Comparison of Photosynthetic Parameters and Some Physilogical Indices of 11 Fennel Varieties

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Abstract. Net Photosynthetic rate(Pn), relative electrical conductivity and MDA content of 11 fennel varieties were tested using LI- 6400 portable photosynthesis system. The results showed that Pn of XJ0710 has distinct difference with other varieties in which there is no obvious difference. But the relative electrical conductivity and MDA of the varieties have obvious difference. Under environmental stress, all of the varieties had different stress resistance. This study provides reference for selecting good fennel varieties.

Keywords: Net photosynthetic rate, Relative electrical conductivity, MDA, Comparison.

1 Introduction

Fennel is apiaceae, foeniculum adans herbage and which place of origin is mediterranean sea. The history of cultivation are more than 1000 years, and the fennel can be found everywhere in our country. Fennel can be used as vegetable, Chinese traditional medicine and flavor. In this report, we studied the differences of physiological characters through comparing photosynthesis rate and other indexes of 11 fennel varieties, in order to selected fine varietie and offered valuable reference.

2 Materials and Methods

2.1 Experimental Field

The experimental field is located in the Dezhou university, and is within east longitude 115°45′-117°36′and north latitude 36°24′25"-38°0′32". Dezhou city is in a warm temperate zone, and has a continental monsoon climate with four distinct

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seasons. The annual average temperature is 12.9 , Highest temperature history is 43.4 , and Minimum temperature history is -27 . Average annual rainfall is 547.5mm, and the average frost-free period is 208 days.

2.2 Materials

The meteials are 11 fennel varieties: DC0410, DC0415, DC0503, LX0611, LY0901, NJ0712, PY0811, QY0811, XJ0603, XJ0710, XJ0712.

2.3 The Methods

The leaves of same parts on 11 fennels were examined net photosynthesis rate (Pn), intercellular CO_2 concentration (Ci), Stomatal conductance (Gs), Transpiration rate (Tr) by Photosynthetic apparatus (LI-6400). The relative conductivity (L) and Malondialdehyde (MDA) were examined by the methods of Zhao et al. (2000). All experiments was examined 3 times at least. The analysis of variance and discrepancy comparison ware analysised by the software SPSS (13.0).

3 Results and Discussion

3.1 Pn and Tr of 11 Different Fennel Varieties

Pn and Tr of 11 different fennel varieties were examined, which showed obvious differences between different varieties. As shown in Table 1, the Pn of LY0901 is highest, about 23.7umolCO_2 $m^{-2}s^{-1}$, and the Pn of XJ0710 is lowest, about

Table 1. Pn and Tr of 11 fennel varieties

Variety	Pn ($umolCO_2.m^{-2}.s^{-1}$)	Test of significance		Variety	Tr $mmolH_2O.m^{-2}.s^{-1}$	Test of significance	
		5%	1%			5%	1%
LY0901	23.7	a	A	LY0901	4.723	a	A
QY0811	23.33	a	A	XJ0712	4.257	a	A
XJ0712	22.8	ab	A	XJ0603	4.257	a	A
XJ0603	22.233	ab	A	DC0503	4.183	a	A
DC0410	20.767	ab	A	QY0811	4.113	a	AB
NJ0712	20.7	ab	A	NJ0712	4.1	a	AB
DC0415	20.7	ab	A	LX0611	3.77	a	AB
LX0611	20.567	ab	A	PY0811	3.69	ab	AB
PY0811	20.3	ab	A	DC0415	3.577	ab	AB
DC0503	20.067	ab	A	DC0410	3.503	ab	AB
XJ0710	18.633	b	B	XJ0710	2.547	b	B

18.633umolCO_2 $m^{-2}s^{-1}$. The array of all Pn is : LY0901>QY0811>XJ0712> XJ0603>DC0410> NJ0712 >DC0415 >LX0611 >PY0816 >DC0503 >XJ0710.

The Tr of LY0901 is highest, about 4.723mmol$H_2O$$m^{-2}s^{-1}$, and The Tr of XJ0710 is lowest, Which is consistent with the Pn value. The array of all Tr is : LY0901>XJ0712>XJ0603> DC0503> QY0811 > NJ0712 >LX0611>PY0816> DC0415 > DC0410>XJ0710.

3.2 Ci and Pn/Ci of 11 Different Fennel Varieties

From Table 2 we can see there is no obvious difference among all the fennel varieties. The Ci value of all array is: DC0503> PY0811> NJ0712> LX611> LY0901> DC0410> XJ0710> XJ0712> XJ0603> QY0811> DC0415. But the Pn/Ci value of QY08 is highest, about 8.7×10^{-2}, and which of XJ0710 is lowest, about 6.5×10^{-2}, among the 11 fennel varieties. The results of Pn/Ci have obvious difference among all the fennel varieties except three varieties DC0503, LX0611and XJ0710. The Pn/Ci value of all array is: QY0811> LY0901 >XJ0712 >XJ0603> PY0811> DC0415> DC0410> NJ0712> DC0503> LX0611> XJ0710.

Table 2. Ci and Pn/Ci of 11 fennel varieties

Variety	Ci (UmolCO$_2$.mol^{-1})	Test of significance		Variety	Pn/Ci (Pn/Ci) ($\times10^{-3}$)	Test of significance	
		5%	1%			5%	1%
DC0503	303	a	A	QY0811	87	a	A
PY0811	289.667	a	A	LY0901	83	ab	A
NJ0712	288.667	a	A	XJ0712	82	ab	A
LX0611	288	a	A	XJ0603	81	ab	A
LY0901	288	a	A	PY0811	77	ab	A
DC0410	284.667	a	A	DC0415	76	ab	A
XJ0710	282.333	a	A	DC0410	73	ab	A
XJ0712	279.667	a	A	NJ0712	72	ab	A
XJ0603	279	a	A	DC0503	67	b	A
QY0811	271.333	a	A	LX0611	65	b	A
DC0415	270.667	a	A	XJ0710	65	b	A

3.3 Gs of 11 Different Fennel Varieties

There is no obvious difference among Gs of all the fennel varieties (Table 3). The Gs value of all varieties array is: Y0901>DC0503>XJ0712>PY0811> NJ0712>XJ0603> LX0611>QY0811>XJ0710>DC0410>DC0415. This result indicated Gs is not the factor that effecting the otherness between XJ0710 and other varieties.

Table 3. Gs of 11 fennel varieties

Variety	Gs ($molH_2O.m^{-2}.S^{-1}$)	Test of significance	
		5%	1%
LY0901	644	a	A
DC0503	608.333	a	A
XJ0712	521.667	a	A
PY0811	520.667	a	A
J0712	511.333	a	A
XJ0603	500.667	a	A
LX0611	493.33	a	A
QY0811	491.333	a	A
XJ0710	480.667	a	A
DC0410	466.667	a	A
DC0415	403.33	a	A

3.4 Rrelative Conductivity and MDA of 11 Different Fennel Varieties

Relative membrane permeability (RMP) of plant cell is an important index to stress tolerance. The change of relative conductivity (L) can reflect the relative membrane permeability of cell under cold stress[3-4]. Low relative conductivity indicated low harm for palnt[5]. As showed in Table 4, the L of NJ0712 is highest, and which of QY0811 is lowest, about 6% and 2.7% respectively.

Table 4. Relative conductivity and MDA content in 11 fennel varieties

variety	Relative conductivity (%)	Test of significance		variety	MDA ($umol.g^{-1}$ FW)	Test of significance	
		5%	1%			5%	1%
NJ0712	6	a	A	PY0811	7.323	a	A
DC0410	5	b	B	DC0415	6.347	b	B
PY0811	4.1	c	C	QY0811	6.345	b	B
XJ0710	4	c	C	NJ0712	5.213	c	C
XJ0712	3.7	d	CD	DC0503	5.072	d	C
LX0611	3.4	de	DE	DC0410	4.88	e	D
DC0503	3.4	de	DE	XJ0712	4.847	e	D
XJ0603	3.345	de	DE	PY0811	4.408	f	E
LY0901	3.3	e	DE	XJ0603	4.232	g	EF
DC0415	3.1	e	EF	XJ0710	4.179	g	F
QY0811	2.7	f	F	LX0611	3.593	h	G

MDA is the lipid peroxidation product that can be induced to a higher level when plants are exposed to a highly osmotic environment, and can be an indicator of increased oxidative damage[6]. the MDA of fennel variety PY0811 is highest, ahout 7.323umol.g^{-1} FW, and which of LX0611 is lowest, about 3.593 umol.g^{-1}FW. Both Ls and MDAs are obviously difference among all the fennel varieties. These results indicated all fennel varieties have different stress tolerance.

4 Discussion and Conclusions

RMP is another index response to plant stress tolerance such as low temperature, drought and salt. When membrane permeability increases, RMP also increases, going with ion leakage out of cell. MDA is the lipid peroxidation product that can be induced to a higher level when plants are exposed to a highly osmotic environment, and can be an indicator of increased oxidative damage[7-8].The MDA accumulation maybe is damage to membrane and cell.

Among the 11fennel varieties, Pn of XJ0710 has distinct difference with other varieties in which there is no obvious difference. But the L and MDA of 11fennel varieties have obvious difference. This showed different varieties have different stress tolerance, which offers groundwork to select good variety for agriculture.

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