

Cover Story

Editor's note:

The competition of comprehensive national strength is ultimately the competition of innovation. From the perspective of the development of non-damaging micromasurement technology over the past 20 years, NMT can gain a competitive advantage in the international scientific research and application market only by knowing itself and its competitors, deeply understanding the foreign innovation experience represented by the West, and learning from each other and improving its own innovation ability based on China's own innovation characteristics.

The cover of this issue is an article entitled "Dynamic Innovation" submitted by Mr. Xu Yue, chairman of Xuyue (Beijing) Technology Co., LTD., to the "Kehai Imagination" column. In this article, Mr. Xu Yue summed up the innovation experience of the national NMT people in the past 20 years, and shared it with readers here.

About article author:

Xu Yue, inventor of Non-invasive Micro-test Technology, founder of living functional omics, practitioner of scientific and technological achievements transformation, advocate of international scientific cooperation, former senior researcher of NASA, President of YoungerUSA, LLC, Chairman and CEO of Xuyue (Beijing) Technology Co., LTD., Chairman of Zhongguancun Xuyue Non-damage Micromasurement Technology Industry Alliance, initiator and chairman of International NMT Alliance.

In 2001, he founded YoungerUSA, LLC. In 2004, under the influence of the older generation of scientists, such as Academician Kuang Tingyun and Academician Yang Fuyu of Chinese Academy of Sciences and Professor Lin Kechun of Peking University, he resigned as a senior researcher of

NASA in 2005. Returned to China to establish Xuyue (Beijing) Technology Co., LTD., to introduce the oscillating electrode concept of American MBL scientist Leo Jaffe into China, under the guidance of the "introduction, digestion, absorption and re-innovation" policy of the government science and technology department and the initial capital support, led the Xuyue team, together with more than 2,000 scientific research workers in the country, After more than 20 years of unremitting struggle and dedicated study from 2001 to 2022, we have forged Non-invasive Micro-test Technology (NMT) and its series of application equipment with Chinese independent intellectual property rights.

In the process of commercialization and industrialization of NMT in the field of scientific research, we have helped domestic and foreign scholars successfully apply NMT to 146 Chinese core articles and 502 SCI articles, including 19 in top journals such as CELL, NATURE, SCIENCE, etc. With a total impact factor of 2123, NMT scientific research equipment has been exported to the University of Zurich, Switzerland in Europe in 2020, completing the leap from the technology to the leader. In the past decade, NMT has gradually started the transformation process of achievements in the livelihood fields of medical care, health, environment, food, epidemic prevention, new materials, new energy, modern agriculture and other fields, and has made gratifying progress, so in June 2021, it passed the international leading level evaluation of institutions recognized by the Ministry of Science and Technology. On this basis, the "International NMT Alliance" will be launched in 2022 to build China's NMT team into a non-damaging micromasurement technology innovation force with international influence.

NMT Literature Express

Lin Wenxiong, LI Zhong, Fujian Agroforestry: NMT found that Lsi1 promoted Ca/K/H Na excretion in rice roots, which provided evidence for its maintenance of rice cell membrane stability and improved cold tolerance

Plant Growth Regulation
<https://doi.org/10.1007/s10725-022-00890-1>

ORIGINAL PAPER



Overexpression of the rice gene *Lsi1* (low silicon gene 1) enhances plant-microbe interactions that result in improved chilling tolerance

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Basic information

- Research platform: NMT temperature Stress Innovation platform
- Journal: Plant Growth Regulation
- Topic: NMT found that overexpression of Lsil promoted Ca/K/H Na excretion in rice roots to provide evidence for maintaining membrane stability and improving cold resistance of rice at low temperature
- Title: Overexpression of the rice gene Lsil (low silicon gene 1) enhances plant-microbe interactions that result in improved chilling tolerance
- Impact factor: 3.242
- Authors: Lin Wenxiong, Li Zhong, Xie Yubin, Fujian Agriculture and Forestry University

Detect ion/molecular indicators

- Ca^{2+} 、 K^{+} 、 Na^{+} 、 H^{+}

Sample information

- Rice root (point on root surface 600 μm from root tip)

Ion/molecular flow experimental treatment method

- 1.5 Leaf stage rice seedlings were treated at 15°C/14 h during the day and 10°C/10 h at night for 48h

Results of ion/molecular flow experiments

- In this study, NMT was used to assess the flow rates of some important ions involved in low temperature response, maintenance of osmotic balance, and root defense signaling. There were significant differences in ion flow rates between WT and OS (Figures 1 and 2). The Ca^{2+} flow rate showed that the Ca^{2+} flow rate of OS root was higher than that of WT. In addition, the roots of WT plants occasionally absorb and release Ca^{2+} . In addition, OS plants absorbed Ca^{2+} as a whole, and the absorption rate reached 54.31 pico mole $\cdot \text{cm}^{-2} \cdot \text{s}^{-1}$. However, wild-type plants generally exhibited Ca^{2+} exocytosis with a rate of 0.92 pico mole $\cdot \text{cm}^{-2} \cdot \text{s}^{-1}$. OS roots can significantly absorb K^{+} , with an absorption rate of 12.78 pico mole $\cdot \text{cm}^{-2} \cdot \text{s}^{-1}$, while WT roots have a large amount of K^{+} excreted, with a rate of 157.02 pico mole $\cdot \text{cm}^{-2} \cdot \text{s}^{-1}$. From the perspective of Na^{+} flow rate, the root excreted more Na^{+} , reaching 43.02 pico mole $\cdot \text{cm}^{-2} \cdot \text{s}^{-1}$, which was significantly different from 14.04 pico mole $\cdot \text{cm}^{-2} \cdot \text{s}^{-1}$ of wild-type plants. Similarly, there was a significant difference in the efflorescent rate of H^{+} between OS (10.21 pico mole $\cdot \text{cm}^{-2} \cdot \text{s}^{-1}$) and WT (0.09 pico mole $\cdot \text{cm}^{-2} \cdot \text{s}^{-1}$). These results indicate that

under low temperature stress, OS plants absorb Ca^{2+} , K^{+} and H^{+} , while Na^{+} expulsion is observed, which maintains the stability of cell membrane function and enhances the cold resistance of plants.

Other experimental results

- At low and normal temperatures, Si content in OS increases significantly compared to WT. There was no significant difference in Pro content between OS and WT at room temperature. Compared with room temperature, Pro content in OS and WT was significantly increased at low temperature, and Pro content in OS was significantly higher than WT. In addition, the contents of Pro and Si in OS plants increased under low temperature stress, which protected the cell membrane system from damage and enhanced the cold resistance of plants.
- It was found that under low temperature stress, more Ca^{2+} was deposited in OS than WT, indicating that Ca^{2+} was involved in the low temperature response, while there was no difference at normal temperature. The ion absorption results of this study also showed that OS plants can absorb a large amount of Ca^{2+} under low temperature stress. The root calcium deposition experiment confirmed that the root calcium content of OS was significantly higher than that of WT at low temperature. In addition, at low temperatures, OS exhibits a higher H^{+} -ATPase activity than WT, which increases the energy level of ion absorption and efflux in OS.
- The results of high-throughput sequencing showed that the number of microorganisms related to photosynthesis, energy metabolism, nitrogen fixation and defense was significantly up-regulated at low temperature, while the number of

microorganisms related to pathogenicity was significantly down-regulated.

Conclusion

- These results suggest that the *Lsi1* gene plays a key role in the response to low temperature tolerance. NMT results showed that OS absorbed a large amount of Ca^{2+} and H^{+} and a small amount of K^{+} . However, a large amount of Na^{+} is excreted to maintain the balance of cell osmotic pressure. Using calcium deposition sites, the calcium content in OS roots was found to be significantly higher than that in WT, which confirmed the results of Ca^{2+} absorption by root ions. In addition, H^{+} -ATPase activity on the root membrane of OS was significantly higher than that of WT, indicating that the plants had stronger energy metabolism, which helped to resist the external low temperature environment. In addition, high-throughput sequencing results showed that the number of microorganisms associated with photosynthesis, energy degradation, nitrogen fixation and defense was significantly up-regulated at low temperatures, while the number of microorganisms associated with pathogenicity was significantly down-regulated. In addition, overexpressed plants can cope with stress in a timely manner under low temperature conditions, and the plants themselves can also tolerate adverse conditions through a series of reactions. In conclusion, the overexpression of *Lsi1* gene enhances the cold tolerance of rice, and the comprehensive analysis of its underlying mechanism can provide further evidence for its role in the stress resistance of rice plants.

Test liquid

0.1mM CaCl₂, 0.1mM KCl, 0.1mM NaCl, 0.3mM MES, pH 6.0

Key words:

low temperature; Rice; Osmotic regulation; Interaction; Rhizosphere microorganism; Ca²⁺; Energy metabolism; flora

Contributions and Messages:

Xie, Y., et al. Overexpression of the rice gene Lsi1 (low silicon gene 1) enhances plant -microbe interactions that result in improved chilling tolerance . Plant Growth Regul 98, 525–538 (2022). <https://doi.org/10.1007/s10725-022-00890-1>

NMT Literature Express

PBJ Lanzhou University Wandongshi: NMT found that salt-stressed OSIC1 positively regulates the rate of root excretion Na^+ , providing evidence to reveal its mechanism of regulating stomatal closure induced by osmotic stress



Research Article | Open Access |

The C_2H_2 -type zinc finger transcription factor OSIC1 positively regulates stomatal closure under osmotic stress in poplar

Qiuxian Bai, Zhimin Niu, Qingyuan Chen, Chengyu Gao, Mingjia Zhu, Jiexian Bai, Meijun Liu, Ling He, Jianquan Liu, Yuanzhong Jiang , Dongshi Wan

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Basic information

- Research platform: NMT saline-alkali stress innovation platform
- Journal: Plant Biotechnology Journal
- Topic: NMT identified the mechanism of C_2H_2 -ZFP transcription factor encoding gene OSIC1 in stomatal closure induced by stress
- Title: The C_2H_2 -type zinc finger transcriptionfactor OSIC1 positively regulates stomatal closure under osmotic stress in poplar
- Impact factor: 13.263
- Authors: Wan Dongshi, Bai Qiuxian, Niu Zhimin, Lanzhou University, Jiang Yuanzhong, Sichuan University

Detect ion/molecular indicators

- Na^+

Sample information

- Xinjiang poplar root (point on the root table 300 μm from the apex)

Ion/molecular flow experimental treatment method

- The root tips of 4-week-old poplar seedlings were treated with 100 mM NaCl for 30 min

Results of ion/molecular flow experiments

- The root Na^+ flow rate was measured by NMT, and it was found that under salt stress, plants would maintain normal cell metabolism by rebuilding ion homeostasis and alleviate the damage caused by salt stress. In order to explore whether *osic1* is involved in the reconstruction of ion homeostasis, the Na^+ efflux of WT, OSIC1-OE and OSIC1-KO Xinyang root tips under the transient stimulation of 100 mM NaCl was examined. Under normal conditions, the Na^+ flux of WT, OSIC1-OE and *osic1*-ko poplar roots fluctuated steadily between $\pm 200 \text{ pmol cm}^{-2} \text{ s}^{-1}$, which was used as the control group. Compared with the control group, NMT experimental analysis showed that salt treatment resulted in an increase in Na^+ flux in root systems of these poplar trees, but the effect of Na^+ in OSIC1-OE was the largest, followed by WT, and the effect of Na^+ in *osic1*-ko was the smallest. These results indicated that OSIC1-OE could enhance the root tolerance to salt stress by effecting more Na^+ to the root.

Other experimental results

- OSIC1 positively regulates the tolerance of poplar to salt stress

The authors obtained *osic1* overexpression (OSIC1-OE) and CRISPR-Cas9 knockdown (OSIC1-KO) transgenic Xinjiang poplar by *Agrobacterium*-mediated genetic transformation system. Under normal growth conditions, compared with wild-type Xinjiang Poplar (WT) and *osic1*-ko strains, OSIC1-OE strains showed more branches and roots, and the salt stress tolerance of *osic1*-ko strains was greatly damaged under salt treatment, while OSIC1-OE strains showed stronger salt tolerance. Therefore, OSIC1-OE is a positive regulator of salt tolerance in poplar. It was further found that OSIC1 played an active role in stomatal closure under salt stress.

- OSIC1 positively regulates the drought stress tolerance of poplar

In addition, the authors also tracked the phenotype, stomatal conductance, leaf transpiration and net photosynthetic rate of poplar trees after drought treatment. The results show that OSIC1 responds to drought stress by positively regulating stomatal closure.

- OSIC1 positively regulates ABA-mediated stomatal closure

Since ABA-induced OSIC1 regulates stomatal closure under salt and drought stress, we suggest that OSIC1-induced stomatal closure is related to ABA signaling pathways. To prove this hypothesis, we observed and measured stomatal pore sizes of ABA-treated OSIC1-OE, *osic1*-ko and WT poplars. When the leaves were immersed in an open solution (OS), there was no significant difference in the length, width and area of the stomata. However, the stomatal width and area of overexpressed leaves decreased the most after 1.5 h of ABA treatment, and further decreased after 3 h, and the stomatal area of mutant leaves was the largest. These results suggest that OSIC1 plays an active role in ABA-mediated stomatal closure.

- Under salt, drought and ABA treatment, OSIC1 promoted the accumulation of H₂O₂ in guard cells

The accumulation of H₂O₂ in guard cells is essential for stomatal closure. We used H₂O₂-sensitive fluorescent dyes to detect endogenous H₂O₂ levels in guard cells treated with normal conditions and salt, PEG6000(simulated drought), and ABA. Under normal conditions, the fluorescence intensity of OSIC1-OE strain was the highest. After salt treatment, PEG6000(simulated drought) and ABA treatment, the fluorescence intensity of overexpression line increased significantly, WT followed, OSIC1-ko line had the weakest fluorescence intensity. Therefore, OSIC1 positively regulates H₂O₂ accumulation in stress-induced guard cells to participate in ABA signaling.

- OSIC1 is targeted on the promoter of Palcuao-ζ

In order to determine the effect of OSIC1 ectopic expression on poplar genes, we performed RNA seq analysis using wild poplars, salt-stressed wild poplars, and non-stressed OSIC1-OE poplar lines. The cupramine oxidase gene Palcuao-ζ, which catalyzes substrate production of H₂O₂, was identified from 584 DEGs upregulated in both heterotopic OSIC1-expressing strains and salt-stressed wild poplars, suggesting that it may be the target of OSIC1 transcription factor that causes H₂O₂ accumulation. Subsequently, we demonstrated that OSIC1 directly activated the expression of Palcuaoζ by binding OBE1 and OBE3 binding elements on the Palcuaoζ promoter through yeast single hybridization (Y1H) and gel mobility assay (EMSA). Therefore, the authors suggest that Palcuao-ζ mediates OSIC1 to increase H₂O₂ content in guard cells. To determine this, the authors used the CRISPR-Cas9 system to generate Palcuao-zeta knockout poplar trees under WT (Pacuao-zeta -ko) and OSIC1-OE poplar lines (Pacuao-zeta -ko/OSIC1-OE), respectively. Compared with WT, the stomatal width and area of both Palcuaozeta-ko and Palcuaozeta-ko /OSIC1-OE poplar trees increased even without ABA. In addition, the pore width and area after ABA treatment were improved

The reduction was significantly smaller than that of WT. This suggests that OSIC1 regulates ABA-induced stomatal closure by regulating the expression of Palcuao-ζ. In addition, the content of H₂O₂ in protective cells of mutant poplar was also detected. After the elimination of Palcuao-ζ, the H₂O₂ content decreased significantly and the overexpression of OSIC1 could not be recovered even if ABA was provided. Thus, induced H₂O₂ PalCuAOζ is a necessary condition for OSIC1 to regulate stomatal closure, and PalCuAOζ is the hereditary epigastric of OSIC1.

- Phosphorylation of OSIC1 enhances its transcriptional activation activity

In order to further elucidate the transcriptional regulation mechanism of OSIC1, the interacting proteins of OSIC1 were identified by yeast two-hybridization (Y2H) sieve library. Among the candidate proteins, the authors found a homologue of Arabidopsis mitogen-activated protein kinase (MPK3), hence the name PalMPK3. The interaction between OSIC1 and PalMPK3 was further determined by the point-to-point yeast two-hybrid assay (Y2H) and co-immunoprecipitation assay (Co-IP). In addition, phosphorylation tests showed that PalMPK3 phosphorylated OSIC1 both in vitro and in vivo (Figure 9). In order to investigate the effect of phosphorylated OSIC1 on its transcriptional activity, we demonstrated that phosphorylation can enhance the transcriptional activation activity of OSIC1 using double luciferase assay (LUC). In addition, another LUC experiment showed that OSIC1 co-expressing PalMPK3 and PalMKK5DD did significantly increase LUC intensity; With the increase of NaCl concentration, LUC intensity further increased (FIG. 10). These results suggest that OSIC1 has additional phosphorylation sites that are phosphorylated by other salt stress-induced protein kinases.

Conclusion

- In conclusion, this paper reports the biological function of C2H2-ZFP transcription factor encoding gene OSIC1 in poplar during stress-induced stomatal closure. Firstly, OSIC1 was mainly expressed in leaves and xylem, and was significantly induced by salt, drought, PEG6000 and ABA. Second, in transgenic poplar, OSIC1 plays an active role in salt-tolerance and drought stress, and causes comprehensive transcriptome rearrangement. Third, OSIC1 accelerates the accumulation of H₂O₂ by up-regulating the expression of Palcua α - ζ , leading to stomatal closure. Finally, OSIC1 can be phosphorylated by PalMPK3 to enhance its transcriptional activity. Therefore, we propose a new working model for poplar response to osmotic stress: Under normal circumstances, the mRNA abundance of PalMPK3 and OSIC1 is maintained at a low level, and their encoded products are inactivated; As a result, the transcription of Palcua α - ζ is not heavily activated. Therefore, the H₂O₂ content is not sufficient to induce stomatal closure. ABA accumulates when poplar trees are subjected to osmotic stress caused by salt or drought. The accumulated ABA induces the expression of PalMPK3 and OSIC1, activates PalMKK4/5, and further phosphorylates PalMPK3. Subsequently, OSIC1 is phosphorylated by activated PalMPK3. Phosphorylated OSIC1 binds to the promoter of Palcua α - ζ and up-regulates its expression. Palcua α - ζ catalyzes the production of more H₂O₂, which mediates stomatal closure and reduces water loss. These results not only deepen the understanding of the regulation mechanism of osmotic stress response of woody plants, but also provide a new idea and theoretical basis for the screening and breeding of poplar germplasm under stress.

Test liquid

0.1 mM KCl, 0.1 mM CaCl₂, 0.1 mM MgCl₂·6 H₂O, 0.5 mM NaCl, 0.3 mM MES , 0.2 mM Na₂SO₄ , pH=6.5

Key words:

OSIC1; C₂H₂; ABA; Drought stress; Salt stress; *Populus xinjiangensis*; Air hole; flora

Contributions and Messages:

Qiuxian Bai, et al. The C₂H₂-type zinc finger transcription factor OSIC1 positively regulates stomatal closure under osmotic stress in poplar. PLANT BIOTECHNOL J. doi: 10.1111/pbi.14007

NMT Literature Express

PLA General Hospital, Eastern University School of Medicine: NMT found that Dagaglizin can reduce the rate of oxygen consumption of renal tubular epithelial cells, providing evidence to reveal the mechanism of Daglizin alleviating contrast nephropathy

ORIGINAL ARTICLE

Dapagliflozin Attenuates Contrast-induced Acute Kidney Injury by Regulating the HIF-1 α /HE4/NF- κ B Pathway

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Basic information

- Research platform: NMT Medical Research Innovation platform
- Journal: Journal of Cardiovascular Pharmacology
- Topic: NMT found that dagaglipzin can reduce the oxygen consumption of renal tubular epithelial cells, which provides evidence for alleviating contrast nephropathy by inhibiting HIF-1 α /HE4/NF- κ B pathway
- Title: Dapagliflozin Attenuates Contrast-induced Acute Kidney Injury by Regulating the HIF-1 α /HE4/NF- κ B Pathway
- Impact factor: 3.242
- Authors: Cao Feng, Second Medical Center, PLA General Hospital; Tang Chengchun, Huang Xu, School of Medicine, Southeast University

Detect ion/molecular indicators

- O₂

Sample information

- Renal tubular epithelial cell line

Ion/molecular flow experimental treatment method

- Renal tubular epithelial cells treated with 100 mM daglizin for 24 h were examined under normal and hypoxia conditions

Results of ion/molecular flow experiments

- The study found that under normal oxygen conditions, daglipzin reduced the O₂ flow rate of the cells to 26% compared to the control group. Compared with normal oxygen, oxygen deprivation significantly reduced the O₂ flow rate of cells to 49%. Under hypoxia conditions, compared with the control group, daglizin further inhibited the O₂ uptake rate of cells.

Other experimental results

- Daglipzin can inhibit the hypoxia of renal tubular epithelial cells.
- Daglipzin inhibits HIF-1 α /HE4/NF- κ B expression in hypoxic tubular epithelial cells.
- Daglipzin can reduce creatinine and urea nitrogen of rat contrast agent kidney injury.
- Daglipzin inhibits apoptosis of renal tubular epithelial cells in rat models of contrast agent kidney injury.

Conclusion

- The results of this study indicate that hypoxia injury is one of the pathological mechanisms of kidney injury caused by contrast media. Daglizin, at least to a certain extent, has a protective effect on this disease by inhibiting the HIF-1 α /HE4/NF- κ B signaling pathway. Dagglizin is expected to be used as an adjunct therapy for clinical management of renal injury.

Test liquid

1.8 mM CaCl₂, 5.0 mM KCl, 25 mM NaHCO₃, 100 mM NaCl, 0.8 mM MgSO₄, 5mM Glucose, pH 6.8

The hypoxic test solution is nitrogen injected into the normal test solution.

Key words:

CI-AKI; Daglizin; HIF-1 α /HE4/NF- κ B pathway; Diabetes mellitus; Cell apoptosis; Medical science

Contributions and Messages:

Huang X, Guo X, Yan G, Zhang Y, Yao Y, Qiao Y, Wang D, Chen G, Zhang W, Tang C, Cao F. Dapagliflozin Attenuates Contrast-induced Acute Kidney Injury by Regulating the HIF-1 α /HE4/NF- κ B Pathway. J Cardiovasc Pharmacol. 2022 Jun 1;79(6):904-913. doi: 10.1097/FJC.0000000000001268. PMID: 35383661; PMCID: PMC9162274.

Dynamic innovation and peaceful innovation

-- Analysis of NMT innovation practice

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I. Introduction

The competition of comprehensive national strength is ultimately the competition of innovation.

Innovation has become a hot word nowadays, which is inevitably related to the increasingly fierce competition among nations, countries, ideologies and even civilizations.

From the perspective of an NMT person who is first and foremost a life science worker, competition is a good thing in line with the laws of nature! Because competition not only improves individual and collective strength, but also makes a nation and a country strong and ultimately promotes human progress and development!

At the same time, the level of innovation ability also determines who can occupy a comparative advantage in the competition.

From the perspective of the development of non-damaging micromasurement technology in more than 20 years, knowing oneself and the other, deeply understanding the foreign innovation experience represented by the West, as well as China's own innovation characteristics, learning from each other, exchange and mutual learning, is crucial to improve and improve the innovation ability, and gain competitive advantages in the international scientific research and application market!

The following is a summary of the relevant experiences of the national NMT people in these years of struggle.

II. Chinese and Western innovation has its own characteristics

NMT innovation is inseparable from the great historical background of the rejuvenation of the Chinese nation, that is, our overall material and financial resources, scientific and technological strength, innovation ability and experience are still in a climbing stage, which is significantly insufficient compared with the West, so NMT people also rationally and objectively recognize the respective characteristics of modern and Western innovation.

Western characteristics: 0 to 1 original innovation

There is no doubt that the apple that fell on Newton's head must have also fallen on the heads of many Chinese people in the form of apples, pears and other fruits..... However, it was Newton who discovered and proposed gravitation. In modern times, the West has indeed contributed many original innovations from 0 to 1 to mankind.

Chinese characteristics: 1 to N application innovation

As we all know, Internet technology is the original innovation of 0 to 1 completed in the United States, but the Chinese have changed Internet technology from 1 application innovation to N.

For example, TikTok's popularity in the world can be said to bring the application innovation of Internet technology to the extreme.

In addition, the new energy industry, domestic mobile phones, and so on, the story of 1 to N is endless.

"Human civilizations only vary, but no one is better or worse." Therefore, the innovation characteristics of each country and nation

are also the extension of the characteristics of their own civilization, and there is no superior or inferior. Application innovation should be based on original innovation. Original innovation also needs sufficient accumulation of application innovation to complete the quantitative change to. Qualitative change. The two are interdependent and mutually causal.

III. static innovation and dynamic innovation

Static innovation

Not so long ago, it was possible to examine and distinguish between original and applied innovations with a relatively static gaze.

For example, China is not the original innovator of mobile communication technologies, such as 2G, 3G and 4G, but it is the leader of excellent application innovation of these technologies. However, through application innovation, China has not only accumulated rich funds needed for innovation by taking advantage of the population base and huge market, but also has the technical reserves of original innovation such as 5G. So as to finally complete the original innovation of 5G.

Dynamic innovation

With the rapid development of today's technology, mutual cross and penetration, increasingly extensive and in-depth, the boundary between original innovation and applied innovation is gradually more difficult to define.

In particular, the biotechnology field to which NMT belongs is different from the relatively single field, such as the above communication field, other modern technologies involved in biotechnology are both complex and highly integrated, and the original innovation and application innovation in each branch field

exist at the same time, but continue to develop rapidly according to their own laws.

Therefore, this kind of multi-dimensional dynamic innovation, in which original innovation and applied innovation are interdependent, interexisting and accelerating their transformation, is a new normal of innovation that Chinese NMT people have mastered through NMT innovation practice in recent years.

IV. NMT Innovation Practice and Peaceful innovation

NMT Innovation Practice

China's NMT: Non-invasive Micro-test Technology, also experienced an application innovator from the original innovation, after nearly 20 years of technology accumulation has become an original innovator.

NMT technology followed the original innovation called "oscillating electrode technology", which was proposed by the American MBL scientist, Professor Lionel Jaffe, in 1990 to detect ion flow rate.

Of course, this 0-1 integrated technological innovation also benefited from the accumulation of 1-N application innovation in many fields of Western personal computers, polymer chemistry, precision machinery, electronic circuits and other technologies for decades from the 1960s to the 1980s.

Similarly, as China's original innovation and application innovation in polymer chemistry, precision machinery, software science, especially artificial intelligence technology are gradually approaching or even leading the world, Chinese NMT people seize these opportunities, combined with specialization, convenience, automation and other market-leading innovation elements, making NMT's own original innovation account for an increasing proportion. Finally, in 2021, it was recognized as "International leading level"

by the evaluation institution of the Ministry of Science and Technology, completing the 0 to 1 sublimation of the Chinese people from application innovation to original innovation.

Peaceful innovation

If we put innovation into the long river of history, China is certainly not a country that lacks 0 to 1 original innovation. Because, as we all know, China's modern and modern innovation is weak, mainly due to the bullying of foreign powers, broken mountains and rivers, people's livelihood is depressed, and the reform and opening up of the past 40 years of innovation recovery, whether original innovation or applied innovation, is thanks to a peaceful, stable and relatively rich people's livelihood environment.

We should not only cherish this era of peace and innovation, which countless modern ancestors exchanged with unremitting struggle, blood, and even life, but also work hard, use wisdom and sweat, and fulfill the responsibility of our generation's innovation and power!

In particular, the global outbreak of the new coronavirus epidemic has made us biotechnology workers feel more personally that in these special war environments, advanced technology has the hard power to protect the country.

Therefore, although dynamic innovation gives us a head start in innovation methods, we must keep in mind the historical mission of peaceful innovation, so that we NMT people can always maintain the passion for innovation! Only through continuous innovation can we continue to enhance our national competitiveness, ensure that the nation is no longer bullied, and let our children enjoy eternal peace.....

Innovation Opportunity

Rapid screening and evaluation method of crop varieties with low accumulation of heavy metals

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Background and challenge

Protozoan parasites are single-celled eukaryotes that can cause serious human diseases and pose a huge health and socio-economic burden worldwide, with at least 10,000 deaths per year, particularly in developing countries.

From the articles published in internationally renowned parasite research journals in the past two years, it can be seen that the treatment of parasitic diseases and the development of parasitic drugs are hot spots in the field of parasite research:

Transcription factors are located at the junction of various signaling pathways in eukaryotes, and transcription factors and the pathways they regulate can be used as targets for anti-parasitic drug design. Understanding parasite transcriptional pathways and how parasites alter host gene expression is critical to discovering innovative drug targets.

REDOX active substances such as glutathione, cysteine, and other inorganic intermediates (hydrogen peroxide, nitric oxide) play an important role in the regulation of REDOX homeostasis, which can help parasites cope with oxidative stress. Therefore, a better understanding of the role of these molecules in drug resistance and REDOX homeostasis will help target metabolic pathway proteins to combat leishmaniasis and trypanosomiasis.

Under laboratory conditions, high-dose intestinal nematode infection resulted in protective immunity based on a strong type 2 response in most mouse strains. This suggests that natural whipworm and pinworm infection induce different immune regulatory and effect characteristics.

The above studies have pointed out that the treatment of parasitic diseases and the development of parasitic drugs need to understand a series of physiological response mechanisms of the host and the parasite after the infection of the parasite, such as transcription and gene expression, REDOX homeostasis regulation and immune regulation. Therefore, there is a need for a technique that can quickly verify physiological functions within a certain range of time and spatial resolution.

NMT Solutions

We all know that all physiological processes of organisms are closely related to ions and molecules:

Calcium ion is one of the most important second messengers in the cell, which plays an important role in the transmission of information within and between cells, and its regulation of transcription factors has become one of the frontiers of research.

T cell mediated cellular immunity is an important part of human immune system. The sensitivity of T cells to external antigen stimulation affects the speed of human immune response to a certain extent. Calcium ion can amplify the initial T cell receptor activation signal, and then improve the sensitivity of T cells to external antigen stimulation, indicating that calcium ion has a role in maintaining the human immune system.

Hydrogen peroxide is a kind of reactive oxygen species (ROS). Under the catalysis of enzymes, hydrogen peroxide can be produced by various REDOX reactions in living organisms.

Noninvasive micrometry (NMT) can detect the transmembrane movement of ions and molecules (including Ca^{2+} , H^+ , O_2 , H_2O_2 , etc.) in the cells, tissues and organs of the host infected by the parasite, and study the related physiological functions and mechanisms. The sensitivity of ion and molecular flow rate detection can reach femto ($10^{-15} \text{mole} \cdot \text{cm}^{-2} \cdot \text{s}^{-1}$) level, and it has its own unique advantage of wide coverage in terms of temporal and spatial resolution, so it is very suitable for parasite-related physiological mechanism research, drug resistance research and drug development.

Reference

1. Walters H A , Temesvari L A . Targetacquired: transcriptional regulators as drugtargets for protozoan parasites[J]. International Journal for Parasitology, 2021(12).
2. Va A , Sb A , An A , et al. Unique thiolmetabolism in trypanosomatids: Redox homeostasis and drug resistance[J]. Advances in Parasitology, 2022, 117:75-155.
3. Zhang H , Bednar L , Heitlinger E , et al. Whip- and pinworm infections elicit contrasting effector and distinct regulatory responses in wild house mice[J]. International Journal for Parasitology, 2022(8):52.
4. Ca^{2+} regulates T-cell receptor activation by modulating the charge property of lipids[J]. Nature, 2013, 493(7430):111.
5. 许越. 非损伤微测技术—2022[J].NMT通讯,2022(01):11-17.

6. 刘蕴琦, 叶斌, 陆旭, 等. 非损伤微测技术在肿瘤个体化治疗中的潜在应用[J].NMT通讯, 2022(01):12-18.

Innovation Opportunity

Rapid screening and evaluation method of crop varieties with low accumulation of heavy metals

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Abstract: According to the different edible parts of crops, the requirements of agricultural production on the ability of crops to absorb and transport heavy metals are different. For crops with edible underground parts, the less heavy metal accumulation in underground parts is required, the better. NMT can detect the absorption rates of Cd^{2+} , Pb^{2+} , and Cu^{2+} of living rice roots and their transport rates to above-ground parts. The lower the rate of heavy metal ion uptake by roots, the higher the transport rate to above-ground parts. The lower the accumulation of heavy metals in the underground part. On the contrary, the lower the rate of heavy metal ions absorbed by the root system, the lower the transport rate to the above-ground part, the less the accumulation of heavy metals in the above-ground part.

Key words: NMT; Heavy metals; Pollution; crop

1 Background

According to statistics, the probability of heavy metal pollution in the soil of cultivated land in China is about 16.67%, so it is inferred that the area of heavy metal pollution in cultivated land in China accounts for about 1/6 of the total cultivated land. According to the third National land survey, the cultivated land area of China is 1.918 billion mu. It can be seen that the heavy metal pollution area of the cultivated land in China is about 320 million mu. Cadmium, lead and copper are the main heavy metal pollution elements, among which

the pollution rate of cadmium is as high as 25.20%. The crops, vegetables, melons and fruits produced by these polluted cultivated lands will cause serious harm to human health. With the development of China's life science research, some crops, vegetables, melons and fruits have been born with low cadmium accumulation plants, these plants because of the weak ability to absorb cadmium, lead, copper and other heavy metal pollution elements, so their own accumulated heavy metal pollution elements content is low, the output of agricultural products is relatively safe. However, there is currently a lack of methods that can detect the ability of crops, vegetables, melons and fruits to absorb heavy metal pollution elements before planting.

2 Methods and Principles

2.1 Technical Basis

NMT

2.2 Detection Principle

NMT can directly detect the ability of living plants to absorb heavy metal pollutants (cadmium, copper, lead) in soil

2.3 Criteria

The absorption capacity of heavy metal pollution elements (cadmium, lead, copper) was determined by measuring the flow rate of living plants

2.4 Method Advantages

(1) High efficiency: no need for field planting, plants only need to undergo short-term cultivation, can be tested;

- (2) High precision: orders of magnitude can reach pico mole
- (3) More accurate: the detection environment can simulate the concentration of heavy metals in the soil;
- (4) Short cycle: real-time and dynamic detection of living organisms can achieve synchronous detection of a variety of indicators.

3 Application Cases

Case: Rapid screening of cadmium absorption capacity of different sweet sorghum varieties Variety H18 has stronger cadmium absorption capacity than variety L69.

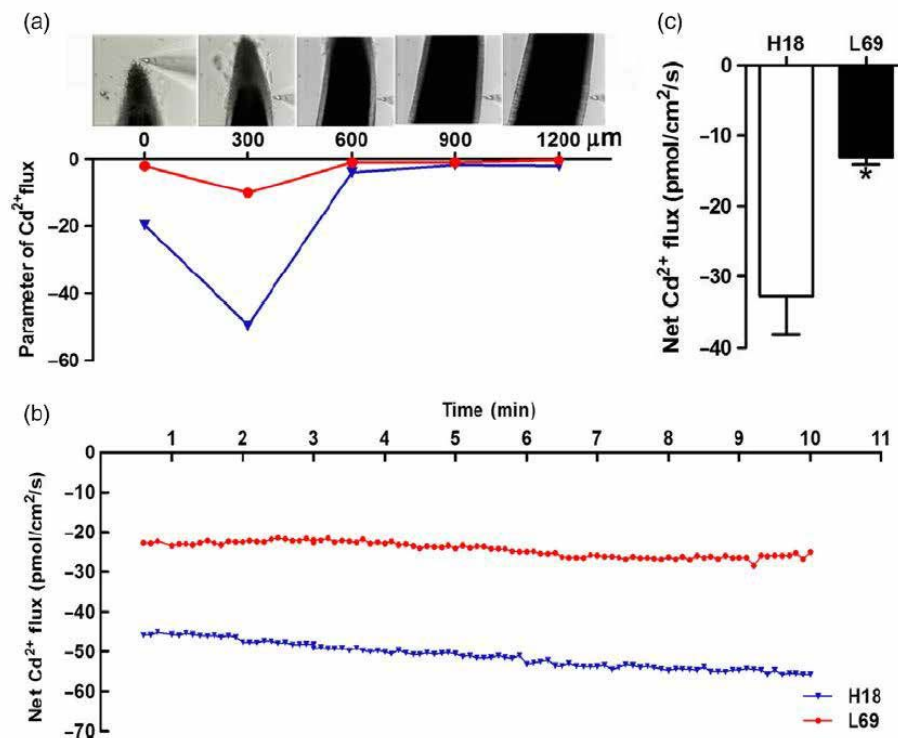


Figure: (a) Comparison of the absorption capacity of different parts of the root of variety H18 and variety L69

(b) Comparison of cadmium ion absorption capacity between variety H18 and variety L69 at a distance of 300μm from the top of the root shoot

(c) Comparison of the average cadmium ion absorption capacity of variety H18 and variety L69 within 10min

Reference

- [1] Feng J , Jia W , Lv S , et al. Comparative transcriptome combined with morphophysiological analyses revealed key factors for differential cadmium accumulation in two contrasting sweet sorghum genotypes[J]. Plant Biotechnology Journal, 2018.
- [2] Bza B , Jie M , Fc A , et al. Mechanisms underlying silicon-dependent metal tolerance in the marine diatom *Phaeodactylum tricornutum* - ScienceDirect[J]. Environmental Pollution, 262.
- [3] Han X , Zhang Y , Yu M , et al. Transporters and ascorbate - glutathione metabolism for differential cadmium accumulation and tolerance in two contrasting willow genotypes[J]. Tree Physiology, 2020.
- [4] Feng J, Jia W, Lv S, Bao H, Miao F, Zhang X, Wang J, Li J, Li D, Zhu C, Li S, Li Y. Comparative transcriptome combined with morpho-physiological analyses revealed key factors for differential cadmium accumulation in two contrasting sweet sorghum genotypes. Plant Biotechnol J. 2018 Feb;16(2):558-571. doi: 10.1111/pbi.12795. Epub 2017 Aug 3. PMID: 28703450; PMCID: PMC5787832.
- [5] 许越. 非损伤微测技术—2022[J].NMT通讯,2022(01):11-17.