



Crop Associations (general)



Crop Associations

Polyculture vs monoculture



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Associations

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- Plants attracting particular beneficials



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- **Trap plants: pennisetum, brachiaria**

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- Trap plants: pennisetum, brachiaria
- **General repellent plants (chilli, ginger, onion, garlic, tagetes, nasturtium).**
- Specific repellent plants: onion, desmodium
- In case of destruction of a crop by a pest, the associated crop will be able to compensate this loss.

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Associations

Benefits of pest control

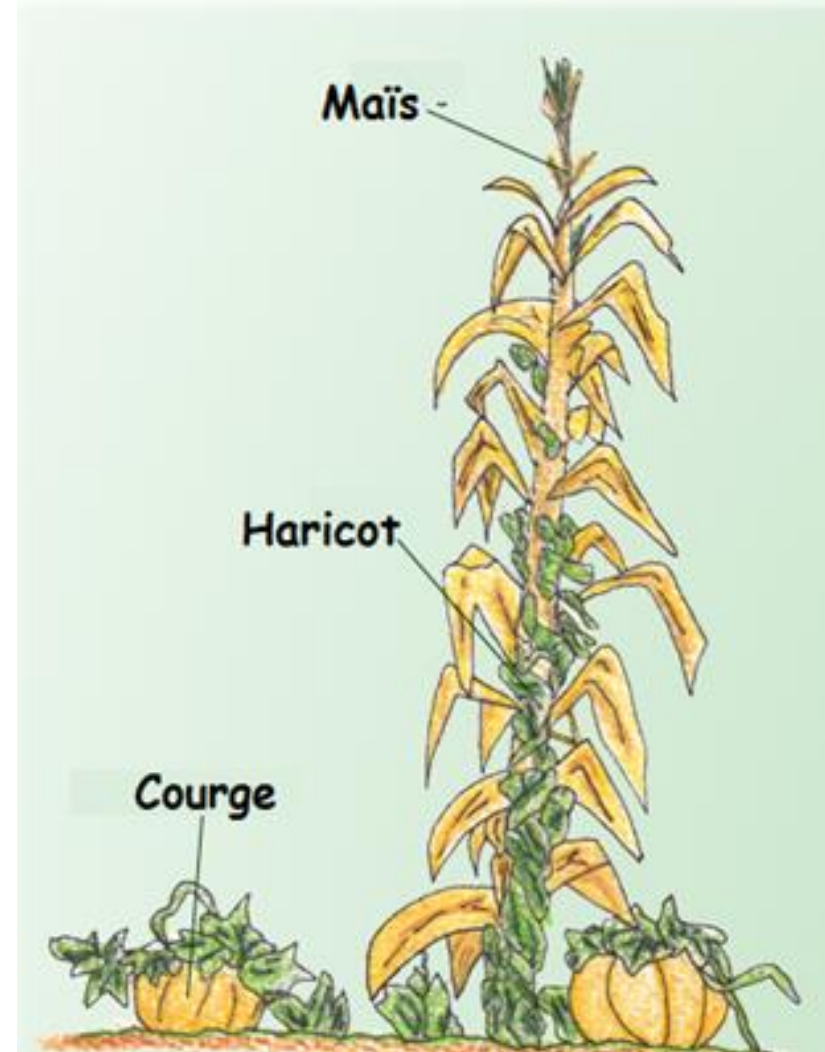
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Crop Associations

Benefits not related to pest control

- Better soil cover
- Better use of space
- Better use of soil resources
- Diversification of production
- Harvesting at different times
- Higher yields than a monoculture

To summarize: complementarity of associated species



Crop Association

Effectiveness of an association

- Measure taken with the "LER" Land Equivalent Ratio

$$LER = \frac{\text{Crop yield } A_{\text{associated}}}{\text{Crop yield } A_{\text{monoculture}}} + \frac{\text{Crop yield } B_{\text{associated}}}{\text{Crop yield } B_{\text{monoculture}}}$$

LER > 1: Crop association is more productive than monoculture

LER = 1: There is no advantage to a crop association over a monoculture

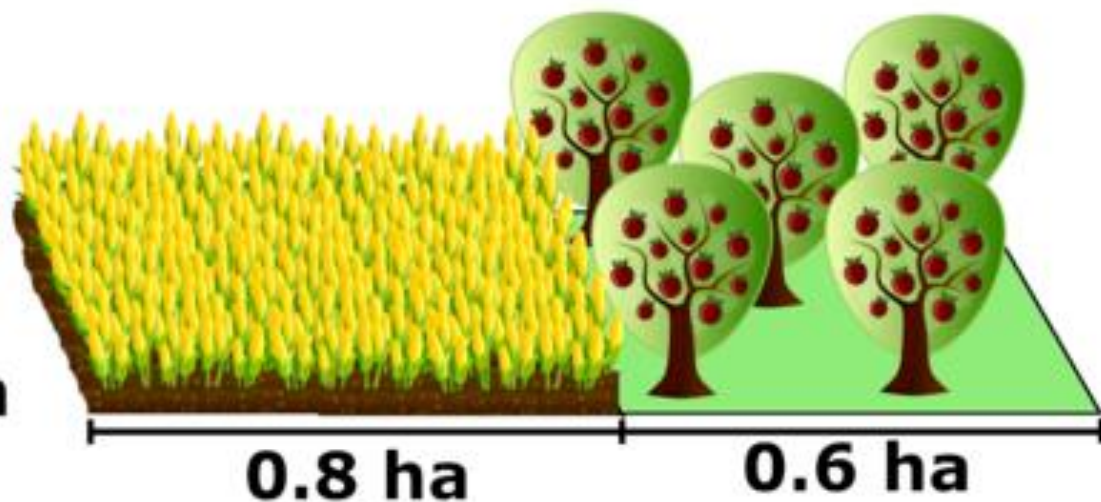
LER < 1: Crop association is less productive than monoculture

Example calculation for Land Equivalent Ratio (LER)

Monoculture:

Grain: 5t/ha

Fruit: 15t/ha



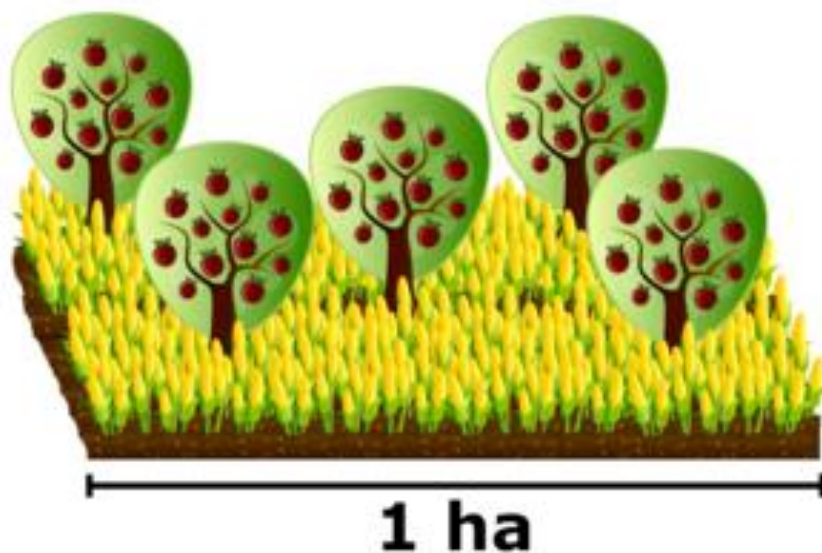
$$5\text{t/ha} \times 0.8\text{ha} \\ = 4\text{t/ha} \times 1\text{ha}$$

$$15\text{t/ha} \times 0.6\text{ha} \\ = 9\text{t/ha} \times 1\text{ha}$$

Polyculture:

Grain: 4t/ha

Fruit: 9t/ha



**1 ha of polyculture
produces as much
grain and fruit as
1.4 ha of monoculture
(LER = 1.4)**

Cereal-legume associations

Association known and practiced throughout the world for thousands of years

Complementarity in:

- Space
 - Erect cereal vs. bushy or climbing legumes
- Root systems
 - deep and powerful system of cereals vs superficial system of legumes
- Nitrogen use
 - High N uptake by cereals, forcing legumes to promote biological fixation
- Phosphorus use
 - Capacity of legumes to mobilize P

Cereal-legume associations

- Some possibilities of cereal-legume associations...

Cereal	Density [cm x cm]	Legume	Density [cm x cm]
Corn	100 x 40	Soybeans	100 x 5
	80 x 40	Peanut	80 x 30
	100 x 40	Cowpea	100 x 25
	100 x 40	Green beans	100 x 20
Sorgo	80 x 20	Peanut/potato	80 x 30
	100 x 20	Niebe	100 x 25
	100 x 20	Green beans	100 x 20
Wheat	50 x 3	Chickpea	50 x 10
Barley	25 x 30	Peas	25 x 3

CEREAL-LEGUME ASSOCIATION

THE 3 SISTERS OR MILPA

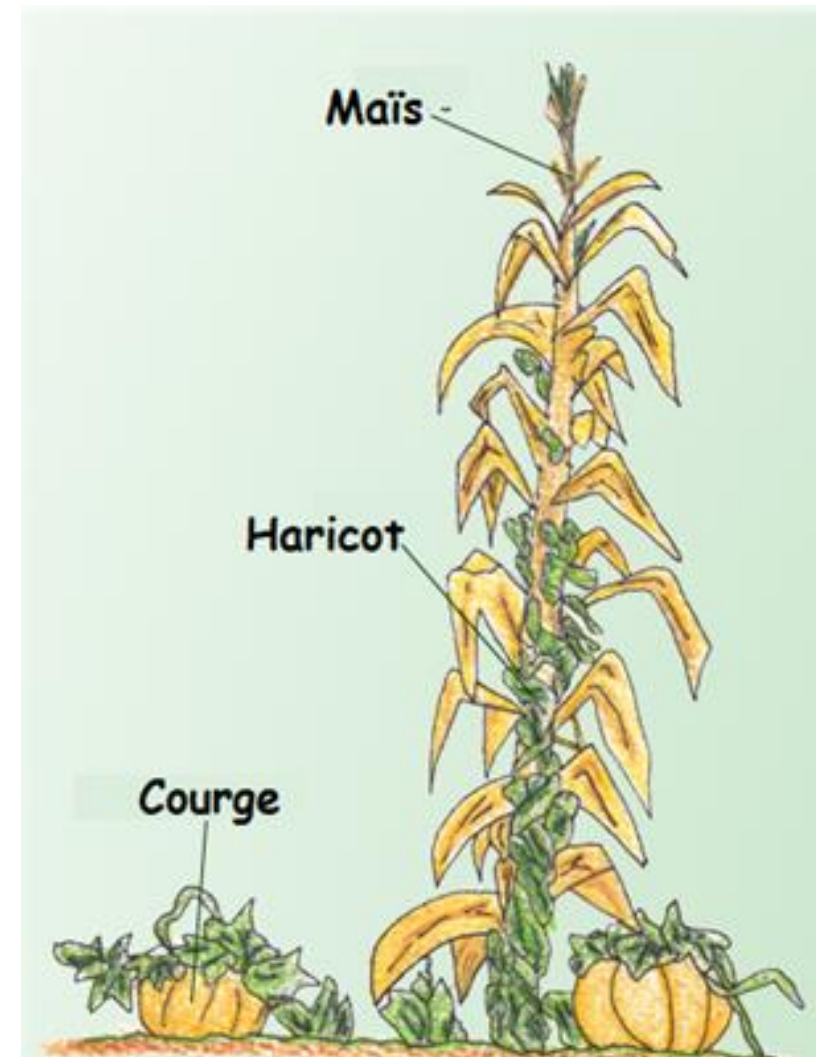
Corn, climbing bean and squash

Traditional association of the Maya of Central America

Corn as a stake for climbing beans

➤ Density of a corn crop equal to a monoculture

Soil cover optimized by squash



Spacing:

Corn : 75 x 40 cm

Climbing bean: 75 x 20 cm

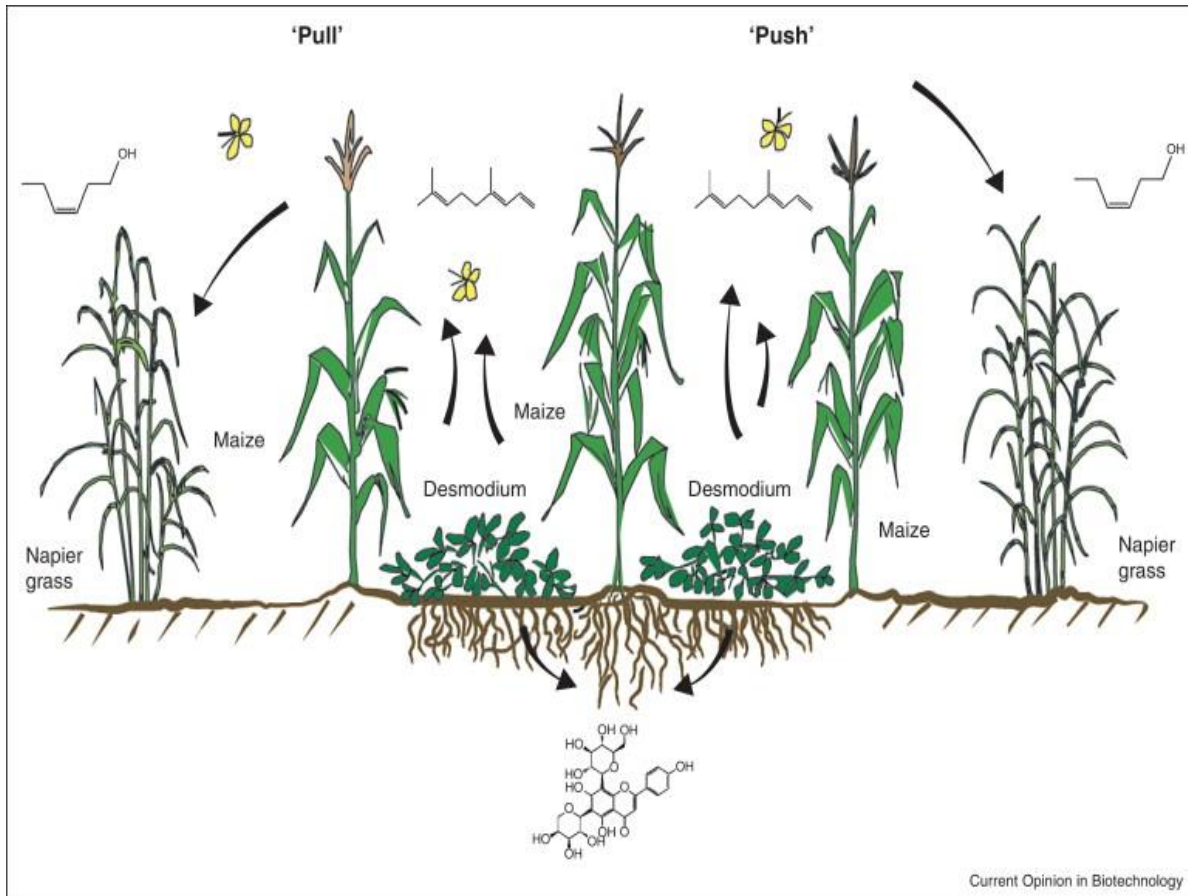
Squash : 75 x 250 cm



Cereal-legume association

Push-Pull

Pest and striga control in cereals



- Desmodium: repels stem borers and armyworms. (PUSH)
- Pennisetum/brachiaria: attracts and traps these pests (PULL)
- Desmodium also leguminous: nitrogen fixation.
- Desmodium controls striga
- Desmodium and pennisetum/brachiaria quality fodder

CEREAL-LEGUME ASSOCIATION

RAINFED RICE AND STYLOSANTHES

Allows rain fed rice to be grown in arid environments.

Allows to regenerate the soil while producing rice and fodder.

Ideal combination for:

- Optimal and permanent soil cover
- Fodder production in dry season



Spacing:

Rice: double rows spaced 40 cm apart,
20 x 20 cm

Stylosanthes: 60 x 30 cm

Seeds per bed:

Rice: 3-5

Stylosanthes: 7-12

Vegetable associations

Pest repellent species

- **Onions, garlic and other alliums: suitable for small, uncompetitive crops**



Vegetable associations

Pest repellent species

- **Ginger, Turmeric**
- **Mint**
- **Lemongrass**



Vegetable associations

Pest repellent species

- **Aromatic herbs (lamiaceae): basil, thyme, oregano, savory**



Vegetable associations

Pest repellent species

- **Tagetes, nasturtium: repels white flies and protects solanaceae.**



Vegetable associations

Generalities

- Alliaceae (garlic, onion) protect Apiaceae (carrot, celery).
- Tagetes and nasturtiums protect Solanaceae and Brassicas.
- Aromatic herbs (Lamiaceae) protect almost all vegetables.

Vegetable associations

Generalities

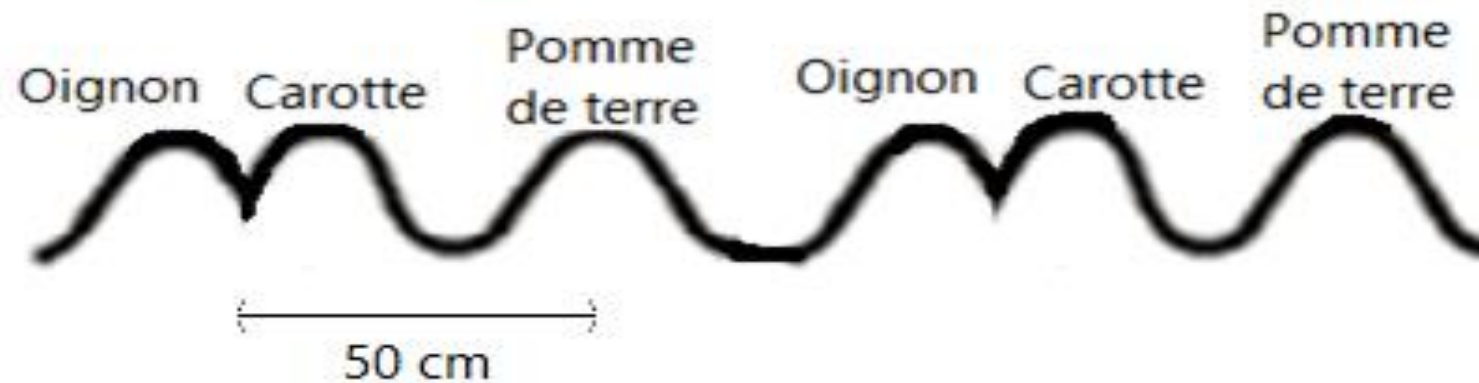
- Alliums have a negative impact on legumes.
- Brassicas have a negative impact on rosaceous plants (strawberry).
- Solanaceae-brassicaceae associations are often unfavorable (except potatoes).
- Associations within the same family are very rarely favorable.

Vegetable Associations

	Basil	Beetroot	Cabbage	Carrot	Celery	Courgette	Cucumber	Eggplant	Garlic	Green Beans	Leek	Lettuce	Marigold	Mashua	Melon	Okra	Onion	Parsley	Peas	Pepper	Potatoes	Radish	Squash	Tomato
Basil	Grey	Green				Green	Green	Green							Green					Green			Green	Green
Beetroot	Green	Grey	Green	Red	Green			Red		Red	Red	Green					Green			Red				Red
Cabbage		Green	Grey			Green	Green	Green	Red	Green	Red	Green		Green			Red		Green	Green	Green	Red	Green	
Carrot				Grey	Yellow			Green	Green	Green	Green						Green	Yellow			Green	Green		Green
Celery		Green	Green		Grey	Green	Green	Green		Green	Green						Green		Green	Green	Green	Green	Green	Green
Courgette	Green		Green		Green	Grey	Yellow			Green		Green		Green	Yellow		Green		Green	Green	Green	Red	Yellow	
Cucumber	Green		Green		Green	Yellow	Grey			Green		Green			Yellow		Green		Green	Green	Red	Green	Yellow	
Eggplant	Green	Red		Green	Green			Grey	Green	Red	Green		Green	Green		Green		Green	Red					
Garlic			Red	Green				Green	Grey	Red	Yellow						Yellow		Red	Green	Green			Green
Green Beans			Green	Green	Green	Green	Green	Red	Red	Grey	Green				Green		Red		Green	Green	Green	Green	Green	Red
Leek		Red	Red	Green				Green	Yellow	Green	Grey						Green	Red	Red	Green				Green
Lettuce		Green	Green			Green	Green			Green		Grey					Green		Green	Green		Green	Green	
Marigold								Green					Grey							Green				Green
Mashua			Green			Green		Green						Grey	Green					Green	Green	Green	Green	Green
Melon	Green		Green	Green	Green	Yellow	Yellow			Green		Green		Green	Grey		Green		Green	Green	Green		Yellow	Green
Okra								Green								Grey				Green				
Onion		Green	Red	Green	Green	Green	Green	Green	Yellow	Red	Green				Green		Grey		Red	Green			Green	Green
Parsley				Yellow	Red			Green			Red	Red						Grey		Red	Green	Green		Green
Peas			Green		Green	Green	Green	Red	Red	Green	Red	Green			Green		Red	Red	Grey	Red	Green	Green	Green	Red
Pepper	Green	Red		Green	Green			Yellow	Green		Green		Green	Green		Green	Green	Green	Red	Grey	Yellow			Yellow
Potatoes			Green		Green	Green		Yellow	Green	Green		Green		Green	Green				Green	Yellow	Grey		Green	Yellow
Radish				Green			Green			Green		Green		Green				Green	Green	Green		Grey		Green
Squash	Green		Green		Green	Yellow	Yellow			Green		Green		Green	Yellow		Green		Green	Green	Green		Grey	
Tomato	Green	Red		Green	Green			Yellow	Green	Red	Green		Green	Green			Green	Green	Red	Yellow	Yellow	Green		Grey

Potato, onion and carrot

- Onions effectively repel the carrot fly *Psilia rosa*.
- Carrot-onion ridges limit the spread of potato fungal diseases.



Questions?

