

Alternative and Sustainable Pest Management

Researched and compiled by Aminah Hassoun

I. Introduction and Statement of Purpose

Food grows in dirt. It goes without having to mention that all soil has its fair share of bugs and critters. And while the inclination of most inexperienced food growers may be to kill all pests, these very bugs are the evidence of a healthy organic garden. Sustainable food gardening inevitably puts to use natural and organic methods to control garden pests which take into account the health of the affected ecosphere. Gardening methods such as integrated pest management, companion planting, and the use of noninvasive tools undoubtedly promote and maintain the integrity of the garden— including water and soil quality, and increase the beneficial value of the food. While much of these practices come with years of gardening experience, a few simple methods can add to the prosperity of any growing garden.

As opposed to the popular use of non-organic methods such as herbicides and pesticides in today's farming practices, the practices of the Community Garden at California Lutheran University should carry an understood responsibility for the Earth, and focus on minimizing the harmful effects caused to the biotic community. CLU carries a commitment to education, leadership, and justice, as well as a growing mission to promote sustainability and stewardship. The practices of the CLU Community Garden—including the use of pest management, should reflect the identity and mission of the University, and above all, ensure the integrity of all those involved.

II. Pest Identification and Solutions

Garden pests include harmful or destructive insects, small animals such as rodents and birds, and invasive plants like weeds. For the purpose of this project, larger animals which can potentially be identified as 'pests' like deer, coyotes, racoons, and possibly uninvited human intruders are to be addressed through fencing options and other deterrent techniques.

Insects

Squashing bugs is a relatively easy task, but for the purpose of an organic garden it is not the most desirable solution, especially since *not all bugs are bad!* In fact, there is an entire catalogue of “working” insects that are extremely beneficial to a vegetable garden. By introducing and harboring good insects that feed on pests, the amount of 'bad' insects can be greatly minimized without the use of harmful pesticides. The obvious list of harmful insects includes: snails, slugs, aphids, white grub (june beetle larva), grasshoppers, (some) beetles, and earwigs.

Pests in the form of destructive insects can be addressed several different ways, the most beneficial is to attract beneficial insects that prey on the harmful ones. The most comprehensive method is through integrated pest management and companion planting of both vegetables and flowers.

1. Companion Planting: used mainly in small-scale gardens, this method is described as the planting or establishment of two or more plant species in close proximity to maximize the beneficial impact of biodiversity (pest control, disease resistance, higher crop yield, etc) as well as improving the

aesthetic appeal of the garden. Scientific study has confirmed that some combinations have actual benefit to plants' integrity, and provide for mutual benefit; the practical experience of organic gardeners have also seen real successes with this planting method. A compiled list of suggested combinations is provided below:

Alfalfa: Perennial that roots deeply. Fixes the soil with nitrogen, accumulates iron, magnesium, phosphorous and potassium. Withstands droughts with its long taproot and can improve just about any soil! Alfalfa has the ability to break up hard clay soil and can even send its' roots through rocks. Alfalfa is practically pest and disease free, and especially deters weeds; spreading alfalfa as mulch is also effective in curtailing the spread of weeds.

Anise: Licorice flavored herb, good host for predatory wasps which prey on aphids and it is also said to repel aphids. Deters pests from brassicas by camouflaging their odor. Improves the vigor of any plants growing near it. Used in ointments to protect against bug stings and bites. Good to plant with coriander.

Basil: Plant with tomatoes to improve growth and flavor. Basil also does well with peppers, oregano, asparagus and petunias. Basil can be helpful in repelling thrips. It is said to repel flies and mosquitoes.
Opal basil: An annual herb that is pretty, tasty and said to repel hornworms. Like the other basil it also does well with peppers, oregano, asparagus and petunias. (Do not plant either near rue or sage).

Bay leaf: Can be sprinkled as dried leaves with other deterrent herbs on a garden as natural insecticide dust. A good combination: Bay leaves, cayenne pepper, tansy, and peppermint.

Beans: All bean enrich the soil with nitrogen fixed from the air. In general they are good company for carrots, celery, chards, corn, eggplant, peas, potatoes, brassicas, beets, radish, strawberry and cucumbers. Beans are great for heavy nitrogen users like tomatoes. Summer savory beans deter bean beetles and improve growth and flavor.

Bee balm(Oswego, Monarda): Plant with tomatoes to improve growth and flavor. Great for attracting beneficials and bees of course. Pretty perennial that tends to get powdery mildew.

Beet: Good for adding minerals to the soil. The leaves are composed of 25% magnesium making them a valuable addition to the compost pile if you don't care to eat them. Beets are also beneficial to beans with the exception of runner beans. Runner or pole beans and beets stunt each other's growth. Companions for beets are lettuce, onions and brassicas. Beets and kohlrabi grow perfectly together. Beets are helped by garlic and mints. Garlic improves growth and flavor. Rather than planting invasive mints around beets use your mint clippings as a mulch.

Borage: Companion plant for tomatoes, squash, strawberries and most plants. Deters tomato hornworms and cabbage worms. One of the best bee and wasp attracting plants. Adds trace minerals to the soil and a good addition to the compost pile. The leaves contain vitamin C and are rich in calcium, potassium and mineral salts. Borage may benefit any plant it is growing next to via increasing resistance to pests and disease. It also makes a nice mulch for most plants. Borage and strawberries help each other and strawberry farmers always set a few plants in their beds to enhance the fruits flavor and yield. Plant near tomatoes to improve growth and disease resistance. After you have planned this annual once it will self-seed. Borage flowers are also edible.

Cabbage: Celery, dill, onions and potatoes are good companion plants. Celery improves growth and

health. Clover interplanted with cabbage has been shown to reduce the native cabbage aphid and cabbageworm populations by interfering with the colonization of the pests and increasing the number of predatory ground beetles. Plant Chamomile with cabbage to improve growth and flavor. Cabbage does not get along with strawberries, tomatoes, peppers, eggplants, rue, grapes and pole beans.

Carrots: Work well with leaf lettuce, onions and tomatoes. Plant dill and parsnips away from carrots. Flax produces an oil that may protect root vegetables like carrots from some pests. One drawback with tomatoes and carrots: tomato plants can stunt the growth of your carrots but the carrots will still be of good flavor.

Catnip: Deters flea beetles, aphids, Japanese beetles, squash bugs, ants and weevils. It has also been found to repel mice quite well; but be careful, on the flip side, this may attract cats...

Celery: Companions include beans, cabbage, leek, onion, spinach and tomato. Flowers to plant near celery are cosmos, daisies and snapdragons.

Chards: Companions include bean, cabbage family, and onion.

Chervil: Companion to radishes, lettuce and broccoli for improved growth and flavor. Also keeps aphids off lettuce and is said to deter slugs. Grows best in shade.

Chives: Improves growth and flavor of carrots and tomatoes. A friend to carrots, tomatoes, brassica (broccoli, cabbage, mustard, etc) and many others. Helps to keep aphids away from tomatoes, mums and sunflowers. Chives may drive away Japanese beetles and carrot rust flies. Avoid planting near beans and peas.

Chrysanthemums: *C. coccineum* kills root nematodes. (the bad ones) Its flowers along with those of *C. cinerariaefolium* have been used as botanical pesticides for centuries. (i.e. pyrethrum) White flowering chrysanthemums repel Japanese beetles. Costmary is a 2-3 foot tall perennial of the chrysanthemum family helps to repel moths.

Clover: Long used as a green manure and plant companion and is especially good to plant under grapevines. Attracts many beneficials. Useful planted around apple trees to attract predators of the woolly aphid. Clover interplanted with cabbage has been shown to reduce the native cabbage aphid and cabbageworm populations by interfering with the colonization of the pests and increasing the number of predator ground beetles.

Coriander: Repels aphids, spider mites and potato beetles. A tea from this can be used as a spray directly on crops for spider mites. A good companion for anise.

Cucumbers: Cucumbers are great to plant with beans because they both like the same conditions (warmth, rich soil and plenty of moisture). A great pairing is to plant cukes with sunflowers. The sunflowers provide a strong support for the vines. Cukes also do well with peas, beets, radishes and carrots. Radishes are a good deterrent against cucumber beetles. Dill planted with cucumbers helps by attracting beneficial predators. Keep sage, potatoes and rue away from cucumbers.

Dahlias: Aside from being a beautiful garden addition, these flowers repel (bad) nematodes.

Eggplant: Plant with amaranth, beans, peas, spinach, tarragon, thyme and marigold. Eggplant is a member of the nightshade family and does well with peppers.

Garlic: Plant near roses to repel aphids. It also benefits apple trees, pear trees, cucumbers, peas, lettuce, and celery. Garlic accumulates sulfur: a naturally occurring fungicide which will help in the garden with disease prevention. Garlic is systemic in action as it is taken up the plants through their pores and when garlic tea is used as a soil drench it is also taken up by the plant roots. Has value in offending codling moths, Japanese beetles, root maggots, snails, and carrot root fly. Researchers have observed that time-released garlic capsules planted at the bases of fruit trees actually kept deer away. Concentrated garlic sprays have been observed to repel and kill whiteflies, aphids and fungus gnats among others with as little as a 6-8% concentration. It is safe for use on orchids too.

Geranium: Repels cabbage worms and Japanese beetles, plant around grapes, roses, tomatoes, peppers and cabbage. Geraniums also help to distract beet leafhoppers away from green vegetables.

Gopher (S)purge: Deters gophers, and moles. (caution: plant's sap can cause skin irritation for humans).

Kelp: When used in a powder mixture or tea as a spray, this versatile sea herb will not only repel insects but feed the vegetables. In particular, kelp foliar sprays keep aphids and Japanese beetles away when used as a spray every 8 days before and during infestation times. The use of seaweed as a mulch is effective in keeping slugs away.

Kohlrabi: May be planted with cucumber, onion and chives. Kohlrabi and beets are perfect to grow with one another. Do not plant kohlrabi with pole beans, pepper, strawberry or tomatoes.

Lamium: This will repel potato bugs- a big problem for many gardeners!

Lavender: Repels fleas and moths. Prolific flowering lavender nourishes many nectar feeding and beneficial insects. Lavenders can protect nearby plants from insects such as whitefly, and lavender planted under and near fruit trees can deter codling moth. Use dried sprigs of lavender to repel moths.

Lettuce: Does well with beets, bush beans, pole beans, cabbage, carrots, cucumbers, onion, radish and strawberries. It grows happily in the shade under young sunflowers.

Marigolds: (Calendula) Given a lot of credit as a pest deterrent. Keeps soil free of bad nematodes; supposed to discourage many insects. Plant freely throughout the garden. The marigolds you choose must be a scented variety for them to work. One down side is that marigolds do attract spider mites and slugs. **Mexican marigold** (T. minuta) is the most powerful of the insect repelling marigolds and may also overwhelm weed roots such as bind weed. It is said to repel the Mexican bean beetle and wild rabbits. Be careful, it can have an herbicidal effect on some plants like beans and cabbage. **French Marigold** (T. patula) has roots that exude a substance which spreads in their immediate vicinity killing nematodes. For nematode control you want to plant dense areas of them. There have been some studies done that proved this nematode killing effect lasted for several years after the plants were removed. These marigolds also help to deter whiteflies when planted around tomatoes and can be used in greenhouses for the same purpose. Do not plant French marigolds next to bean plants.

Marjoram: As a companion plant it improves the flavor of vegetables and herbs. Sweet marjoram is the most commonly grown type.

Mint: Deters white cabbage moths, ants, rodents, flea beetles, fleas, aphids and improves the health of cabbage and tomatoes. Use cuttings as a mulch around members of the brassica family. Mint flowers attract hoverflies and predatory wasps. Earthworms are also attracted to mint plantings. Be careful where you plant it as mint is an incredibly invasive perennial, and spreads wildly. A suggested location to plant mint is near a water faucet, or hose main; it will grow freely from the amount of water lost to due to faucet leaks, and wont affect the other crops.

Morning glories: attract hoverflies, and overall beautiful flowering plant.

Nasturtiums: an excellent companion for many plants including radishes, cabbage, collards, cauliflower, kale, kohlrabi, broccoli and mustards. Effective in deterring aphids, squash bugs, and striped pumpkin beetles, and improving growth and flavor. Plant as a barrier around tomatoes, cabbage, cucumbers, and under fruit trees. Deters woolly aphids, whiteflies, cucumber beetles and other pests of the cucurbit family. Great trap crop for aphids (in particular the black aphids) which it does attract, especially the yellow flowering varieties. It likes poor soil with low moisture and no fertilizer. Keeping that in mind there is no reason not to set potted nasturtiums among your garden beds. It has been the practice of some fruit growers that planting nasturtiums every year in the root zone of fruit trees allow the trees to take up the pungent odor of the plants and repel bugs. Studies say it is among the best at attracting predatory insects. It has no taste effect on the fruit. A nice variety to grow is Alaska which has attractive green and white variegated leaves. The leaves, flowers and seeds of nasturtiums are all edible too!

Okra: (*Hibiscus esculentus*) Plant lettuce around your okra plants and they will shade the lettuce in the summer giving you some more growing time. Okra also does well with peppers and eggplants as it helps protect these brittle stemmed plants from high winds. It also gets along with basil, cucumbers, melons, and black eyed peas. For planting with the peas, plant the Okra first. When the okra is up and established plant the peas around the edges of the okra planting. You may find that the peas are far less bothered by aphids when near okra.

Onions: Planting chamomile and summer savory with onions improves their flavor. Other companions are carrot, leek, beets, kohlrabi, strawberries, brassicas, dill, lettuce and tomatoes. Intercropping onions and leeks with your carrots confuses the carrot and onion flies. Onions planted with strawberries help the berries fight disease. Keep onions away from peas and asparagus.

Oregano: Can be used with most crops but especially good for cabbage. Plant near broccoli, cabbage and cauliflower to repel cabbage butterfly and near cucumbers to repel cucumber beetle.

Parsley: Works well with asparagus, carrot, chives, onions, roses, and tomato. Also affective to spread the leaves on tomatoes and asparagus, or as a tea to ward off asparagus beetles. Parsley increases the fragrance of roses when planted around their base. Rose problems?

Peas: Like other beans, peas fix nitrogen in the soil. Companions for peas are bush beans, pole beans, carrots, celery, chicory, cucumber, eggplant, parsley, radish, spinach, strawberry, sweet pepper and turnips.

Peppermint: Repels white cabbage moths, aphids and flea beetles. It is the menthol content in mints that acts as an insect repellent. Bees and other good bugs love it too.

Peppers, Bell (Sweet Peppers): Plant peppers near tomatoes, parsley, basil, geraniums, marjoram, lovage, petunia and carrots. Onions make an excellent companion plant for peppers. They do quite well with okra as it shelters them and protects the brittle stems from wind.

Peppers, Hot: Chili peppers have root exudates that prevent root rot and other fusarium diseases. While you should always plant chili peppers close together, providing shelter from the sun with other plants will help keep them from drying out and provide more humidity. Tomato plants, green peppers, and okra are good protection for them. Teas made from hot peppers can be useful as insect sprays. Hot peppers like to be grouped with cucumbers, eggplant, tomato, okra, Swiss chard and squash. Herbs to plant near them include basil, oregano, parsley, and rosemary. Never put them next to any beans, broccoli, cabbage, cauliflower, Brussels sprouts or fennel.

Petunias: They repel the asparagus beetle, leafhoppers, certain aphids, tomato worms, Mexican bean beetles and general garden pests. A good companion to tomatoes, but also great anywhere. The leaves can be used in a tea to make a potent bug spray.

Pumpkins: Pumpkin great with melons and squash. Marigold deters beetles that attack pumpkins, and nasturtium deters bugs, beetles. Oregano provides general pest protection, as well.

Radish: *One of the workhorses for the garden.* Companions for radishes are: radish, beet, broccoli, bush beans, pole beans, carrots, chervil, cucumber, lettuce, melons, nasturtium, parsnip, peas, spinach and members of the squash family. Radishes may protect squash plants from squash borers. Radishes are a deterrent against cucumber beetles and rust flies. Chervil and nasturtium improve radish growth and flavor. Radishes will lure leafminers away from spinach. The damage the leafminers do to radish leaves does not stop the radish roots from growing, providing for a win-win situation.

Rhubarb: A good companion to all brassicas. Planting cabbage and broccoli plants near rhubarb patch will help them thrive. Rhubarb also protects beans against black fly. Some other interesting companions for rhubarb are columbine flowers, garlic, onion and roses. It helps deter red spider mites from the columbines. A spray made from boiled rhubarb leaves, which contain the poison oxalic acid may be used to prevent blackspot on roses and as an aphicide.

Rosemary: Companion plant to cabbage, beans, carrots and sage. Deters cabbage moths, bean beetles, and carrot flies. Use cuttings to place by the crowns of carrots for carrot flies.

Sage: Use as a companion plant with broccoli, cauliflower, rosemary, cabbage, and carrots to deter cabbage moths, beetles, black flea beetles and carrot flies. Do not plant near cucumbers, onions or rue. Sage repels cabbage moths and black flea beetles. Allowing sage to flower will also attract many beneficial insects and the flowers are pretty. There are some very striking varieties of sage with variegated foliage that can be used for their ornamental as well as practical qualities.

Spinach: Plant with peas and beans as they provide natural shade for the spinach. Gets along with cabbage, cauliflower, celery, eggplant, onion, peas, and strawberries.

Soybeans: They add nitrogen to the soil making them a good companion to corn. They repel chinch bugs and Japanese beetles.

Squash: Companions include cucumbers, icicle radishes, melon, and pumpkin. Borage deters worms from squash plants, and improves growth and flavor. Marigolds deters beetles. Nasturtium deters squash bugs and beetles. Oregano provides general pest protection.

Strawberry: Friends are beans, borage, lettuce, onions, spinach and thyme. Borage strengthens resistance to insects and disease, and thyme, as a border, deters worms.

Sunflowers: Planting sunflowers with corn is said by some to increase the yield. Highly effective against aphids, and sunflowers are so tough that the aphids cause very little damage to the seed heads, leaving them intact. Sunflowers also attract hummingbirds which eat whiteflies.

Tarragon: Plant throughout the garden, not many pests like this one. Recommended to enhance growth and flavor of vegetables.

Thyme: Deters cabbage worms, and commonly used as ground-cover to deter weeds.

Tomatoes: Tomato allies include asparagus, basil, bean, carrots, celery, chive, cucumber, garlic, head lettuce, marigold, mint, nasturtium, onion, parsley, pepper, marigold, pot marigold, and sow thistle. One drawback with tomatoes and carrots, tomato plants can stunt the growth of your carrots but the carrots will still be of good flavor. Basil helps repel flies and mosquitoes, improves growth and flavor. Bee balm, chives and mint improve health and flavor. Borage deters tomato worm, improves growth and flavor. Dill, until mature, improves growth and health, mature dill retards tomato growth.

Wormwood: Keeps animals out of the garden when planted as a border. An excellent deterrent to most insects. Don't plant wormwood with peas or beans. Note: wormwood actually produces a botanical poison do not use it directly on food crops.

Yarrow: has insect repelling qualities and is an excellent natural fertilizer. A handful of yarrow leaves added to the compost pile really speeds up the composting process. It also attracts predatory wasps and ladybugs. It may increase the essential oil content of herbs when planted among them.

Zinnia: attract hummingbirds which eat whiteflies. Alternately the pastel varieties of zinnias can be used as a trap crop for Japanese beetles. All zinnias attract bees and other insect pollinators.

2. Insect Traps: most effective for large bug infestations, and can be used to combat many types of insects from moths to slugs. Bug traps are available in a variety of forms; note that some of them use harsh pesticides and chemicals while others are simple container-like traps. The important part is to make sure that any insect traps used for the purpose of this garden are safe, efficient, and non-toxic. Several examples of popular products are listed below:

Slug Saloon/ Snailer: These products are small green canisters which are placed throughout the garden. As their names suggest, they mainly attract snails and slugs, but also earwigs and sowbugs. The products contain a non-toxic bait made of food-grade ingredients which does have to be replaced on a monthly basis. The average cost ranges from \$6 to \$8 for each.

Sticky Paper: hang vertically above plants primarily to attract aphids, whiteflies, gnats, flies, and leafhoppers. These traps will not repel bugs and only minimally eliminate the bugs which find themselves stuck to the paper, but generally, this is a relatively inexpensive technique used to monitor the types of insects surrounding plants.

Fly/Moth Traps: hang in areas of high pest concentration to trap insects. Prices range from \$5 to \$15 per kit.

3. Protection of Plants and Sprout-lings: one of the most vital stages of a garden is the process of ensuring that sprouts are protected in the early stages of their planthood. It is important never to underestimate the impact that insects and pests can have on vulnerable baby plants and delicate sprouts. **Screens** that cover plants (especially leafy plants!) provide a deterrent to bugs which can not find their way under a properly placed plant barricade. A functioning screen can be constructed by attaching a mesh/screening material to a simple frame made of metal rods, chicken wire, or strips of wood. After the spouts appear to be sturdy enough, the screens can be removed or continually used for increased protection. Make sure all screening devices are weighed down to resist being carried off by the wind.

Birds:

Though it may not seem possible, birds can be as destructive as insects to any garden. What's more, bugs can actually attract birds which feed on the insects, but can also do damage to newly planted seeds by eating those too! It's no wonder most gardens have some kind of scarecrow device to ward off birds, especially when planting is at its initial stages. While the general rule may be to rid a garden of birds altogether, realistically this isn't always possible—not to mention, the word among gardeners is scarecrows don't work. Small birds can be a great help in a garden by eating bugs (especially grub and caterpillars) that do significant damage to gardens.

1. Scare Tactics: A newly seeded bed should always be protected. An easy and portable method involves hanging strips of reflective plastic or streamers from a line above the bed. As the strips blow in the wind, birds are scared away by the change in light as it reflects off the shiny surface. Another obvious solution is to simply cover the beds entirely with mesh screening until the plants can support themselves. Additionally, any sort of moving objects placed around a garden like wind chimes or flags made of fabric attached to a pole, can deter birds from approaching a garden.

2. Invitations That Go A Long Way: There's nothing more harmonious than a few chirping birds in a garden to liven up the place! To keep birds from eating newly planted seeds while also encouraging them into a garden to eat all those pesky bugs, there is no greater way to invite them than to put up a bird-feeder. By placing a bird-feeder around a garden (away from the plants), birds can quickly become regular visitors of the feeders instead of the plants in your garden. Another option is to put in a birdbath, but be careful that stagnant water doesn't become a home for mosquitos or other unintended guests.

Weeds:

A weedless garden starts with good soil and lots of elbow-grease. The important thing to consider is clearing out any weeds prior to planting anything. As the soil is prepared and amended, remove any

weeds or remnants of weeds to ensure there won't be a problem later on. In addition, remove any weeds surrounding the perimeter to contain the spread of weeds into the garden area. Throughout the gardening process, weeds will constantly have to be addressed, and the easiest way to do it is to manually pull them out of the ground with the roots intact. Here are some methods that can help reduce the impact weeds could have, but either way, there is no guarantee that every so often, some weed-picking labor might become necessary.

1. Organic Herbicides: weed-killers made of clove oil, wintergreen oil, cinnamon oil, vinegar, and other natural ingredients can be purchased at virtually any nursery or gardening store. The effectiveness or reliability of these products depends on the individual label, but the downside is they can actually be quite expensive averaging at around \$70 per gallon. Most products are non-selective meaning they target and kill a large range of weed types including: chickweed, plantain, dandelion, pigweed, oxalis, mustard, foxtail, and morning glory. Another possible negative aspect to this approach is that some products will actually kill or affect any plant coated with the herbicide which can do some real damage plants located near the weeds that were the primary targets. Examples of such organic products include *Weed Zap*, *BurnOut II*, and *Matran*.

2. Weed Fabric/ Mulch: used to cover the soil between plants and is laid directly over the ground. Primarily used to control the spread of weeds and protect beds from becoming overrun with weeds which can affect the prosperity of plants. Most weed-fabric products are made of a woven, black polypropylene fabric. While this material is permeable to let in air, water, and nutrients, it blocks the light required for weeds to grow. It provides the ideal choice for safe weed control and water conservation. Mulch, like fabric, accomplishes just as much and is generally less expensive.

III. Conclusion

Gardening and growing food is not only a process of trial and error, but of constantly being aware of what is actually taking place, what *is* working, and how things could be done differently. It's no mistake that this is intended as a community gardening project, from an academic and community-oriented perspective, the goal of this garden is to share our growing knowledge, and draw from the wisdom that is already rooted in experienced gardeners in the community. Remember that above all else, learning is a primary goal for all members of the garden, and in order to ensure that it remains a permanent establishment of CLU, the *sustainability* of it all is paramount. From the use of water and land, to the methods used for pest control and crop management, the gardeners here should never forget the responsibility they have to maintain and preserve the integrity, stability and beauty of the entire community.

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