内蒙古農業大學
Inner Mongolia Agricultural University

The 9th International Oat Conference

Effect of water stress on yield and quality of different oat varieties

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June-22-2012

Content

1 Introduction

2 Material and Method

3 Result and Analysis

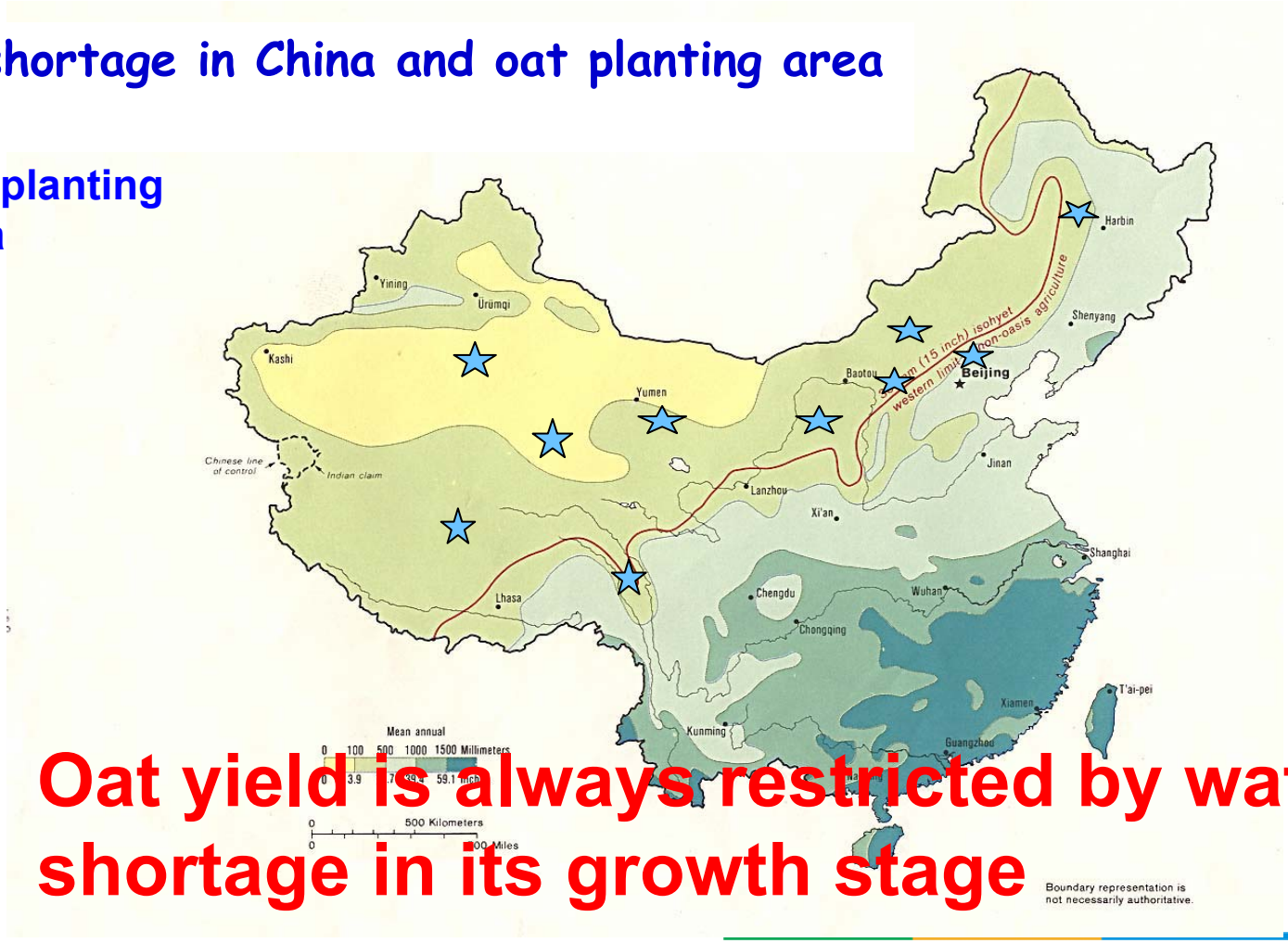
4 Conclusion

5 Acknowledgement

Introduction

Water shortage in China and oat planting area

☆ Oat planting area



Oat yield is always restricted by water shortage in its growth stage

Background of the study

- As for drought resistance and water use efficiency of oat, we have already know:
  - Oat cultivars were superior in environments where stress was due to drought. (Kenneth ,1998)
  - Compared with other crops, water use efficiency (WUE) of oat appeared to be lower. (Ehlers,1989)
  - From jointing to heading stage is the key water need stage of oat.

Different oat varieties have different drought resistance(our pervious work, 2010)

Comprehensive evaluation of drought resistance of different oat varieties

code	name	U(wet weight)	U(dry weight)	U(leaf dry weight)	U(spike sry weight)	U（averange）	Drought resistance
1	Nndy 1	0.21	0.13	0.68	0.03	0.26	L
2	Neiyan 3	0.58	0.52	0.75	0.41	0.56	M
3	Baoluo	0.29	0.38	0.81	0.17	0.41	M
4	Big oat	0.76	0.65	0.93	0.72	0.76	H
5	Baiyan 7	0.52	0.46	0.48	0.68	0.54	M
6	Baiyan 2	0.54	0.50	0.64	0.37	0.51	M
7	Baiyan 8	0.37	0.46	0.00	0.29	0.28	L
8	Baiyan 4	0.01	0.01	0.06	0.00	0.02	L
9	Bayou 3	0.14	0.08	0.03	0.00	0.06	L
10	Bayou 1	0.82	0.78	0.49	0.00	0.52	M
11	Bayou 8	0.38	0.45	0.67	0.00	0.37	L
12	Yanke 1	0.65	0.50	0.98	0.49	0.65	H
13	Mengyan 1	0.96	0.75	0.61	0.96	0.82	VH
14	Yan 2006	0.69	0.65	0.85	0.96	0.79	H
15	Youmai 4400	0.93	0.68	0.42	0.50	0.63	H
16	QYJ 440	1.00	1.00	1.00	0.70	0.92	VH
17	JZY 2	0.50	0.20	0.23	0.27	0.30	L
18	Xinyuan oat	0.78	0.37	0.96	0.24	0.59	M
19	Caiyou 1	0.75	0.37	0.44	0.42	0.50	M
20	Yan 2004	0.56	0.40	0.45	1.01	0.60	H
21	Baiyan 10	0.31	0.39	0.83	0.31	0.46	M

Very high drought oat varieties(VH): Mengyan 1 and QYJ440

Low drought oat varieties(L): Nndy 1, Bayan 8, Baiyan4, Bayou 3, Bayou 8, JZY 2.

Objective

2 different drought resistance varieties

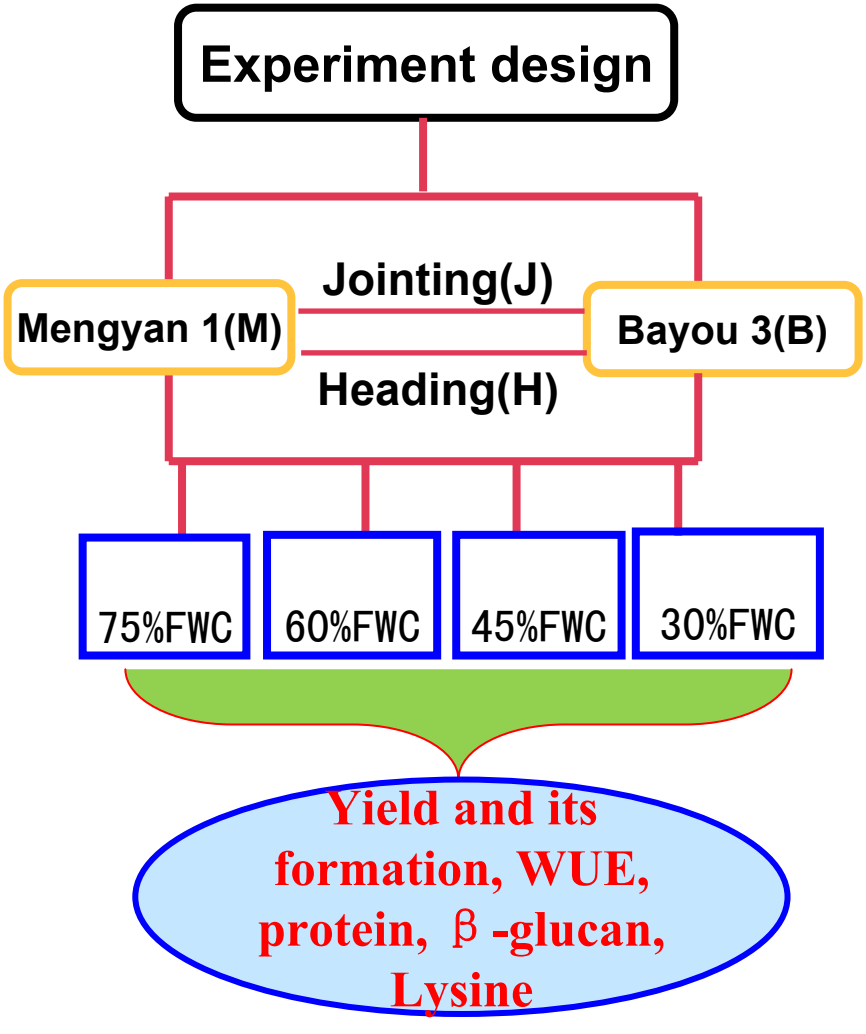
2 growth stage

4 water stress level

Different in yield and quality

To understand the response difference of different drought resistance oat varieties to water stress at different stage, and provide a theoretical basis for the high WUE in oats and the breeding of high yield, quality and drought tolerance oat.

Material and Method



Material and Method

Experiment site and environment: pot experiment conducted in greenhouse in Hohhot, Inner Mongolia

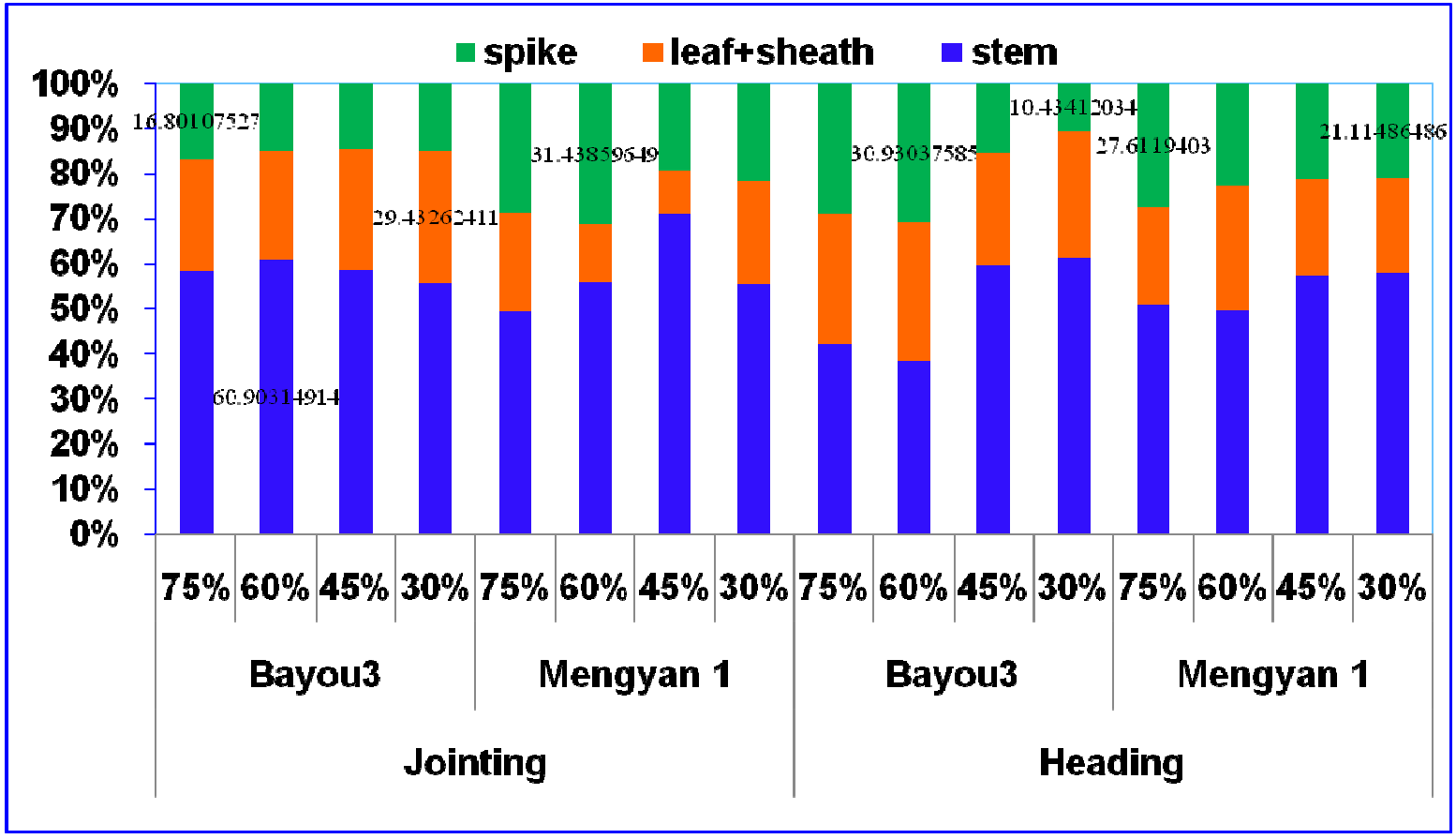
Experiment Time: April 2010-July 2011

Material :

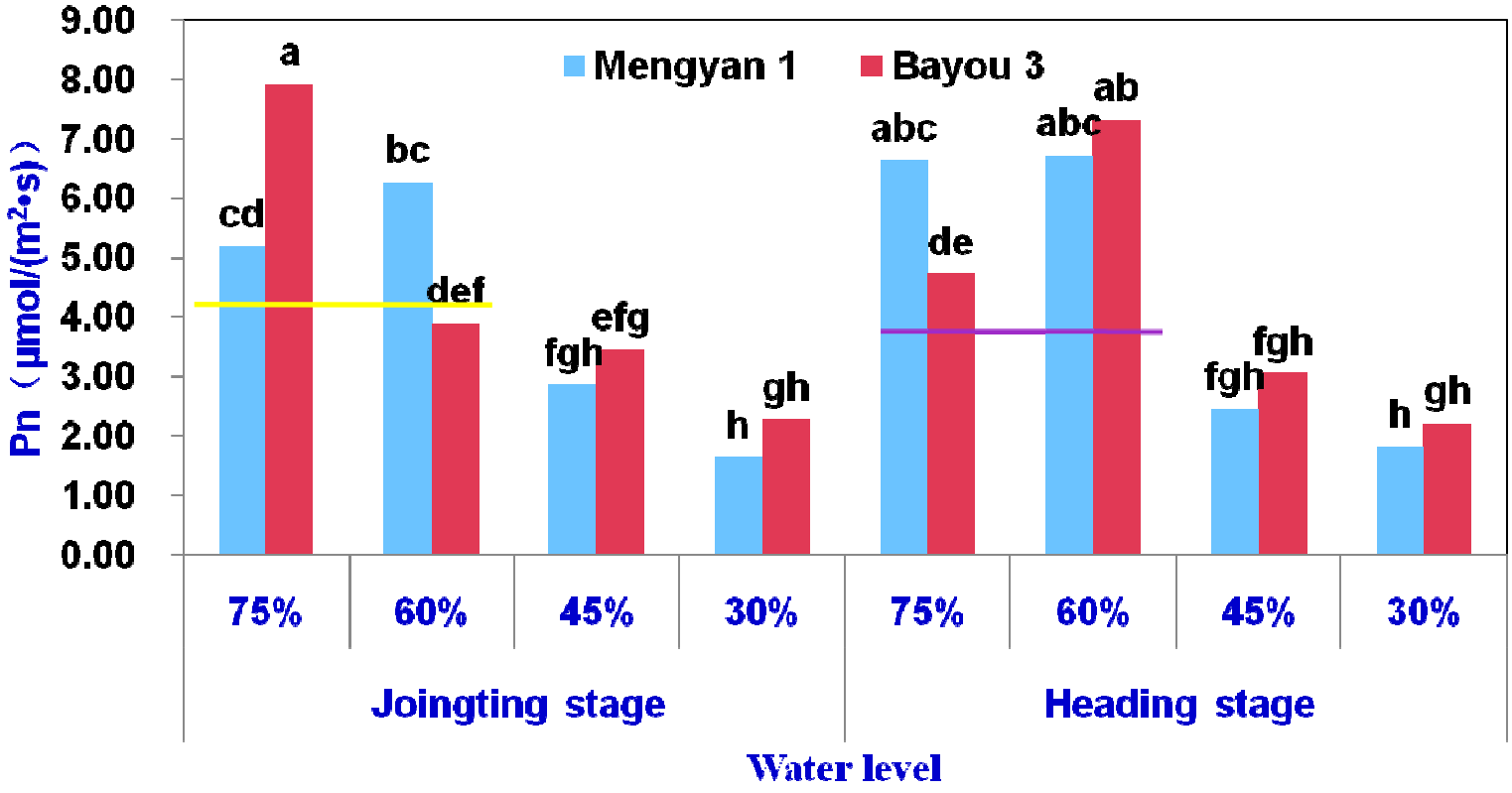
name	Hulled/naked	Drought resistance	Breeding source
Bayou 3	Neked	Low	Hebei
Mengyan 1	Hulled	High	Inner Mongolia

Result and Analysis

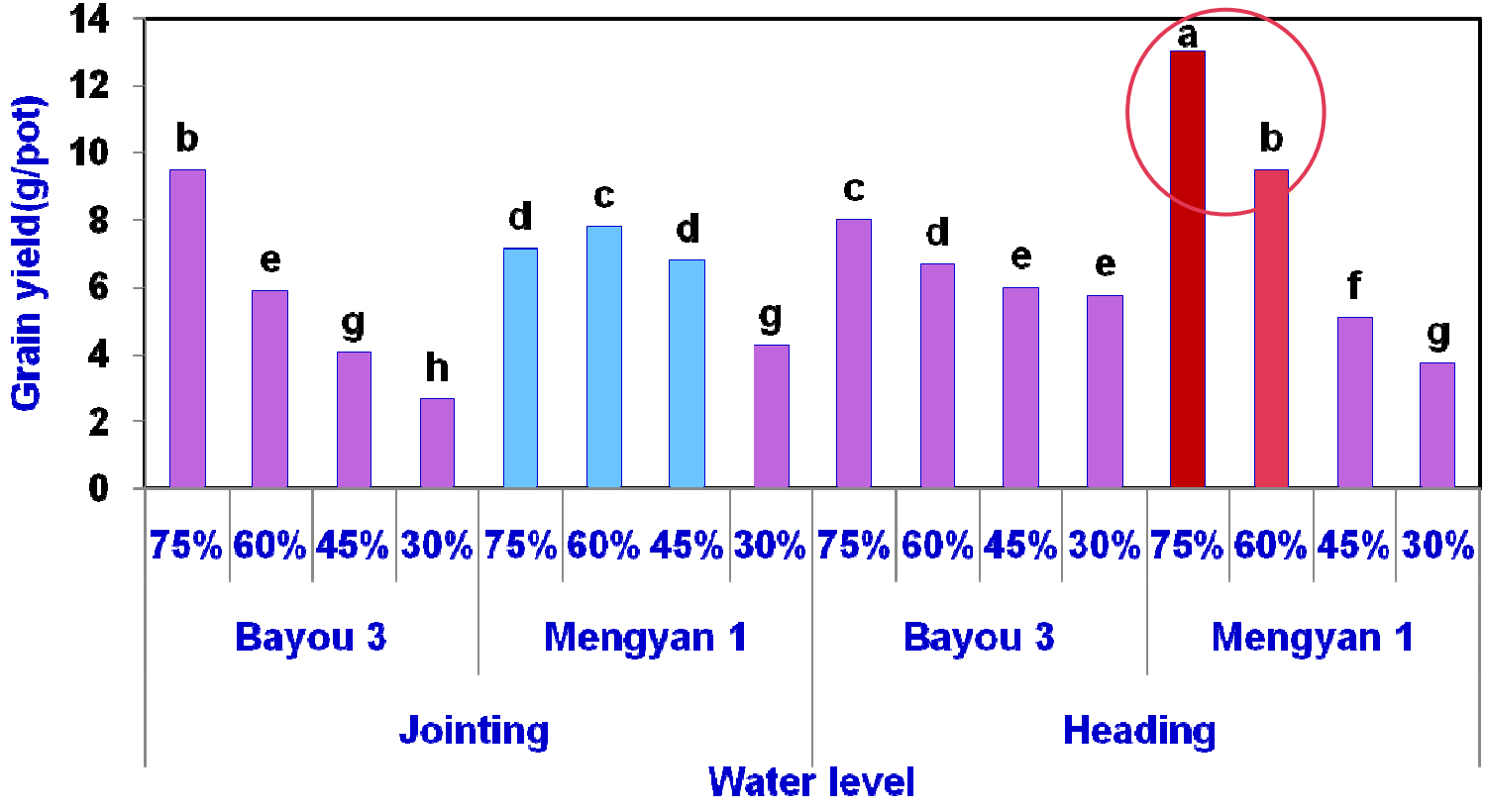
Dry matter distribution



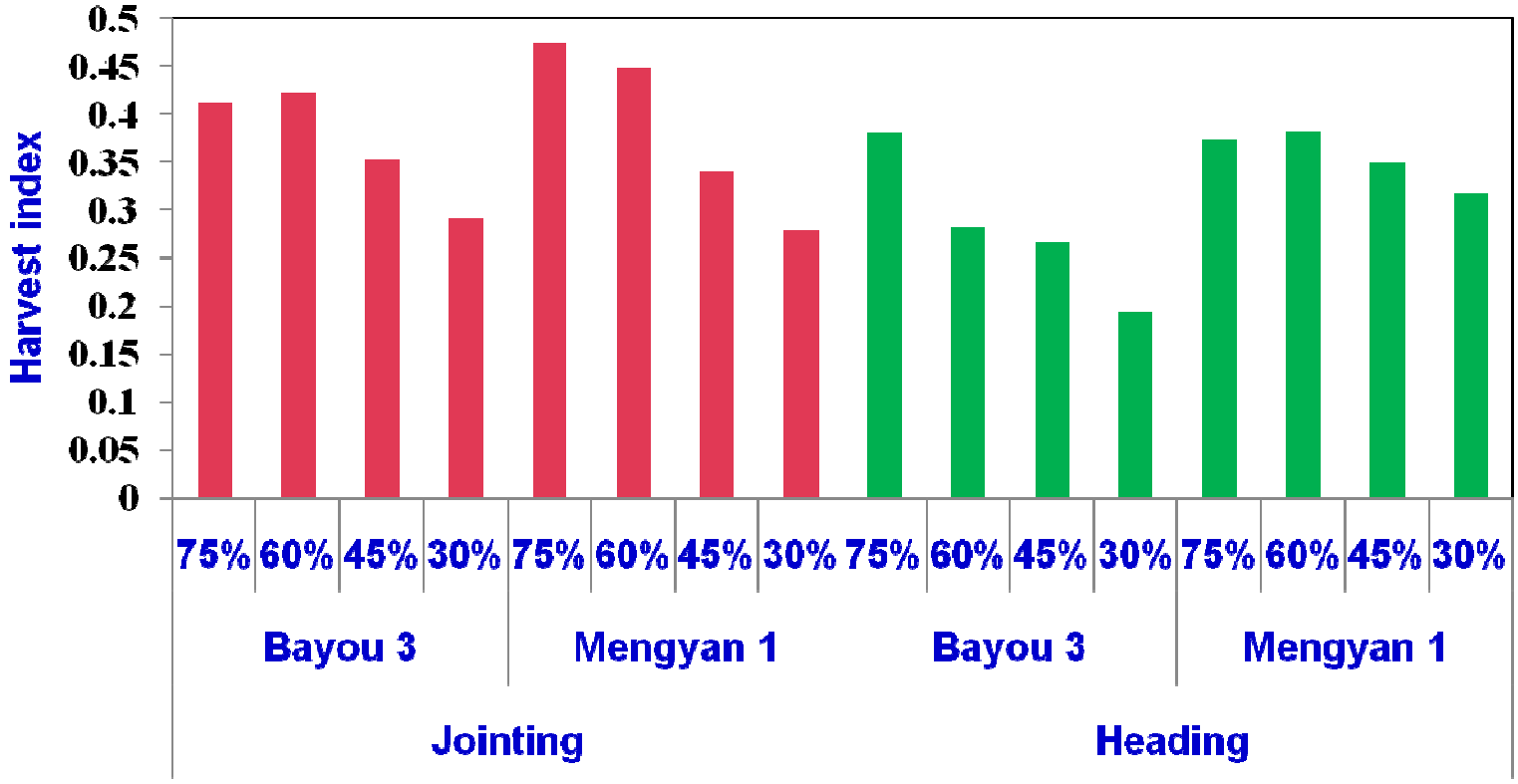
Photosynthesis rate



Grain yield

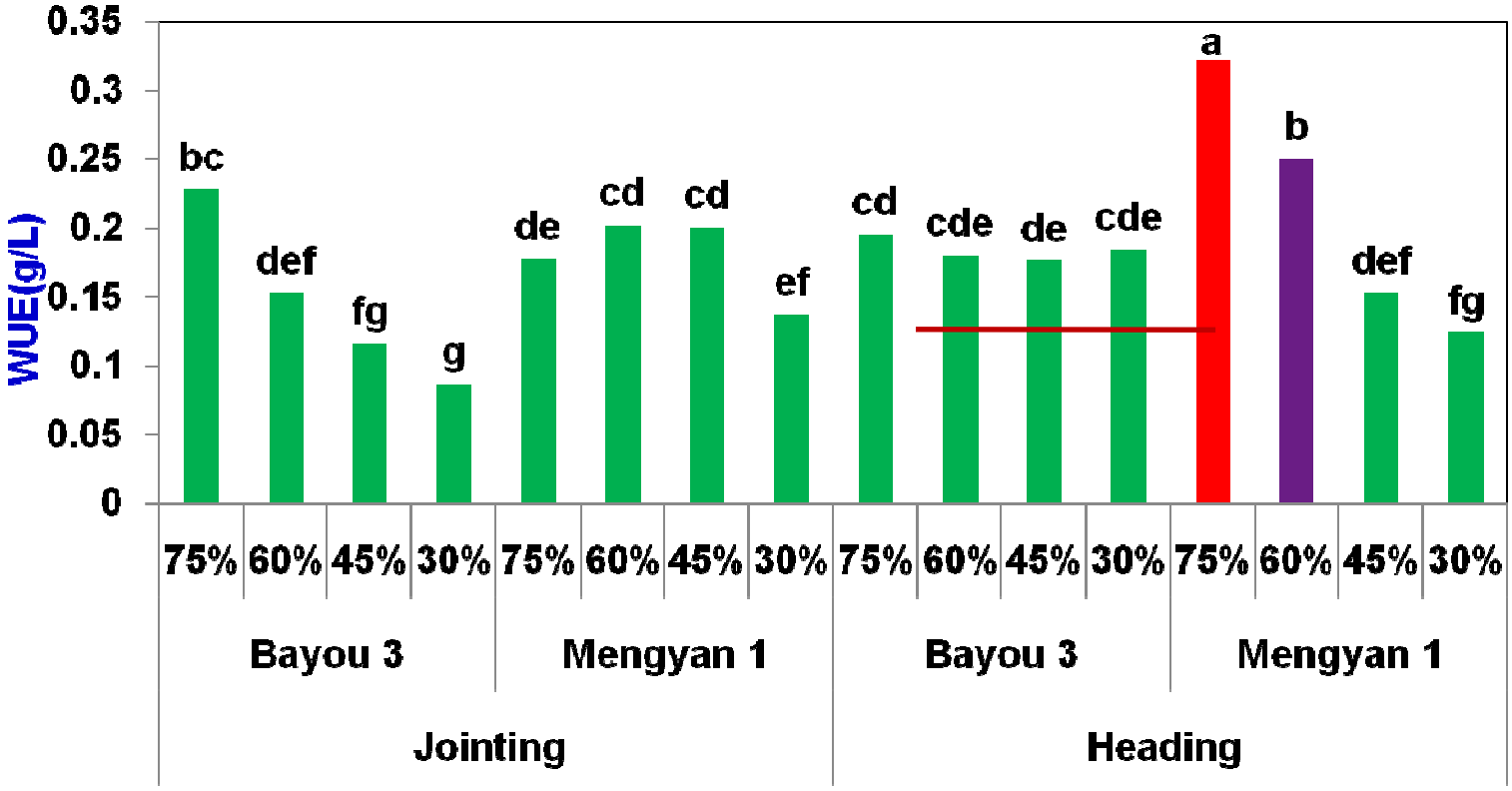

Grain yield(g/pot)
14
12
10
8
6
4
2
0
b
e
g
h
d
c
d
g
c
d
e
e
a
b
f
g
75%
60%
45%
30%
75%
60%
45%
30%
75%
60%
45%
30%
75%
60%
45%
30%
Bayou 3
Mengyan 1
Bayou 3
Mengyan 1
Jointing
Heading
Water level

Harvest index



Under water stress at jointing stage, Mengyan 1 had higher HI than that of Bayou 3.

WUE

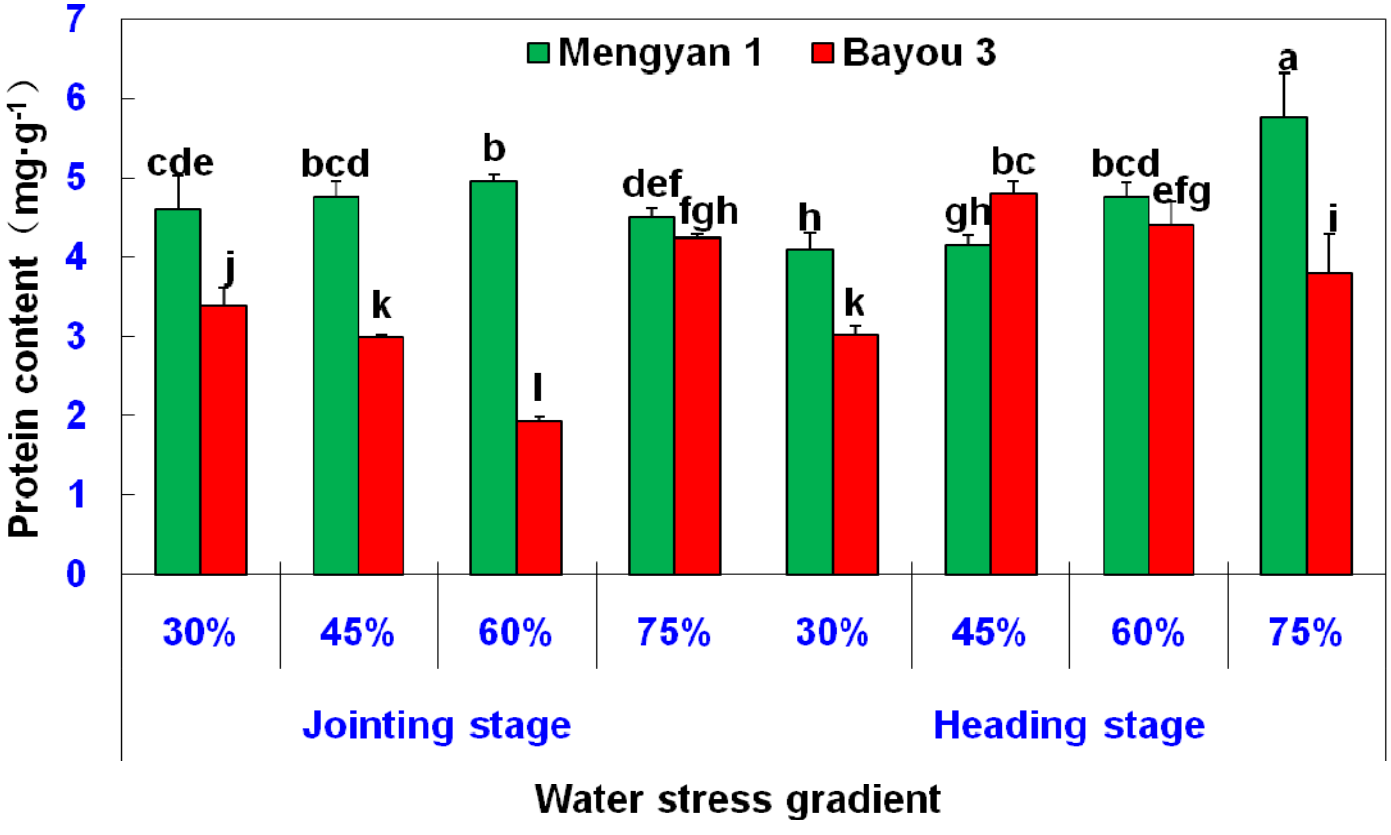

WUE(g/L)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
bc
def
fg
g
de
cd
cd
ef
cd
cde
de
cde
a
b
def
fg
75%
60%
45%
30%
75%
60%
45%
30%
75%
60%
45%
30%
75%
60%
45%
30%
Bayou 3
Mengyan 1
Bayou 3
Mengyan 1
Jointing
Heading

Spike characters

Effect of water stress on spike characters of different oat varieties

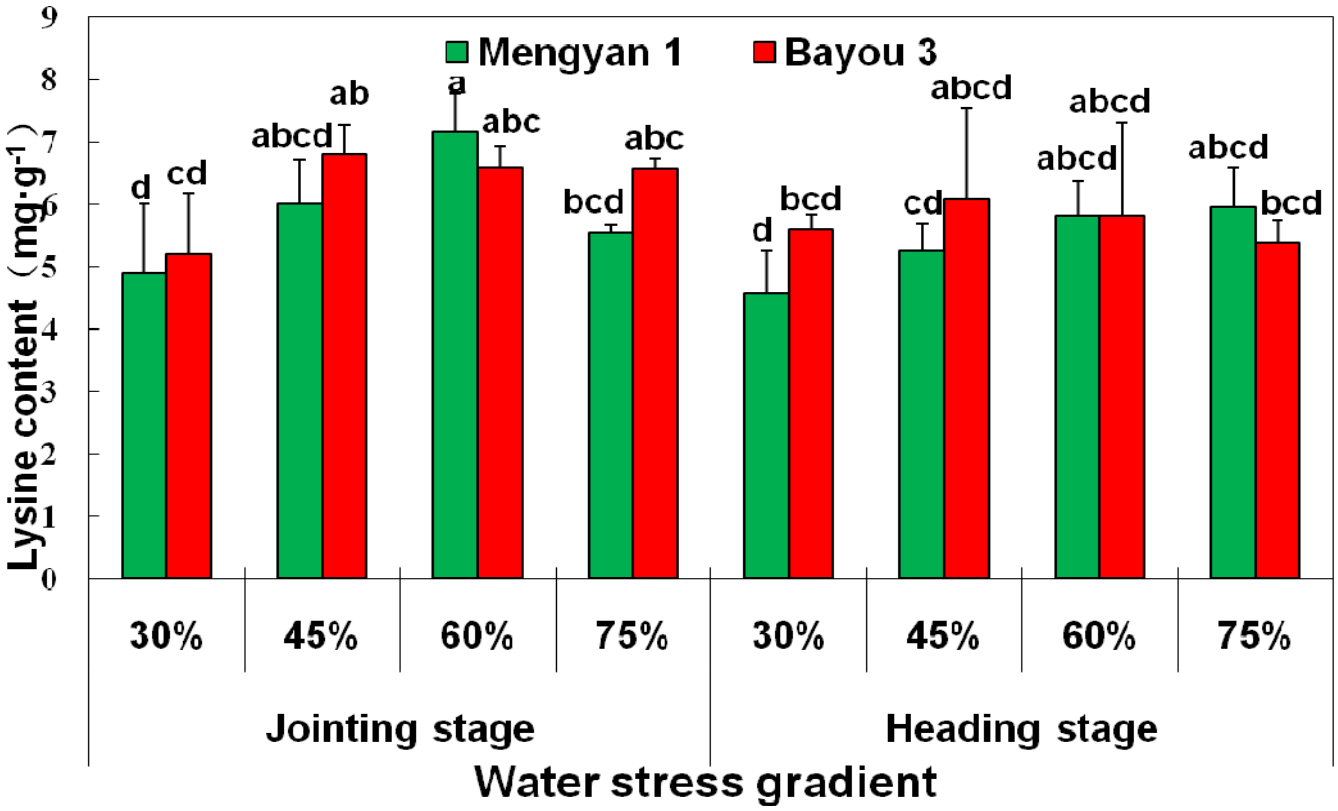
Growth stage	Variety	Treatment	Spike length (cm)	Spike weight (g)	Effective spike number	Invalid spike number
Jointing	Bayou 3	75%	16.77 a	0.63 a	6.40 bcd	8.90 a
		60%	16.00 ab	0.46 bc	9.87 a	7.80 abc
		45%	14.83 abc	0.34 bcde	4.27 de	3.73 g
		30%	12.93 cd	0.30 e	3.53 e	7.07 bcd
	Mengyan 1	75%	12.87 cd	0.44 bcd	7.93 ab	5.93 def
		60%	12.47 d	0.48 b	5.57 bcde	8.20 abc
		45%	11.57 d	0.40 bcde	5.27 cde	7.00 bcd
		30%	11.50 d	0.31 de	3.73 e	4.33 fg
Heading	Bayou 3	75%	14.53 bc	0.61 a	7.33 bc	5.20 efg
		60%	14.77 abc	0.47 b	6.33 bcd	6.53 cde
		45%	15.57 ab	0.43 bcde	5.80 bcde	6.47 cde
		30%	14.60 bc	0.35 bcde	5.20 cde	4.77 fg
	Mengyan 1	75%	11.67 d	0.65 a	7.20 bc	5.93 def
		60%	11.90 d	0.38 bcde	5.33 cde	8.50 ab
		45%	12.20 d	0.32de	5.80 bcde	7.00 bcd
		30%	11.97 d	0.32 cde	7.80 ab	7.33 abcd

Protein content



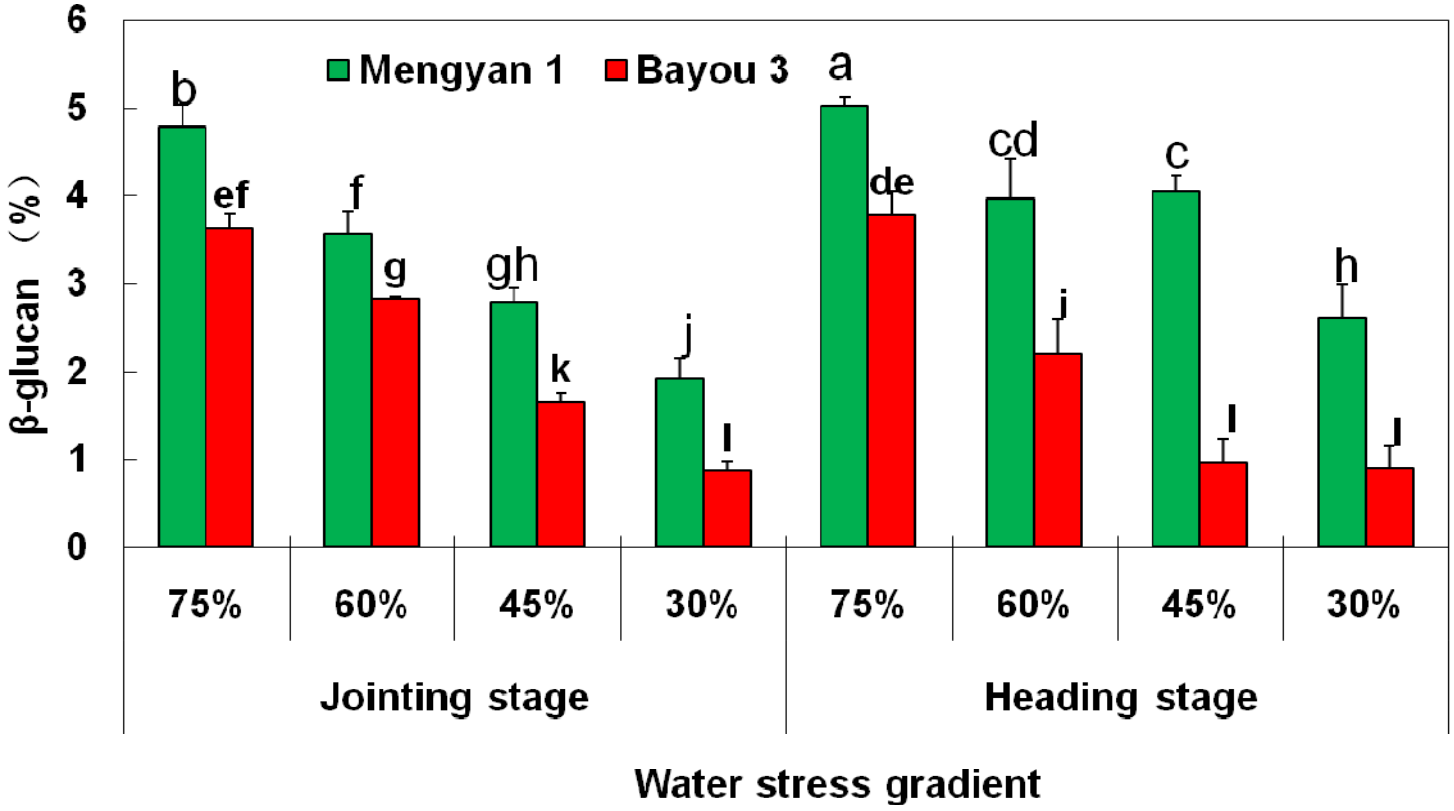
Water stress did not affected protein content for Mengyan 1; water stress at jointing stage, PC decreased for Bayou 3.

Lysine content



As water stress increased, the lysine content increased first and then decreased.

Beta-Glucan


Mengyan 1
Bayou 3
β-glucan （%）
0
1
2
3
4
5
6
b
ef
f
g
gh
k
j
l
a
de
cd
j
c
l
h
l
75%
60%
45%
30%
75%
60%
45%
30%
Jointing stage
Heading stage
Water stress gradient

Conclusion

1. Under water stress, drought resistance oat variety Mengyan 1 distribute more dry matter to spike at both growth stage; From *Pn* and grain yield result, Mengyan 1 showed higher drought resistance at jointing stage, not obvious at heading stage.

2. The suitable water level of Mengyan 1 should at or above 60%FWC at both growth stage, 45%FWC not affect its grain yield greatly; Bayou 3 should at 75%FWC at jointing, and above 60%FWC at heading stage.

3. Protein content of Mengyan 1 not affected by water stress. As water stress increased, the lysine content increased first and then decreased, and beta-Glucan decreased, and Mengyan 1 decreased less than Bayou 3.

Acknowledgement

- This study was financially supported in part by Natural Science Foundation of China (31101126), the research grants from the Modern Agro-Industry Technology Research System (CARS08-B5).
- Thanks to my supervisor Dr. Bao-Luo Ma and Yuegao Hu.
- Thanks to Prof. Jinghui Liu, Changzhong Ren and other colleagues in IMAU, CAU, AAFC and all the colleagues of oat& buckwheat industry team.

Thank You !