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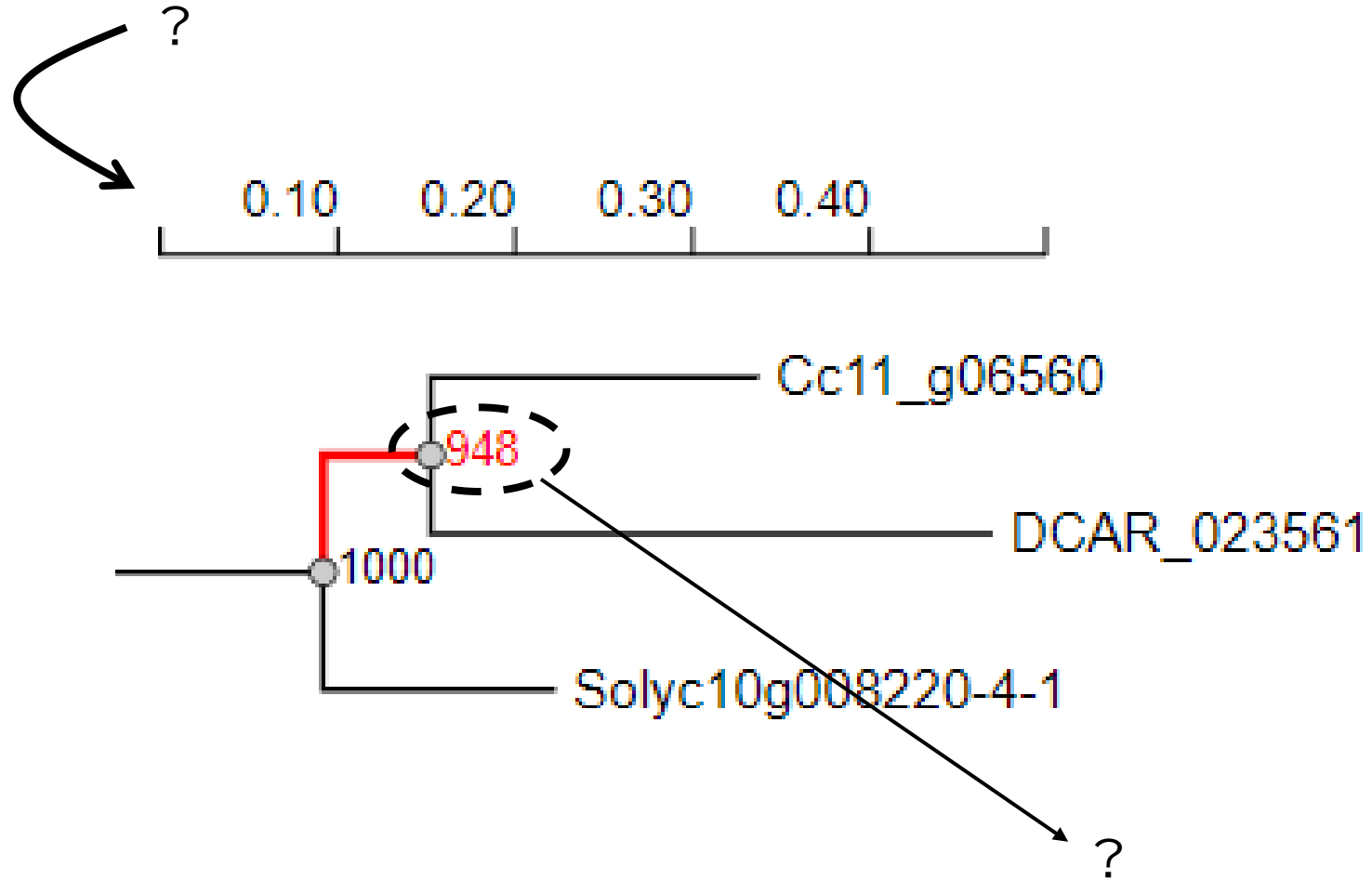
# 系統樹について & NCBIデータベースについて

2025/04/22

栽培植物起原学分野 助教

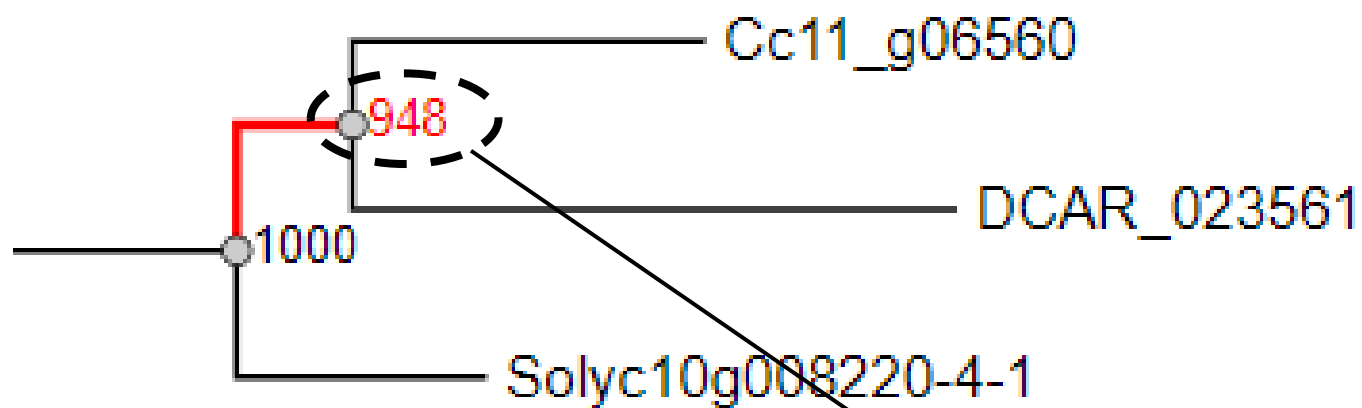
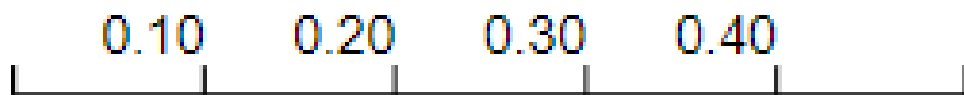
堺 俊之

# 系統樹の数値の意味



# 各数値は系統的な距離や分岐の信頼度を示す

Phylogenetic distance: 系統的な距離、  
どれだけ配列に違いがあるかの基準



Branch support value

分岐の信頼度。

反復数に近いほど信頼度が高い。

(分岐していると考えて良い。)

Bootstrap branch supports

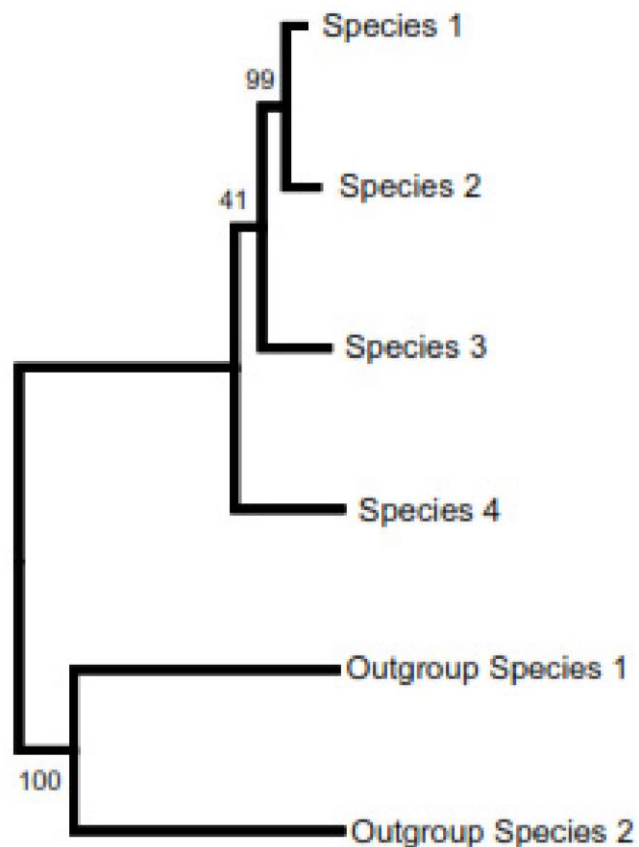
Yes

Number of replicates

1000

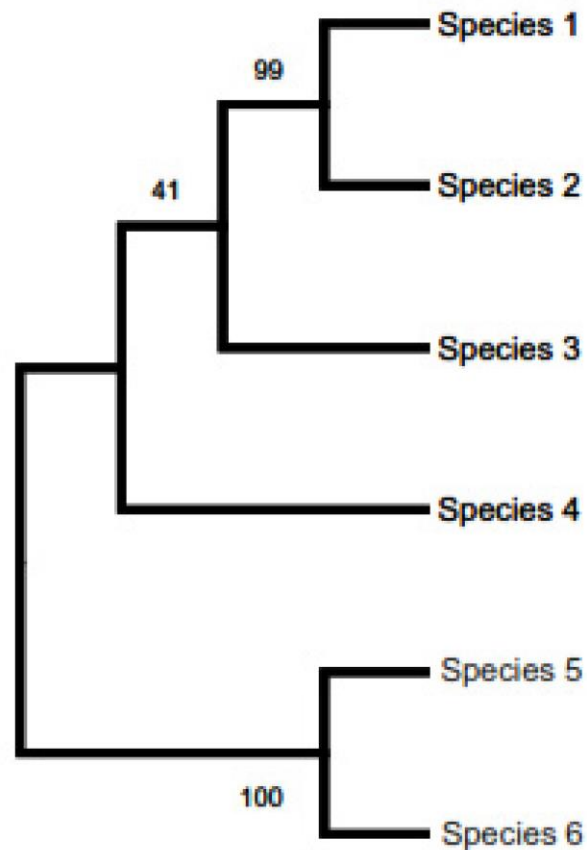
# 系統樹は系統的な距離の情報を含んでいるものを示す

○ Phylogenetic tree



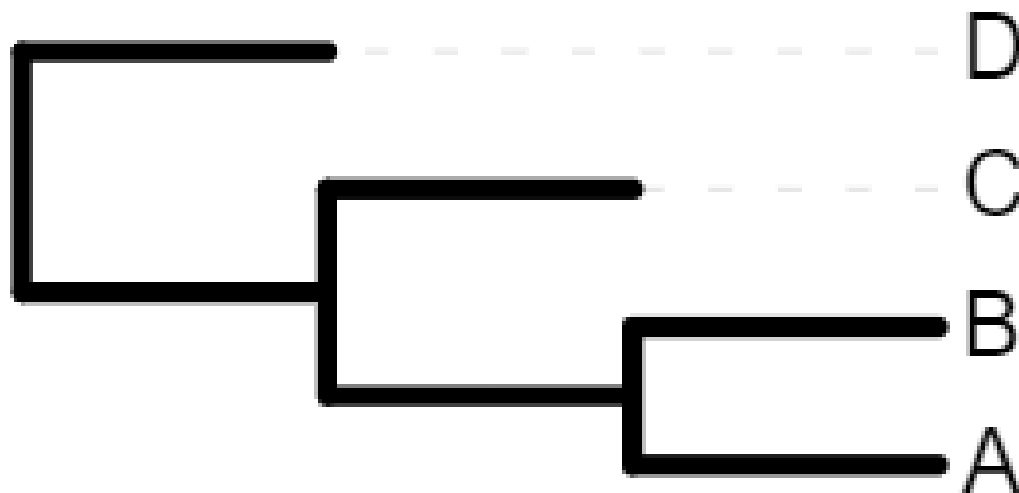
0.01

✗ Cladogram



## 系統樹に基づいた進化的な関係の推定

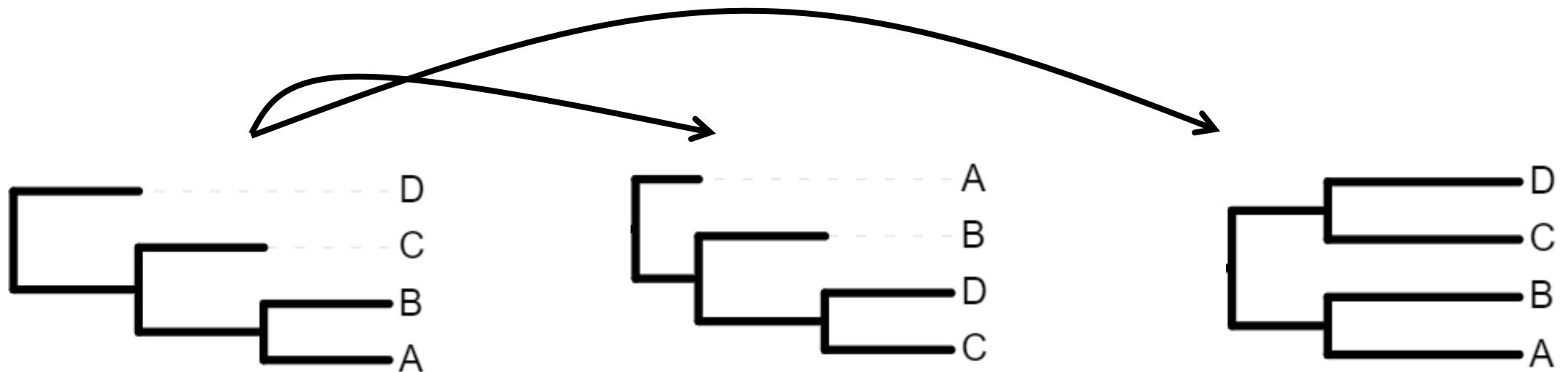
Q. 配列から以下の様な系統樹が得られた。進化の過程で DからCに分化し、B,Aに更に分化したと言えるか…？



# 系統樹に基づいた進化的な関係の推定

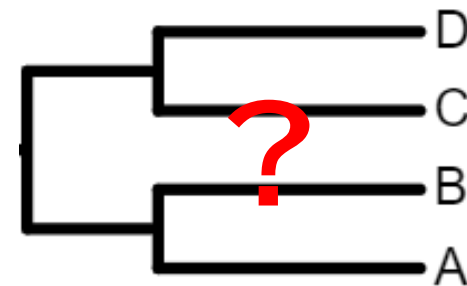
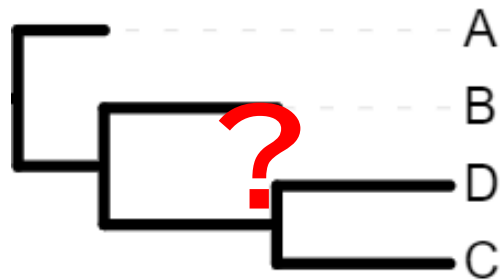
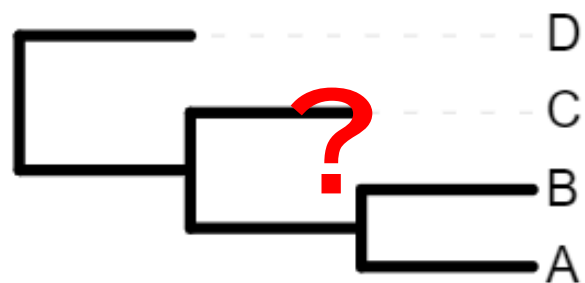
## A. 言えない

どの遺伝子/種が最初(Rootと呼ぶ)か分からないので、  
系統樹の関係からだけでは起源や進化的な関係は判断できない

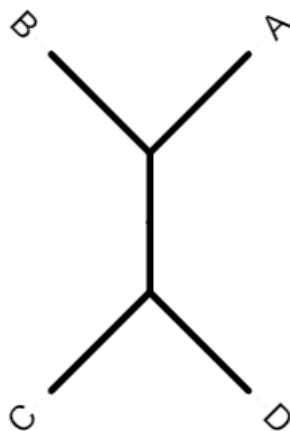
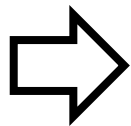


# 系統樹に基づいた進化的な関係の推定

起源や進化的な関係が判断できない場合: その①



系統的な関係性  
(系統的に近いか遠いか)  
のみ示す

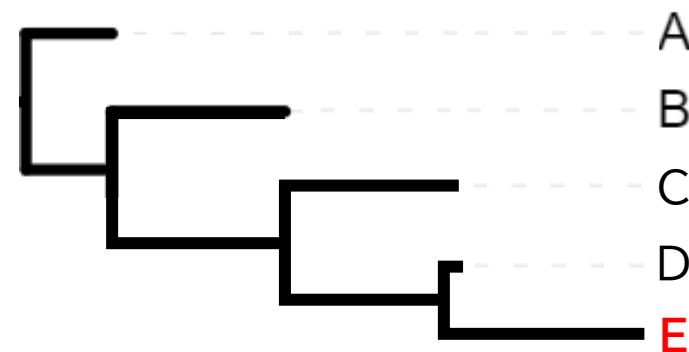
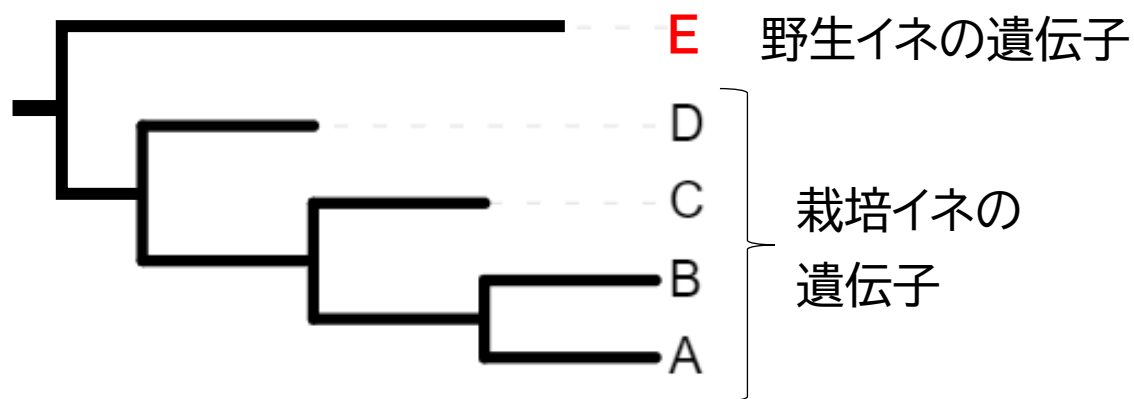
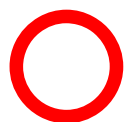


**Unrooted tree** と呼ぶ

# 系統樹に基づいた進化的な関係の推定

起源や進化的な関係が判断できない場合: その②

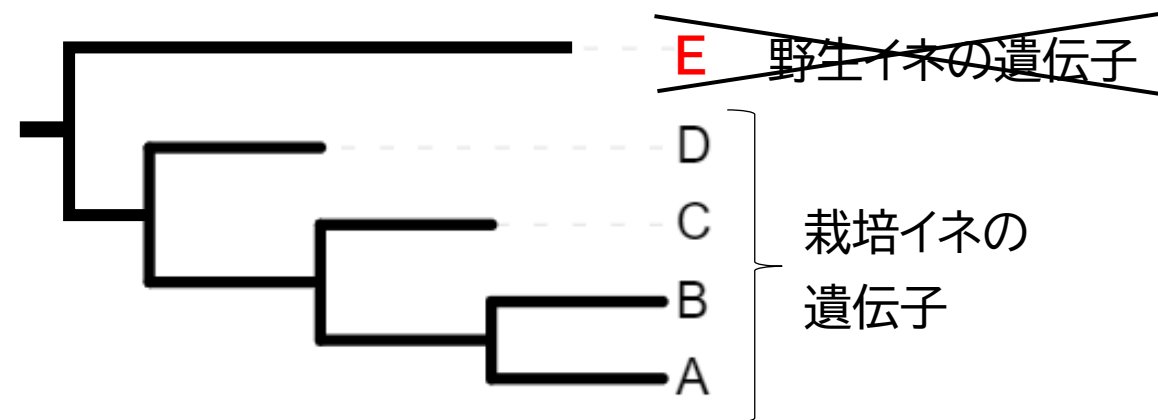
Outgroup(外群)を入れRootを決める



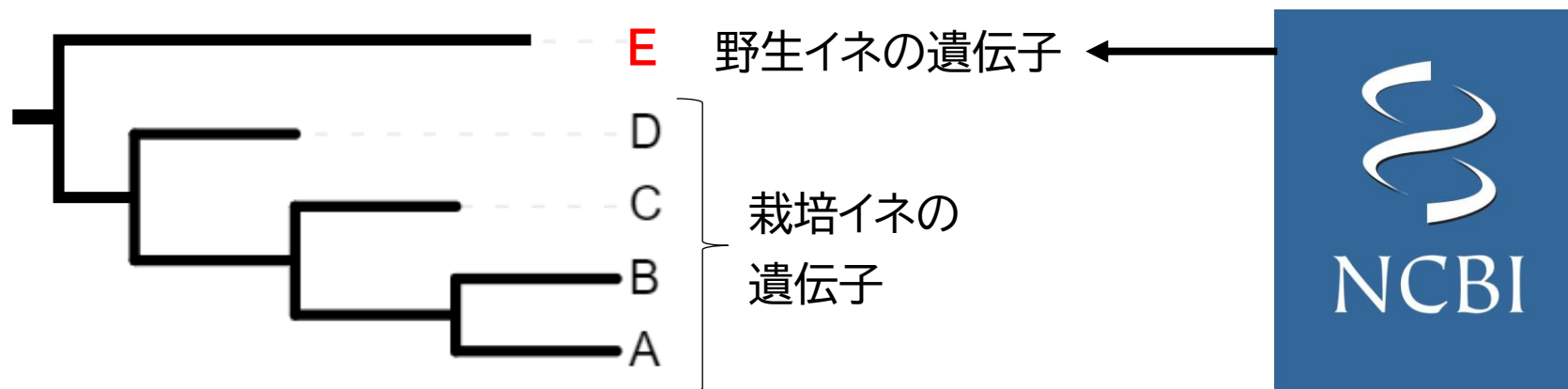


# 外群の配列をどう手に入れるのか？

- ① 外群のサンプルを準備しておく  
→ 今回は無い



- ② NCBI等のシーケンスデータベースで使えるような遺伝子配列を探す



# 代表的な生物学のデータベース

- NCBI (National Center of Biotechnology Information)



- EBI (European Bioinformatics Institute)



- SIB (Swiss Institute of Bioinformatics)



塩基配列・アミノ酸配列・タンパク質の構造・文献情報等、  
様々な生物学のデータを上記のプラットフォームを通じて検索可能

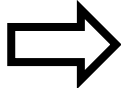
# NCBIのBLASTで外群となる類似配列を検索する

BLAST ... NCBIに保存されているデータの中で類似する配列を検索

ex) どんな種が配列Aの類似配列を持っているか？

配列A

GGGAAAAAACATTTTA  
AAAAAATCTATAAAAAA  
AATAGAATTCATAAAAT  
TCTTGCTTTTCCATATAT  
TGAGCTTCAATTATTTT  
TTTTTCTCATAAAAAGTT  
GCTTTTGGGAAAAAAA  
AAAAAACTCATTTCTAA  
TACCAAACAAGTATTT  
CTTCAGGGAGAGTGC...



Descriptions										Graphic Summary	Alignments	Taxonomy					
Sequences producing significant alignments										Download		Select columns		Show	100		
<input checked="" type="checkbox"/> select all 30 sequences selected										<a href="#">GenBank</a>		<a href="#">Graphics</a>		<a href="#">Distance tree of results</a>		<a href="#">MSA Viewer</a>	
	Description	Scientific Name	Max Score	Total Score	Query Cover	E value	Per. Ident	Acc. Len	Accession								
<input checked="" type="checkbox"/>	<a href="#">PREDICTED: Solanum lycopersicum putative late blight resistance protein homolog R1B-14 (LOC10126636...</a>	<a href="#">Solanum lycopersicum</a>	6231	6231	100%	0.0	100.00%	3374	<a href="#">XM_004248127.5</a>								
<input checked="" type="checkbox"/>	<a href="#">PREDICTED: Solanum pennellii putative late blight resistance protein homolog R1B-14 (LOC107002325), tr...</a>	<a href="#">Solanum pennellii</a>	5749	5749	98%	0.0	98.07%	3309	<a href="#">XM_015200299.2</a>								
<input checked="" type="checkbox"/>	<a href="#">PREDICTED: Solanum pennellii putative late blight resistance protein homolog R1B-14 (LOC107002325), tr...</a>	<a href="#">Solanum pennellii</a>	5557	5557	94%	0.0	98.45%	3179	<a href="#">XM_027912601.1</a>								
<input checked="" type="checkbox"/>	<a href="#">PREDICTED: Solanum tuberosum putative late blight resistance protein homolog R1B-14 (LOC102595315),...</a>	<a href="#">Solanum tuberosum</a>	5142	5142	99%	0.0	94.65%	3305	<a href="#">XM_006366246.2</a>								
<input checked="" type="checkbox"/>	<a href="#">Solanum lycopersicum clone SINRC0 NLR required for cell death 0 mRNA, complete cds</a>	<a href="#">Solanum lycopersicum</a>	4876	4876	79%	0.0	99.70%	2664	<a href="#">PP886667.1</a>								
<input checked="" type="checkbox"/>	<a href="#">PREDICTED: Solanum stenotomum putative disease resistance RPP13-like protein 3 (LOC125866224), tra...</a>	<a href="#">Solanum stenotomum</a>	4752	4752	83%	0.0	99.68%	3362	<a href="#">XM_049346547.1</a>								
<input checked="" type="checkbox"/>	<a href="#">PREDICTED: Solanum stenotomum putative disease resistance RPP13-like protein 3 (LOC125866224), tra...</a>	<a href="#">Solanum stenotomum</a>	4643	4643	81%	0.0	99.15%	3272	<a href="#">XM_049546546.1</a>								
<input checked="" type="checkbox"/>	<a href="#">PREDICTED: Solanum stenotomum putative disease resistance RPP13-like protein 3 (LOC125866224), tra...</a>	<a href="#">Solanum stenotomum</a>	4632	4632	81%	0.0	99.15%	3272	<a href="#">XM_049546548.1</a>								
<input checked="" type="checkbox"/>	<a href="#">PREDICTED: Solanum verrucosum putative late blight resistance protein homolog R1B-14 (LOC125835496),...</a>	<a href="#">Solanum verrucosum</a>	4527	4527	79%	0.0	97.33%	2664	<a href="#">XM_049514631.1</a>								
<input checked="" type="checkbox"/>	<a href="#">PREDICTED: Solanum dulcamara putative disease resistance RPP13-like protein 3 (LOC129877507), mRNA</a>	<a href="#">Solanum dulcamara</a>	4337	4337	81%	0.0	95.13%	3103	<a href="#">XM_055953019.1</a>								
<input checked="" type="checkbox"/>	<a href="#">PREDICTED: Lycium barbarum putative late blight resistance protein homolog R1B-14 (LOC132630207), tra...</a>	<a href="#">Lycium barbarum</a>	4235	4235	80%	0.0	99.21%	3449	<a href="#">XM_060345805.1</a>								
<input checked="" type="checkbox"/>	<a href="#">PREDICTED: Lycium barbarum putative late blight resistance protein homolog R1B-14 (LOC132630207), tra...</a>	<a href="#">Lycium barbarum</a>	4071	4071	79%	0.0	93.22%	3406	<a href="#">XM_060345794.1</a>								
<input checked="" type="checkbox"/>	<a href="#">PREDICTED: Lycium barbarum putative late blight resistance protein homolog R1B-14 (LOC132630207), tra...</a>	<a href="#">Lycium barbarum</a>	4052	4268	92%	0.0	93.39%	3422	<a href="#">XM_060345798.1</a>								

**Solanum lycopersicum**  
**Solanum pennellii**  
**Solanum tuberosum**  
**Lycium barbarum**  
等々

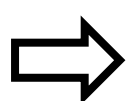
# NCBIのBLASTで外群となる類似配列を検索する

特定の種が持つ遺伝子の中で類似する配列を検索等も可能

ex) *Arabidopsis thaliana*のゲノム中に似た配列があるか？

配列A

GGGAAAAAACATTTTA  
AAAAAATCTATAAAAAA  
AATAGAATTCATAAAAT  
TCTTGCTTTTCCATATAT  
TGAGCTTCAATTATTTTT  
TTTTTCTCATAAAAAGTT  
GCTTTTGGGAAAAAAA  
AAAAAACTCATTTCTAA  
TACCAAACAAGTATTT  
CTTCAGGGAGAGTG...



*Arabidopsis  
Thaliana*  
のみ対象

Descriptions		Graphic Summary		Alignments		Taxonomy															
Sequences producing significant alignments						Download ▾		Select columns ▾		Show 100 ▾		?									
<input checked="" type="checkbox"/> select all 100 sequences selected						<a href="#">GenPept</a>		<a href="#">Graphics</a>		<a href="#">Distance tree of results</a>		<a href="#">Multiple alignment</a>		<a href="#">MSA Viewer</a>							
Description ▾						Scientific Name ▾		Max Score ▾		Total Score ▾		Query Cover ▾		E value ▾		Per. Ident ▾		Acc. Len ▾		Accession	
<input checked="" type="checkbox"/> <a href="#">ZAR1 [Arabidopsis thaliana]</a>						<a href="#">Arabidopsis thali...</a>		180		180		94%		1e-49		31.41%		850		<a href="#">OAP03660.1</a>	
<input checked="" type="checkbox"/> <a href="#">unnamed protein product [Arabidopsis thaliana]</a>						<a href="#">Arabidopsis thali...</a>		179		179		94%		1e-49		31.41%		850		<a href="#">CAA0385601.1</a>	
<input checked="" type="checkbox"/> <a href="#">HOPZ-ACTIVATED RESISTANCE 1 [Arabidopsis thaliana]</a>						<a href="#">Arabidopsis thali...</a>		179		179		94%		1e-49		31.41%		852		<a href="#">NP_190664.1</a>	
<input checked="" type="checkbox"/> <a href="#">myosin heavy chain homolog, partial [Arabidopsis thaliana]</a>						<a href="#">Arabidopsis thali...</a>		179		179		94%		2e-49		31.41%		904		<a href="#">AAA63149.1</a>	
<input checked="" type="checkbox"/> <a href="#">unnamed protein product [Arabidopsis thaliana]</a>						<a href="#">Arabidopsis thali...</a>		179		179		94%		3e-49		31.41%		1306		<a href="#">CAD5325452.1</a>	
<input checked="" type="checkbox"/> <a href="#">unnamed protein product [Arabidopsis thaliana]</a>						<a href="#">Arabidopsis thali...</a>		179		179		94%		3e-49		31.41%		1304		<a href="#">CAD5325453.1</a>	
<input checked="" type="checkbox"/> <a href="#">unnamed protein product [Arabidopsis thaliana]</a>						<a href="#">Arabidopsis thali...</a>		178		178		92%		5e-49		34.87%		837		<a href="#">CAD5325042.1</a>	
<input checked="" type="checkbox"/> <a href="#">unnamed protein product [Arabidopsis thaliana]</a>						<a href="#">Arabidopsis thali...</a>		178		178		92%		5e-49		34.87%		837		<a href="#">VYS59567.1</a>	
<input checked="" type="checkbox"/> <a href="#">unnamed protein product [Arabidopsis thaliana]</a>						<a href="#">Arabidopsis thali...</a>		177		177		96%		1e-48		30.89%		906		<a href="#">CAA0407261.1</a>	
<input checked="" type="checkbox"/> <a href="#">unnamed protein product [Arabidopsis thaliana]</a>						<a href="#">Arabidopsis thali...</a>		177		177		96%		1e-48		31.44%		906		<a href="#">CAA0291745.1</a>	
<input checked="" type="checkbox"/> <a href="#">Disease resistance protein (CC-NBS-LRR class) family [Arabidopsis thaliana]</a>						<a href="#">Arabidopsis thali...</a>		177		177		96%		1e-48		31.44%		906		<a href="#">NP_001319213.1</a>	
<input checked="" type="checkbox"/> <a href="#">hypothetical protein AXX17_AT1G47690 [Arabidopsis thaliana]</a>						<a href="#">Arabidopsis thali...</a>		177		177		96%		1e-48		31.44%		906		<a href="#">OAP11997.1</a>	
<input checked="" type="checkbox"/> <a href="#">unnamed protein product [Arabidopsis thaliana]</a>						<a href="#">Arabidopsis thali...</a>		177		177		96%		1e-48		30.89%		990		<a href="#">CAA0407259.1</a>	
<input checked="" type="checkbox"/> <a href="#">F12M16.25 [Arabidopsis thaliana]</a>						<a href="#">Arabidopsis thali...</a>		177		177		96%		2e-48		31.44%		1584		<a href="#">AAF69538.1</a>	

# NCBIのBLASTで外群となる類似配列を検索する

特定の種が持つ遺伝子の中で類似する配列を検索等も可能

ex) *Arabidopsis thaliana*のゲノム中に似た配列があるか？

より祖先の種に類似配列があれば、外群として利用できる可能性がある

