

Semantic Technologies for Companion Planting

with the CoPla Ontology

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Companion planting

- Benefits:
 - plant growth and health,
 - natural pest deterrent,
 - soil enhancers
- Leverages synergies between plants

Challenges

- Dispersed and multimodal knowledge
- Complex relationships



COMPANION PLANTING
Companion planting can decrease your need for fertilizers and weeding and keep your plants healthy. Here are some benefits for companion planting.

SMELLER

- The larger plants will help protect other smaller plants from being eaten by insects.
- Some smell strong, which repels insects.
- Some have a strong smell that insects like, which attracts them to the larger plants, away from the smaller plants.

REPEL INSECTS

- Some plants have a strong smell that insects don't like.
- Some plants have a strong smell that insects like, which attracts them to the larger plants, away from the smaller plants.

DECOY PLANTS

- Some plants have a strong smell that insects like, which attracts them to the larger plants, away from the smaller plants.

SOIL IMPROVEMENT

- Some plants have a strong smell that insects like, which attracts them to the larger plants, away from the smaller plants.

SUPPORT

- Some plants have a strong smell that insects like, which attracts them to the larger plants, away from the smaller plants.

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BENEFITS OF COMPANION PLANTING

- Attract Beneficial Bugs
- Deter Harmful Bugs
- Discourage Large Pests
- Share Nutrients
- Create Shade
- Mark Other plants

Boost your Harvest by grouping your plants into mutually beneficial relationships.

CUCUMBERS AND BASIL

LETTUCE AND TOMATOES

MARIGOLDS AND ROSES

Try and mix your own!

insects MDPI

Companion Plants for Aphid Pest Management

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Abstract: A potential strategy for controlling pests is through the use of “companion plants” within a crop system. This strategy has been used in several trials to fight against a major crop insect pest: the aphid. We reviewed the literature to highlight the major mechanisms by which a companion plant may act. Trials carried out under laboratory or field conditions revealed that companion plants operate through several mechanisms. A companion plant may be associated with a target crop for various reasons. Firstly, it can attract aphids and draw them away from their host plants. Secondly, it can alter the recognition of the host plant. This effect is mostly attributed to companion plant volatiles since they disturb the aphid host plant location, and additionally they may react chemically and physically with the host plant, making it an unsuitable host for aphids. Thirdly, it can act as a physical barrier between the host plant and the aphid, making it difficult for the aphid to reach the host plant.



Approach: the CoPla ontology





Requirements

R1: include the core concepts;

R2: describe different types of companion and anti-companion relationship;

R3: define properties describing various mechanisms of companion planting;

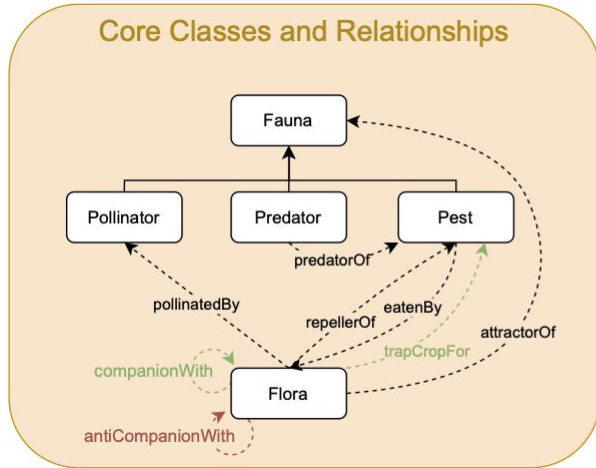
R4: describe qualities of optimal and sub-optimal garden configurations;

R5: model specific plant species and their metadata (common and scientific names)

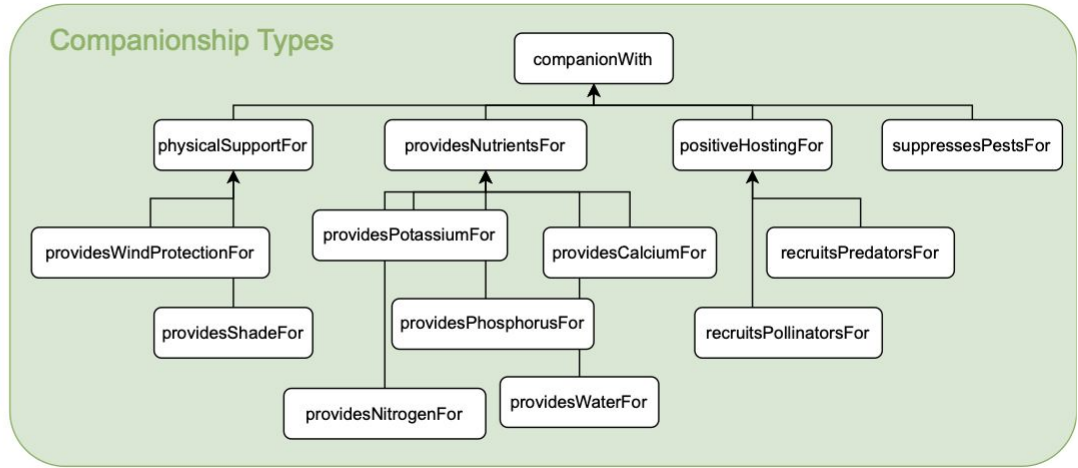


The CoPla ontology

Core Classes and Relationships

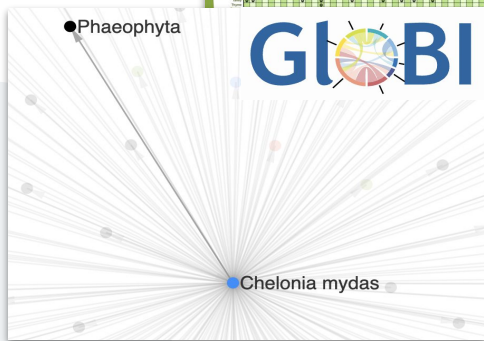
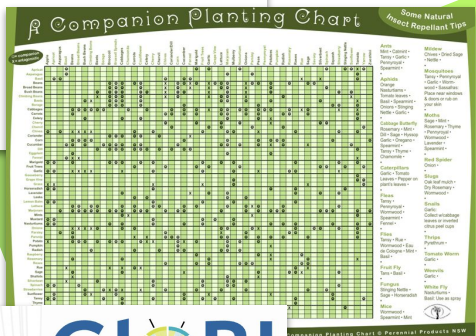
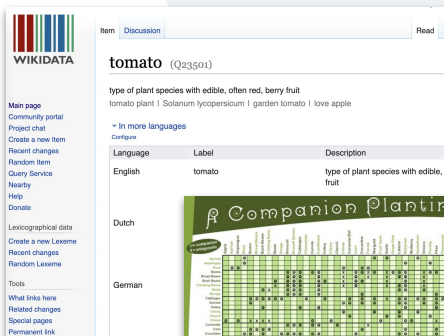


Companionship Types



Data integration

- Companion planting charts
(*Tomato subClassOf Fauna;*
Tomato subClassOf companionWith Beet)
- Wikidata
(*Tomato taxonName "Solanum lycopersicum"*)
- GloBI: Plant-plant, or plant-animal interactions
(*Tomato subClassOf flowersVisitedBy some ApisMellifera;*
ApisMellifera subClassOf pollinates some Beet)
- Books: companionship mechanisms
(*flowersVisitedBy o pollinates subPropertyOf*
recruitsPollinatorsFor)



Show Cases

1. Finding and explaining (anti-) companions
2. Analysing garden configurations
3. Suggesting plant placement

Explanation for Tomato SubClassOf companionWith some Beet

Justification Based Explanation

- Show regular justifications
- Show laconic justifications
- All justifications
- Limit justifications to

Explanation 1 Display laconic explanation

Explanation for: Tomato SubClassOf companionWith some Beet

Tomato SubClassOf flowersVisitedBy some ApisMellifera
ApisMellifera SubClassOf _pollinatedBy some Beet
positiveHostingFor SubPropertyOf: companionWith
flowersVisitedBy o _pollinatedBy SubPropertyOf: recruitsPollinatorsFor
recruitsPollinatorsFor SubPropertyOf: positiveHostingFor

OK

Explanation for Tomato SubClassOf companionWith some Beet

Proofs

ELK Proof, optimized for size

Proof tree for entailment

- Tomato SubClassOf companionWith some Beet
- Class Hierarchy
 - Tomato SubClassOf recruitsPollinatorsFor some Beet
- Existential Composition
 - Tomato SubClassOf flowersVisitedBy some ApisMellifera
 - ApisMellifera SubClassOf _pollinatedBy some Beet
 - flowersVisitedBy o _pollinatedBy SubPropertyOf: recruitsPollinatorsFor
- recruitsPollinatorsFor some Beet SubClassOf companionWith some Beet

OK

Select plants:

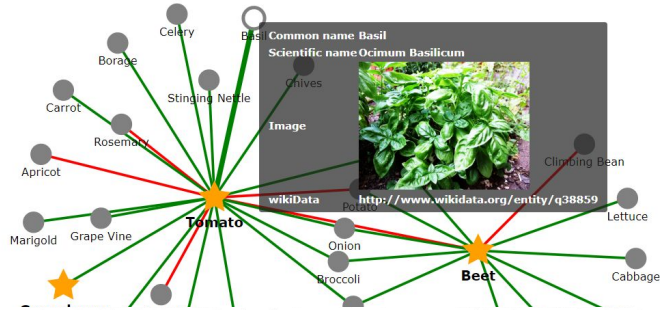
X Gooseberry (Ribes Uva-Crispa) X Beet (Beta Vulgaris) X Tomato (Solanum Lycopersicum)

Check Compatibility

Explore Companions

BETA: Suggest Placement

★ Selected plants ● Other plants — companions — anticompanions



Demo



To sum up...

- The CoPla ontology can help sustainable planting
- CoPla ontology integrates multi-modal data and formally explains garden configuration
- We can contribute to sustainability with the technologies that are already available!

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