

Allelopathic effects of *Leucaena leucocephala* litter on germination and growth of four crop plants in the Virgin Islands



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Background

In the Virgin Islands, the invasive tree species *Leucaena leucocephala* ("tantan" or "false tamarind") is widespread throughout farmlands as a nuisance plant, and **dominates abandoned agricultural landscapes**. Research has identified allelopathic properties of *L. leucocephala* tissues, which may help explain the monotypic stands of this species often encountered in the field¹. However, these **allelopathic effects have been found to affect various species to different degrees**, and some crop species are apparently unaffected².



Fig. 1. A) Typical composition of litter under monotypic *L. leucocephala* canopy; B) typical *L. leucocephala* canopy seen throughout the Virgin Islands, particularly in abandoned agricultural lands.

Meanwhile, agricultural production in the Virgin Islands is characterized by challenging production conditions. A general lack of water, weed and pest control, labor, and other infrastructure severely limits total production, despite a recognized mandate to expand production and reduce reliance on food importation. For example, reliable sources of seed often present an obstacle to timely and efficient planting. **However, seeds available from produce from supermarkets may be a viable alternative for small-scale farmers.**

Objectives

- 1) Monitor germination of four agricultural crops sourced from supermarket seed: **maize** (*Zea mays*), **papaya** (*Carica papaya*), **cowpea** (*Vigna unguiculata*), and **garbanzo** (*Cicer arietinum*).
- 2) Assess the effect of *L. leucocephala* (tantan) litter on height, leaf chlorophyll (CCI) and yield.



Fig. 2. A) Layout of experimental design; B) supermarket-sourced seeds for planting including fresh papaya seeds (top left)

Methods

Our study followed a randomized complete block design in pots with a split-plot treatment and five replications. The main plot treatment was an application of *L. leucocephala* (tantan) litter (20 t/ha) versus a control, and the four crop species were the subplot treatment. Plants were uniformly irrigated and hand-weeded. We measured germination success and growth rates (height and chlorophyll), as well as yield of cowpea and maize. Treatment effects were analyzed by linear mixed-effects modeling.

Results and Discussion

Germination rates were affected by tantan litter depending on the species. Although cowpea and maize were unaffected, garbanzo's germination was significantly inhibited by tantan, while papaya germination was greatly improved with tantan. The effect on cowpea and garbanzo has been reported elsewhere in literature², whereas a reported reduced germination in maize³ was not replicated here. The cowpea germination rate (80%) is consistently high, while the relatively low maize germination rates (~25%) suggest problems with using feed corn as seed stock. Papaya germination in tantan litter (50%) conversely suggests that, in addition to no allelopathic effect on papaya, tantan litter could be a viable seedbed for papaya nurseries for production.

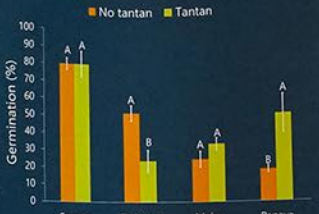


Fig. 3. Germination rate (%) of seeds planted from supermarket produce in cowpea, garbanzo beans, maize, and papaya, with and without tantan litter application. Germination was assessed no later than 14 days after planting (DAP). Letters within the same species group not shared by the other treatment indicates statistical significance in post-hoc testing ($p < 0.05$).

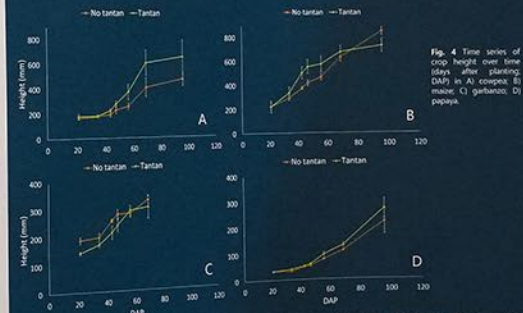


Fig. 4. Time series of crop height over time (days after planting, DAP) in A) cowpea; B) maize; C) garbanzo; D) papaya.

Height over time, displayed a beneficial effect of tantan litter in all species except garbanzo, with the effects of tantan becoming muted by the end of the experiment. Garbanzo beans did not perform well and died before 80 DAP. The experiment. Garbanzo height contrasts with the hypothesis of beneficial effect of tantan litter on plant height contrasts with the hypothesis of beneficial effect of tantan litter to higher soil organic matter and nutrient allelopathy, and is likely attributable to *L. leucocephala* is leguminous. contents of tantan leaves (*L. leucocephala* is leguminous).

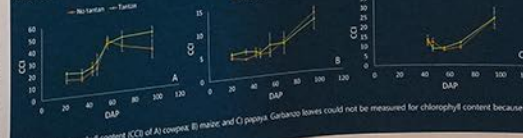


Fig. 5. Leaf chlorophyll content (CCI) of A) cowpea; B) maize; and C) papaya. Garbanzo leaves could not be measured for chlorophyll content because of the small size of leaves.

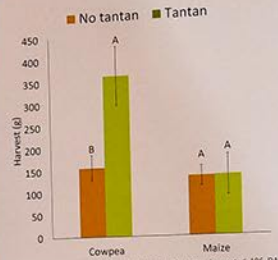


Fig. 6. Dry yield (kg) of cowpea pods and maize ears harvested 106 DAP. Letters within the same species group not shared by the other treatment indicates statistical significance in post-hoc testing ($p < 0.05$).



Fig. 7. A) Tantan leaves deposited on litter surface after germination; B) garbanzo plant senescing after early decline (-80 DAP); C) cowpea harvest of cowpea pods before drying and weighing.

Conclusions

We applied tantan litter at high application rates, designed to replicate field conditions where the litter can be thick (>5 cm). As a result, the **added organic material and nutrients may have overwhelmed any allelopathic effects of tantan tissues — in most cases** (except notably, garbanzo). In fact, the dry yield of cowpea more than doubled under these conditions, and papaya germination rates were significantly improved. Although garbanzo was negatively affected by tantan litter, it performance, regardless of tantan treatment.

L. leucocephala is widespread in the Virgin Islands. Our study demonstrates that certain crops in recently cleared tantan lands could realize tangible benefits for Virgin Islands farmers, **but this depends on the crop species**. Further studies in field conditions would provide additional insight into these complexities of *L. leucocephala* allelopathy.

List of references:
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