

様式 F-7-1

科学研究費助成事業（学術研究助成基金助成金）実施状況報告書（研究実施状況報告書）（平成29年度）

所属研究機関名称		奈良先端科学技術大学院大学	機関番号	14603
研究代表者	部局	研究推進機構		
	職	博士研究員		
	氏名	Cui Songkui		

1. 研究種目名 若手研究(B) 2. 課題番号 17K15142

3. 研究課題名 Molecular mechanism of ethylene on the regulation of haustorium development and function in parasitic plants

4. 補助事業期間 平成29年度～平成30年度

5. 研究実績の概要

In pursuit of understanding the role of ethylene in parasitic plant-host plant interaction, the importance and mechanisms of ethylene signaling pathway in controlling haustorium development and function is partially resolved by molecular and cellular experiments. The results achieved in the year showed that *Phtheirospermum japonicum* does not require ethylene signaling for haustorium initiation, indicating ethylene signaling is not necessary for perception of haustorium inducing factor. In contrast, ethylene signaling is shown to be involved in subsequent haustorium elongation. It shows that haustorium elongation is likely correlated with active proliferation of haustorial apex cells accompanied with the cellular accumulation of auxin. In the absence of host, haustorium elongation terminates within 2 days and this termination process is accompanied with decreased auxin accumulation and proliferation of haustorial apex cells and requires ETR1 and EIN2 mediated ethylene signaling, suggesting the antagonistic role of ethylene and auxin signaling for haustorium development. Infection assay showed that ethylene signaling is required for host tissue invasion, indicating the key role of ethylene signaling in the function of haustorium. In the host side, ethylene biosynthetic genes and ethylene responsive transcription factors were differentially expressed during infection. Furthermore, ethylene-related genes in host are partially required for host invasion by parasitic plants. These reveal that ethylene is the important interplay between host and parasitic plants for parasitism.

6. キーワード

parasitic plant ethylene haustorium parasitism

7. 現在までの進捗状況

区分 (2) おおむね順調に進展している。

理由
Most of the plans proposed in FY2017 were carried out and showed expected results. In details, phenotypic complementation experiment in *Pjein2* mutant using genome fragment successfully restored the haustorium phenotype, which validates the SNP detection result using whole genome sequencing and indicates that the mutant phenotype is indeed caused by defects in ethylene signaling. Phenotypic characterization and auxin response marker expression in the wild type and mutant haustoria revealed that haustorium termination in the absence of host is regulated by cell division activity in haustorial apex via crosstalk between auxin and ethylene. Functional test for mutant haustoria revealed unanticipated and essential role of parasitic ethylene signaling for host invasion. An unanticipated role of host ethylene-related genes in parasitism was observed, showing more general function of ethylene in plant parasitism. Nevertheless, visualization of cellular ethylene response inside haustorium using established ethylene marker EBS promoter fused with GUS and Venus protein did not show any positive result during haustorium development, suggesting that either ethylene signaling activation is independent from EIN3 mediated pathway or EBS is not suitable marker in *Phtheirospermum japonicum* as opposed to *Arabidopsis*. Proposed experiments for measurement of ACC (ethylene precursor) level and transcriptome analysis during haustorium development is initiated at the end of fiscal year and will be carried out soon.

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8. 今後の研究の推進方策

Major efforts in FY2018 will be put in performing the experiments of transcriptomics and direct ethylene measurement during haustorium development. For transcriptomics, network analysis combined with GO enrichment test will be performed to resolve genetic regulation of haustorium development and transcriptional regulation of ethylene-related genes and also to identify key genes involved in proliferation of haustorial apex cells for modulating haustorium elongation and host invasion, a key process for plant parasitism. Investigation of ethylene response during haustorium development will be continuously carried out, this time by using EIN2 translocation system. Generation of new ethylene markers is under consideration using the gene expression data from proposed transcriptomic experiment.

9. 次年度使用が生じた理由と使用計画

次年度使用額が無いため、記入しない。

10. 研究発表（平成29年度の研究成果）

〔雑誌論文〕 計2件（うち査読付論文 2件 / うち国際共著 2件 / うちオープンアクセス 0件）

1. 著者名 Cui Songkui, Wada Syogo, Tobimatsu Yuki, Takeda Yuri, Saucet Simon B., Takano Toshiyuki, Umezawa Toshiaki, Shirasu Ken, Yoshida Satoko	4. 巻 218
2. 論文標題 Host lignin composition affects haustorium induction in the parasitic plants <i>Phtheirospermum japonicum</i> and <i>Striga hermonthica</i>	5. 発行年 2018年
3. 雑誌名 New Phytologist	6. 最初と最後の頁 710-723
掲載論文のDOI（デジタルオブジェクト識別子） 10.1111/nph.15033	査読の有無 有
オープンアクセス オープンアクセスではない、又はオープンアクセスが困難	国際共著 該当する

1. 著者名 Cui Songkui, Suzuki Takuya, Tominaga-Wada Rumi, Yoshida Satoko	4. 巻 in press
2. 論文標題 Regulation and functional diversification of root hairs	5. 発行年 2017年
3. 雑誌名 Seminars in Cell & Developmental Biology	6. 最初と最後の頁 -
掲載論文のDOI（デジタルオブジェクト識別子） 10.1016/j.semcd.2017.10.003	査読の有無 有
オープンアクセス オープンアクセスではない、又はオープンアクセスが困難	国際共著 該当する

〔学会発表〕 計5件（うち招待講演 0件 / うち国際学会 4件）

1. 発表者名 Songkui Cui, Ken Shirasu, Satoko Yoshida
2. 発表標題 Ethylene signaling controls haustorium development in parasitic plant <i>Phtheirospermum japonicum</i>
3. 学会等名 The Japanese Society of Plant Physiologists (国際学会)
4. 発表年 2017年～2018年

1. 発表者名 Songkui Cui, Syogo Wada, Yuki Tobimatsu, Yuri Takeda, Toshiyuki Takano, Toshiaki Umezawa, Ken Shirasu, Satoko Yoshida
2. 発表標題 Host lignin composition affects haustorium induction in parasitic plants
3. 学会等名 The Japanese Society of Plant Physiologists (国際学会)
4. 発表年 2017年～2018年

1. 発表者名 寄生植物ストライガの吸器誘導における活性酸素種の役割
2. 発表標題 和田将吾, Songkui Cui, 吉田聡子
3. 学会等名 The Japanese Society of Plant Physiologists (国際学会)
4. 発表年 2017年～2018年

1. 発表者名 Songkui Cui, Ken Shirasu, Satoko Yoshida
2. 発表標題 The role of ethylene signaling in the haustorium development in the facultative root parasitic plant <i>Phtheirospermum japonicum</i>
3. 学会等名 14th World Congress on Parasitic Plants (国際学会)
4. 発表年 2017年～2018年

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1. 発表者名 Songkui Cui, Shuji Shigenobu, Tomoaki Nishiyama, Tomoko Shibata, Mitsuyasu Hasebe, Ken Shirasu, Satoko Yoshida
2. 発表標題 モデル寄生植物コシオガマの変異体原因遺伝子同定 寄生植物コシオガマの全ゲノム解析を行い、変異体の原因遺伝子を同定する方法を確立した。
3. 学会等名 日本植物学会
4. 発表年 2017年～2018年

〔図書〕 計0件

1 1. 研究成果による産業財産権の出願・取得状況

〔出願〕 計1件

産業財産権の名称 吸器形成阻害剤	発明者 吉田 聡子, 和田 将吾, Songkui Cui	権利者 同左
産業財産権の種類、番号 特許、2018-010715	出願年 2018年	国内・外国の別 国内

〔取得〕 計0件

1 2. 科研費を使用して開催した国際研究集会

計0件

1 3. 本研究に関連して実施した国際共同研究の実施状況

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1 4. 備考

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