

Determine Marigold Planting Date for Plant-Parasitic Nematode Management on Banana



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Abstract:

The perennial nature of banana (*Musa* spp.) crop production, and the lack of an effective nematicide available for post-plant treatment make nematodes a difficult pest to manage on banana. Marigold (*Tagetes* spp.) is known to produce nematocidal compounds while growing. Two field experiments were conducted at the Poamoho Experiment Station on Oahu, HI to determine the best time to introduce marigolds as a cover crop after banana planting for the management of plant-parasitic nematodes. In Experiment I, marigold was planted under 1-, 18-, and 36-month old established bananas in field plots (12 × 14.5m²). Survival of marigold seedlings decreased from 92% at 1-month old to 37.5% at 36-month old bananas. A second experiment was conducted to compare banana and marigold growth, and its impact on nematode suppression within 6 months of banana planting. Marigold was planted at monthly intervals. Banana growth was better than the no-marigold control when marigold seedlings were planted at 4 to 6 months after banana planting ($P < 0.05$). However, marigold grew better when planted at 4 to 5 months after banana planting compared to other planting dates ($P < 0.05$). Planting of marigold did not suppress reniform (*Rotylenchulus reniformis*) and root-knot (*Meloidogyne* spp.) nematodes in the soil compared to control ($P > 0.05$). Nonetheless, planting marigold at 3, 5, and 6 months after banana planting maintained a similar number of root-knot nematodes as the no-marigold control. Combining all these results, it is best to plant marigold under the banana canopy at 5 months after banana planting.

Introduction:

Plant-parasitic nematodes (ppns) are microscopic roundworms that parasitize plant tissues (usually root tissue) and can cause significant yield loss in economic crops. Burrowing (*Radopholus similis*), spiral (*Helicotylenchus multicinctus*), lesion (*Pratylenchus* spp.), reniform (*Rotylenchulus reniformis*), and root-knot (*Meloidogyne* spp.) nematodes are ppns commonly found infecting banana in Hawaii (Wang and Hooks, 2009). Many farmers tolerate the damage caused by ppns by propping up banana trunks at fruiting (Fig. 1), or by frequently replanting. The high cost of nematicide, and their negative impacts on the environment, have led to an overall decline in use of these applicants.

One alternative is the use of a cover crop such as marigold (*Tagetes* spp.) for nematode control. As marigolds grow, their roots release an allelopathic compound, α -terthienyl, that has nematocidal properties. When planted in proximity to a crop, marigolds have been shown to be effective in controlling ppns. This research project attempts to refine the use of marigold as a cover crop under banana by pinpointing the optimum time for marigold planting. Our goal is to provide the farmer with the optimum time after banana planting to introduce marigolds as a cover crop.

Objectives:

- 1) To determine the optimum planting time of marigold as a cover crop after banana planting. (Experiment I)
- 2) To evaluate nematode suppressive effects of marigold when intercropped with banana. (Experiment II)



Fig. 1: Farmers use of wooden sticks to prop up banana in a field heavily infested with spiral nematodes.

Materials and Methods:

Experiment I:

Three ages of banana tested for cover crop survival were:

- Treatment 1- 1-month old banana field
- Treatment 2- 18-month old banana field
- Treatment 3- 36-month old banana field



Fig. 2: Marigolds planted under a banana tree as cover crop.

A field experiment was established in three banana fields with different ages. Each field plot was 12 × 14.5 m² with 24 to 35 banana plants. Four marigold seedlings were planted under 5 randomly selected banana plants from each age treatment plot. At one month after planting, mortality of the marigold seedlings was recorded. The experiment was repeated once and the percentage of marigold seedling survival was calculated for both trials.

Experiment II

Marigold seedlings were planted under the canopy of banana at 6 different times:

- Treatment 1- 1-month old banana
- Treatment 2- 2-month old banana
- Treatment 3- 3-month old banana
- Treatment 4- 4-month old banana
- Treatment 5- 5-month old banana
- Treatment 6- 6-month old banana
- Control- no marigold

A total of 35 tissue cultured 'Apple' banana were planted on Jan 12, 2012. Four marigold seedlings were planted under 5 randomly selected banana at each planting time (Fig. 2). This was a complete randomized design experiment with 5 replications. Heights(cm) of all marigolds and banana plants were recorded monthly until Aug 15, 2012. Banana height differences (final height – initial height) and marigold height ratios (Final height – initial height)/initial height) were calculated. Plant-parasitic nematodes were extracted from the soil collected from each plant using elutriation and centrifugal flotation (Byrd et al., 1976). Plant-parasitic nematodes were counted under an inverted microscope, and data were log transformed. All data were subjected to one-way analysis of variance.

Results and Discussion:

1. Marigold survival:

Marigolds survived better under 1-month old banana (MOB) plants compared to 18 and 36 MOB (Fig. 3).

2. Optimum marigold planting time:

Banana plant growth was better when marigolds were planted under 4-6 MOB as opposed to 1-3 MOB (Fig. 4A). Marigold growth was also better when planted under 4-5 MOB rather than 1-3 MOB (Fig. 4B). Result of marigold growth under 6 MOB was inconclusive due to an irrigation problem. This may be indicative of a shade preference by marigolds, where some shade is optimal but too much hinders growth significantly. Data from Experiment I supports this conclusion.

3. Nematode suppressive effect of marigold:

Reniform nematodes were the most dominant ppn in this field. Planting marigold did not suppress reniform nematodes significantly ($P > 0.05$, Fig. 5). Healthier banana plant growth could lead to higher ppn counts. Conversely, high populations of reniform nematodes may be responsible for the decreased banana growth observed in control and 1-3 MOB. It is encouraging to see lower numbers of root-knot nematodes in treatments 5 and 6 in conjunction with healthier banana growth.

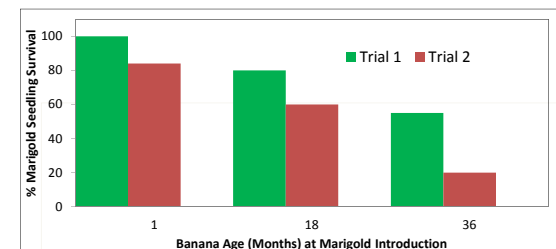


Fig. 3: Survival rates (%) of marigolds planted under three banana age treatments at 1 month after marigold planting.

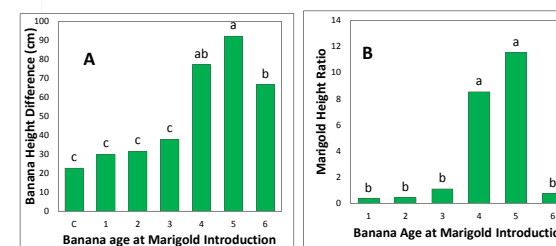


Fig. 4: A) Banana and B) marigold growth affected by marigold planting time (months after introduction) at termination of Experiment II. C= no marigold control. Columns followed by same letter(s) are not different according to Waller-Duncan k-ratio (k=100) t-test.

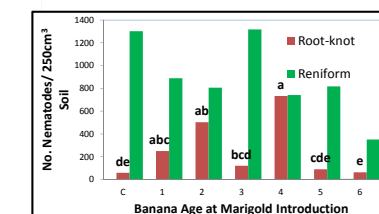


Fig. 5: Data are means of 5 replications. Root-knot significance was determined using the Waller-Duncan k-ratio (k=100) t-test based on log (x+1) transformed values.

Conclusion:

Marigolds established better under younger banana plants as compared to 18- or 36-month old plants. Farmers should aim to plant marigolds as a cover crop under 4 to 5 MOB to maximize marigold growth and minimize competitive effects on banana growth. Marigold can positively affect banana growth when planted at the correct time. The nematode suppressive effects of marigold in this banana living mulch system were inconclusive. Further research is needed to examine this banana-marigold system in a field with more damaging nematodes present.

Acknowledgements

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