Curriculum Vitae

Dr. Mengyu Liu

1. EDUCATION

1981.9-1985.7, got bachlor degree in the Biology Department of Hebei Normal University.

1985.9-1988.6, got master degree in the North Western Institute of Soil and Water Concervasion,CAS.

1993.3-1994.2, visitting scholor in the Plant Division of CSIRO.

1996.10-2000.2, got doctor degree (agronomy) in Hokkaido University, Japan.

2. PROFESSIONAL EXPERIENCE

1988.7-1990.11, research assistant in Shijiazhuang Institute of Agrocultural Modernization (SJZIAM), CAS.

1990.12-1995.10, assistant professor in SJZIAM, CAS.

1995.11-1997.9, associate professor in SJZIAM, CAS.

1997.10-2001.5, professor in SJZIAM, CAS.

2001.6-now, professor in Institute of Genetics and Developmental Biology (IGDB), CAS.

3. HONORS AND ACADEMIC AWARDS (from 2009 to 2013)

2010, Germplasm innovation and new variety breeding of winter wheat for improving drought tolerance and water saving in North China, National science and technology progress award (second), IGDB as the second institution.

2009, Germplasm innovation and new variety breeding of winter wheat for improving drought tolerance and water saving in North China, Chinese award of agricultural science (second), IGDB as the second institution.

4. MAJOR RESEARCH INTERESTS, SELECTED RESEARCH PROJECTS, RESEARCH BACKGROUND, MAJOR RESEARCH ACHIEVEMENTS,

CURRENT RESEARCH AND FUTURE DIRECTIONS

4.1 MAJOR RESEARCH INTERESTS

Research Direction： Efficient water utilization incrops and water-saving tochnologies.

Key Issues: to improve the transpiration efficiency (ET) and harvest index (HI)

4.2 MAJOR RESEARCH INTERESTS

4.2.1 The variation of water use efficiency (WUE) in the winter wheat varities from North China

The results fron pot and field experiments showed that 20-25% difference was exist in Hi among the 19 varieties, and Hi was positive related to water use efficiency at yield level (WUEy) significantly. According to the grain yield and WUEy, The varieties could be classified to 4 groups: ①high yield with high WUEy, ②middle yield with high WUEy, ③middle yield with low WUEy and ④low yield with low WUEy (Fig7.), and they should be planted in irrigated land with rich soil, deficit irrigated land with moderate rich soil, dry land with rich soil and dry land with poor soil, respectively.

4.2.2 Yield and WUE change in wheat cultivars with different drought tolerance under irrigation.

To improve grain yield and water use efficiency of winter wheat in the water shortage region of northern China, field experiments involving 3 irrigation levels and 2 type winter wheat cultivars(Shijiazhuang8 and Xifeng20, with moderate and high drought tolerance respectively) were conducted over 3 growing seasons with different levels of precipitation. The results show that irrigation significantly improved grain yield of both wheat cultivars, as compared to the treatment with no irrigation, grain yields of Shijiazhuang8 and Xifeng20 improved by 86.96% and 57.83% in the treatment with 2 irrigations in dry year, 27.24% and 18.31% in normal year, and 13.72% and 11.69% in humid year, respectively. The total water use (TWU) of the 2 cultivars also increased upon irrigation, and the increase was more pronounced in dry year than in normal or humid year. However, there were no significant differences in the TWUs of the 2 cultivars. The water use efficiency at grain yield level (WUE_y) of Shijiazhuang8 increased significantly upon irrigation in the dry year, did not change in the normal year, and showed a clear decline in the humid year, while the WUE_y of

Xifeng20 was reduced by irrigation in each of the 3 growing seasons. The harvest index (HI) was not altered by irrigation, but it varied by growing season. The HI of Shijiazhuang8 was always higher than that of Xifeng20. A positive correlation was found between WUE_y and the water use efficiency at biomass level (WUE_{bm}) and the HI. It suggests that the changes in WUE_y as a result of irrigation are mainly due to changes in the WUE_{bm}, and that the differences in WUE_y between the 2 cultivars were due to differences in WUE_{bm} and HI.

4.2.3 Physiological regulation of high TE in wheat under drought conditions

Pot experiments were conducted to study the variation and physiological regulation of transpiration efficiency (TE) of four winter wheat (*Triticum aestivum* L.) varieties that are widely grown in different ecological regions in North China. Plants were grown under two soil moisture regimes, normal and drought stress. The results showed that under drought stress condition, both TE at plant level and TE at leaf level (TEl) increased significantly (Fig8). The transpiration rate (Tr) reduced more strongly than leaf net CO_2 assimilation rate (Pn). The decline of Tr was mainly affected by stomatal conductance(Fig9.) and the decline of Pn was affected by non-stomatal factors, which was confirmed by the decline in net photosynthetic oxygen evolution rate(Fig9.). The leaf soluble sugar content and proline content were significantly increased under drought stress. The stomatal density was increased and the stomatal length was reduced. These results led us to make the following conclusions: (1) Under drought stress, the increase in TEl appears to be regulated in two ways: via the stomata by regulating Tr, and independent of the stomata through regulation of Pn; regulation via the stomata was more sensitive. (2) Osmotic adjustment was closely correlated to the non-stomatal regulation, and stomatal aperture was closely correlated to the stomatal way.

4.2.4 Physiological mechanism contributing to efficient water utilization in field tomato

Open field experiment was conducted under furrow irrigation with 3 treatments: (i) CK (control): irrigation was given on both sides of the plants, (ii) PRD (partial root drying): irrigation with the amount of 50% in CK was given on one side of the plants and switched to the other side next time), and (iii) RDI (regulated deficit irrigation): irrigation with the amount of 50% in CK was given on both sides of the plants (Fig10.). Plant growth, water relations, antioxidant enzyme activities and WUE were determined in the experiment. The results showed that the water potential, water content of the leaf and the growth (including plant height, leaf area and biomass) of the plants were decreased under PRD and RDI conditions, especially under RDI condition, which indicated the plant met stronger water stress than in PRD. The water use efficiency(WUE) based on fruit yield reached to 10.95 kg/m^3 and 15.33 kg/m^3, 17.1% and 63.9% increase than CK under RDI and PRD respectively, which caused by 21.9% decrease of yield and 33.4% decrease of water used under RDI, and 15.5% increase of yield and 33.4% decrease of water used under PRD(Tab2.). The photosynthesis rate (Pn) and transpiration rate (Tr) of leaf from RDI treatment reduced significantly, the transpiration efficiency (TE) was kept at the same level as CK, however, the Pn was enhanced by 20.6%, Tr reduced by 9.0% and TE promoted by 32.4% under PRD condition(Tab3.). Proline concentration and MDA concentration of leaves from PRD and RDI were higher than CK, and the MDA concentration under PRD could reduce to the same level as CK at the late growth stage, indicating osmotic regulation was induced and membrane integrality was protected under PRD. The CAT, SOD and POD activities were more active under PRD and RDI conditions, especially under PRD condition than CK. From the results above, follow conclusions could be made: moderate water stress induced osmotic regulation under PRD condition, leading to normal water status of the plants, higher activity of antioxidant enzymes, membrane integrality, higher Pn and lower Tr, the same level of biomass, lower water use, high level of the harvest index, thus providing some part of mechanism to higher WUE under PRD condition.

4.2.5 Effect of elevated CO_2 on the WUE of winter wheat

Winter wheat (*Triticum aestivum* L. cv. Kenong9204) was grown in open top chambers with either ambient or elevated CO_2 concentrations (358±19 μ mol mol^{-1} or 712±22 μ mol mol^{-1}, respectively) in well-watered or drought conditions (Fig9.). Although elevated CO_2 did not significantly affect the height of the plants at harvest, it significantly increased the aboveground biomass by 10.1% and the root/shoot ratio by 16.0%(Fig10.). Elevated CO_2 also significantly increased the grain yield (GY) by 6.7% when well-watered and by 10.4% when drought stressed. Specifically, in the well-watered condition, this increase was due to a greater number of ears (8.7% more) and kernels (8.6%). In the drought condition, it was only due to a greater number of spikes (17.1% more). In addition, elevated CO_2 also significantly increased the water use efficiency (WUE) of the plants by 9.9% when well-watered and by 13.8% under drought conditions, even though the evapo-transpiration (ET) of the plants did not change significantly. Elevated CO_2 also significantly increased the root length in the top half of the soil profile by 35.4% when well-watered and by 44.7% under drought conditions. Finally, elevated CO_2 significantly increased the root water uptake by 52.9% when well-watered and by 10.1% under drought conditions.

4.2.6 Drought and shadeing induced the decrease in seeds number in wheat

With the increase of water stress and shadeing, the seed number decreasedin winter wheat crop, though the changes was existed among the vierieties, the higher the drought tolerance, thelower the drop. The main resoon was that the development of pollen inhabited and its fertility decreased.

4.3. CURRENT RESEARCH AND FUTURE DIRECTIONS

4.3.1 Basic Research

① The transpiration due to the environment factors and the physiology itself. How to troll the water wasted in transpiration.

② The relation between water movement and nutrient absorption & transportation when the transpiration due to the environment factors is much reduced.

③ The role of stomata regulation on Pn and Tr.

④ The mechanism for reducing grain number per spike due to drought and low temperature in wheat crop.

4.3.2 Applied study:

① Sub-surface irrigation techniques for reducing evaporation from the soil surface in green house vegetables

② Mini-border method of irrigation in wheat and maize crops

③ Improving drought tolerance of crop in rain-fed farming.

④ Sustainable development of agriculture in regions.

5. FUNDING AND LABORATORY PERSONNEL (2009-2013)

FUNDINGS（about 15,000,000 RMB）in cluded:

① Sorpted by State Ministry of Sciences and Technology of China, 8,000,000 RMB.

② Sorpted by National Basic Research Program, 1,500,000 RMB.

③ Sorpted by CAS, 3,000,000 RMB.

④ Sorpted by IGDB and the Reaserch Center, 2,500,000 RMB.

LABORATORY PERSONNEL

① 1 PI , 2 associate professors, 1 assitant professor and 8 students

② 1 professor and 2 reseachers were engaged from 2009 to 2010.

6. SELECTED PUBLICATIONS, PATENTS GRANTED，VARIETIES OBTAINED, MAJOR INVITED INTERNATIONAL CONFERENCE TALKS

20 PUBLICATIONS

1. Qiao, Yunzhou, et al. , Agricultural Water Management. 97, 1742 (2013)
2. Li Dongxiao, et al., Agricultural Water Management. 129, 105 (2013).
3. Dongxiao Li, et al., Journal of Food, Agricultural & Environment. 11, 649 (2013).
4. Zhai Hongmei, et al., Fresenius Environmental Bulletin. 21, 2072 (2012).
5. Dongxiao Li, et al., Plant Omics Journal. 5, 432(2012).
6. Zhang Qiuying, et al., Journal of Resources and Ecology. 3, 93 (2012).
7. Baodi Dong, et al. , Agricultural Water Management. 99,103 (2011).
8. Xuemei Ji, et al., Plant Physiology. 156, 647 (2011)
9. Changhai Shi, et al., Plant Soil and Enviroment. 56, 340 (2010).
10. Li Quanqi, et al., Agricultural Water Management. 97, 1676 (2010).
11. ZB Zhang, et al., Australian Journal of Crop Science. 4, 571 (2010).
12. ZB Zhang, et al., Plant Omics. 3, 183 (2010).
13. XJ Hu, et al., Biologia Plantarum. 54, 575 (2010).
14. Hongbin Zhao, et al., Journal of Food, Agriculture & Environment. 8, 1158 (2010).
15. Xiaojun Hu, et al., Biologia Plantarum. 54, 213 (2010).
16. Shi Lei, et al., Plant Soil and Environment. 5, 128 (2009).
17. Q. Li, et al., Plant Soil and Environment. 55, 85 (2009)
18. Xiaojun Hu, et al., Molecular Biology. 43,950 (2009).
19. Xiaojun Hu, et al., Acta Physiol PlantActa Physiol Plant. 31, 1111 (2009).
20. Zhen-Yan Fu, et al., Comptes Rendus Biologies. 332, 591 (2009)

7 PATENTS GRANTED

1 SOFT WARE

1 TECHNICAL REGULATION

7. EDITORIAL DUTIES

Non.

8. CONFERENCE ORGANIZATION

Non.