



Marigold as a Trap Crop

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Marigold is one of the most important flower round the world as well as in India. It is extensively grown in India. Marigold flowers are used as loose flower as well cut flower. Marigold flowers are also useful for religious purpose. Marigold plants produce a number of potentially bioactive compounds, among which α -therthienyl is recognized as one of the most toxic. This sulfur-containing compound is abundant in marigold tissues, including roots. It has nematicidal, insecticidal, fungicidal, antiviral, and cytotoxic activities, and it is believed to be the main compound responsible for the nematicidal activity of marigold. Thus nematodes may be killed either by entering the root system of a marigold plant or contacting soil containing marigold's bioactive compounds. Nematodes are soil-dwelling, microscopic, worm like parasites that feed on plant roots, causing swelling or galls within the roots, obstructing the flow of water, mineral salts and nutrients.

The nematodes are most active in summer when soil temperature ranges between 29 °C to 35 °C. Cucumber, okra, squash, beans, brinjal and non-resistant tomatoes are highly susceptible crops for nematodes. However, nematodes being highly active at high soil temperature, they are not a serious threat to most cool season plants, the exception being carrots and beets which could show moderate to severe nematode infestation. Now the question as to how could we control nematodes leads to the most comprehensive solution of using eco-friendly approaches of growing trap crops, antagonistic nematode suppressing plants, soil solarization and crop rotation. Marigolds could be effectively grown and could serve as a landscaping element while taking care of nematode problem. French marigolds (*Tagetes patula*) suppresses multiple genera of plant parasitic nematodes which includes *Meloidogyne*, Lesion nematode, *Pratylenchus* spp and Reniform nematodes.

Marigold as Effective Nematode Suppressing Crop

Nematodes are minuscule round worms which are subterranean in nature and effect almost all the agricultural crops and cause substantial yield loss. Root knot nematode, *Meloidogyne incognita* is a polyphagous pest which affects all the vegetable crops. This nematode along with other pathogenic fungi and bacteria increases the disease severity in crops and leads to the crop failure. Root knot nematode infected roots show modified galls in the functional root system impairing the conduction of water and mineral nutrients in plants. The entire root system may be shallow with excessive branching.

Marigold (*Tagetes* spp) is an excellent plant for the management of root knot nematodes, the bioactive chemicals secreted by the root exudates of marigold could effectively control the nematode population. Thus use of marigold in nematode control is an environmentally safer and economically viable method. Marigold had been reported to

contain 5-(3-buten-1-ynyl)-2,2-bithienyl and alpha terthienyl in a synthetic form and acts as nematode suppressant. The roots of marigold were reported to contain flavonoids, Di-hydro flavonoid, flavones and flavonones lacking a free OH group. The roots had also been reported to contain chemicals like amines, amides, phenols and ketones. Nematode suppression occurs when marigold is grown as an intercrop with nematode susceptible hosts.

Different Marigold Species in Suppressing Nematode Population

Marigold plants suppress plant parasitic nematodes through the process of biochemical interaction known as Allelopathy, which is defined as the release of compounds from plants that are toxic to other plants, micro-organisms or other organisms such as nematodes. Marigold plants produce a number of potentially bioactive compounds among which alpha terthienyl is recognized as one of the most toxic chemical. The sulfur- containing bioactive compounds is abundant in marigold tissues, including roots. The nematicidal activity of marigold has been detected in roots of growing plants but not in root or leaf extracts. The sequence of various events in marigold roots is triggered by the penetration and movement of plant parasitic nematodes through root vascular tissue and the end products of these reactions have a nematicidal effect. The nematicidal bioactive compounds apparently permeate from marigolds' root tissues into nematode attached to the roots. However, they are also believed to inhibit oviposition and hatching of nematode eggs found in the rhizosphere.

How to Use Marigold for Nematode Suppression

It is important to know that α -terthienyl compounds in marigold have limited nematicidal activity when incorporated into the soil. Only living marigold root systems exhibit significant nematicidal properties. For example, even though a *Tagetes patula* 'Single Gold' crop consistently suppressed a diverse range of plant-parasitic nematodes, when residues were incorporated into the soil it did not suppress the root-knot nematode as well. The critical stage for marigold suppressive effect is during its growth. Therefore, to maximize the nematicidal activities of marigold, it should not be tilled in until fully established (3–4 months). As such, marigolds are typically grown as a cover crop or planted in rotation with the cash crop to manage nematodes. In situations where farmers have a small acreage and cannot afford to have land out of production, rotating marigolds with their cash crops might not be practical or economically feasible, especially if there is no direct economic return from planting marigold. An alternative approach is to use marigold as an intercrop. This approach may not be as potent as applying a nematicide directly into the root zone of a cash crop, but because the nematicidal activity of marigold should permeate to surrounding soils, there will be some nematode suppression in the neighboring cash crop.

Limitations & Concerns about Using Marigold for Nematode Suppression

Marigolds are sensitive to day-length, having what is called short-day photoperiodism. In general, the plant remains vegetative when days are long and flowers when days are short. Marigolds with a strong sensitivity to short-day photoperiod tend to flower quickly even during our longest days. Marigold can serve as a host for some other pests, such as thrips and spider mites. Spider mites especially can be a problem during hot, dry weather. Thrips can be a major problem because they can transmit tomato spotted wilt virus (TMSV), a serious virus disease of a wide range of vegetable crops including tomato and peppers. Other diseases of marigold include damping off (*Pythium* and *Rhizoctonia*), grey mold (*Botrytis*) of flowers, southern bacterial wilt (*Pseudomonas solanacearum*), and bacterial leaf spot (*Pseudomonas syringae* var. *tagetes*). These can be problems when marigold is intercropped with plants susceptible to these pathogens.

Plant-parasitic nematodes generally have a wide host range, and it is therefore important that the marigold crop is free of weeds. Otherwise, nematodes may survive and multiply on the weeds' roots. If weeds are not well controlled, nematode management by marigold may be ineffective. The disadvantage of using marigold as an intercrop is that chemical herbicides are typically compatible with nematicide application but may not be used in a cash crop intercropped with marigold because the herbicide sprays may stunt or kill the marigold. The difficulties associated with weed control may limit its adoption by growers. Further, if sown as an intercrop in a low growing vegetable production system, and not properly managed, marigolds themselves may act as weeds by competing with the cash crop for nutrients, water, and light.

Marigold seeds generally are purchased for ornamental purposes and typically are expensive. It may be very costly to purchase enough seeds to use marigold as a cover crop for nematode suppression, especially when the lack of direct return from using marigold as a rotation crop is considered. Some marigold varieties used in poultry feed are less expensive, but the cost can be high for a large-scale planting. However, marigold plants produce a large number of seeds that can easily be harvested from mature plants. This allows growers to readily produce their own marigold seed supply.

Another potentially negative aspect of growing marigold is that the seeds are plentiful at maturity, readily self-reseeding, light, and easily wind-blown. This can be a problem for those who don't want the marigold to spread to other areas.

References

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