational and successional cropping on soil fertility



#### Conclusions

- Rotational and successional cropping had significant effects on main diseases and pests of oats. 34.6% reduction of aphids per plant was observed at the 4th year of rotation, compared with the succession.
- Under crop rotation, BYDV disease index and smut incidence decreased 18.1% and 59.4% at the 4th year, respectively.

#### Conclusions

- Compared with rotation, 4 years of oat succession reduced soil OM by 26.8%, decreased TN, AN, AP and AK by 17.6%, 15.5%, 32.2% and 14.9%, respectively.
- Crop rotation also significantly affected oat grain yield. 18.6% increase was observed under rotation, and succession caused 17.2% yield loss at the 4th year, due to poor soil fertility and increasing disease and pests.

## Thank you for your attention!