Gameticidal effect of plant-based pesticides in arecanut

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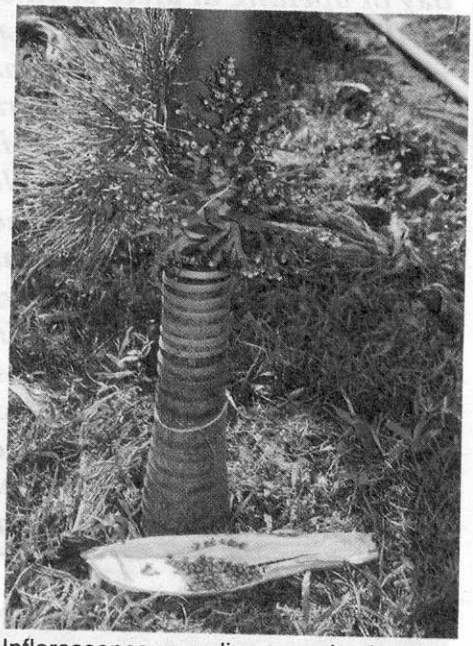
THE whole of Dakshina Kannada and Kasaragod areca growing belts have been silent witnesses for, and victims of neem episode in the recent years. Majority of the growers have experienced the bitterness of this particular phenomenon and have been mourning for the phenomenal loss of newly emerging inflorescences with no flowers, either male or female–and that too with not much involvement of any kind of infectious disease causing pathogens with inflorescence.

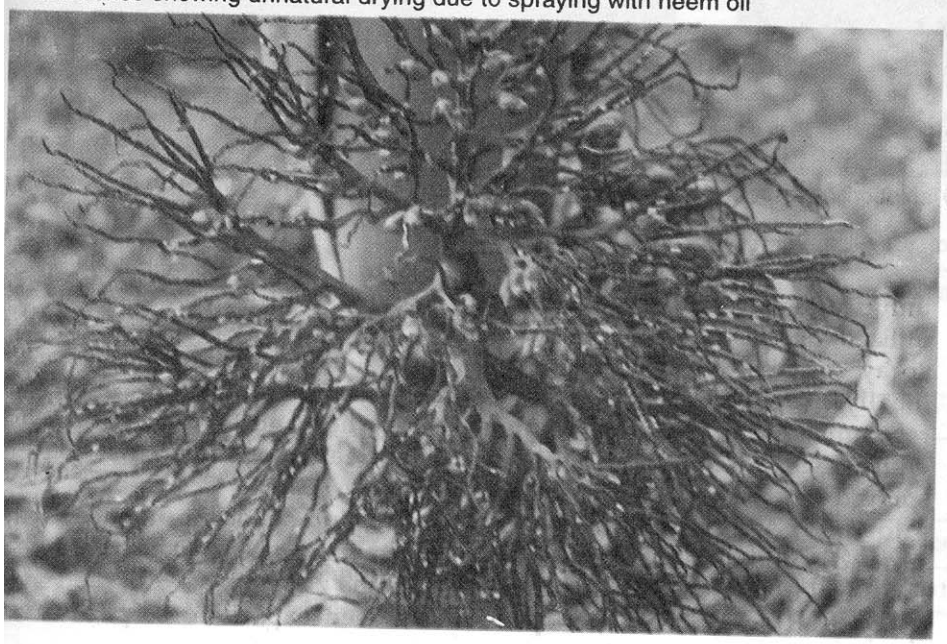
The scale insect infestation has been regularly seen in most of the areca belt as a minor pest, as it caused minimum damage to the crop. Three species of scale insects are found infesting the leaves and stem, while a species of *Chinapsis* is found damaging the arecanut seedlings extensively. The incidence of scale insects of which mainly 2 species, *Aonidiella orientalis* (round) and *Ischnaspis longirostris* (rod-shaped) prevailing in the areca gardens have been observed to be mainly in one or two seasons of the year, while the arecanuts see through their developmental stages. Since two–three years back the scale and such similar sucking insect pests (eg. mealy bugs) have become epidemic in certain pockets.

It is unquestionable that neem is an eco-friendly anti-feedant or feeding deterrent or oviposition deterrent for insects, and hence keeps the pest population repelled from the crop. But its wrong usage at inappropriate time and site definitely proves non-productive. Availability of neem-based products has made the farmers to use them very frequently in their gardens with an over enthusiasm and a conviction of no side-effects on plants and ecology. Overcautious attitude of farmers and improper knowledge on the aftermath have led to the use of these products on newly emerging inflorescences at regular intervals, many a times repeated spray at fort-nightly intervals are also not uncommon. Though the scales were noticed in majority of the cases only on developing nuts and not on inflorescences, people were advised to, and have used neem-oil on inflorescences of all the stages starting from their unfurling (from the covering spathe) and all along the male and female phases in the course of 1 month period of their opening. Eventually, this has resulted in non-availability of pollens to the receptive female flowers on the neighbouring spadices of other palms. Since the prevailing practice has been spraying all the new inflorescences with either neem or other organic-based products at frequent intervals, it has created a major physical barrier for the normal opening and anther dehiscence of male flowers and an artificial pollen scarcity is created.



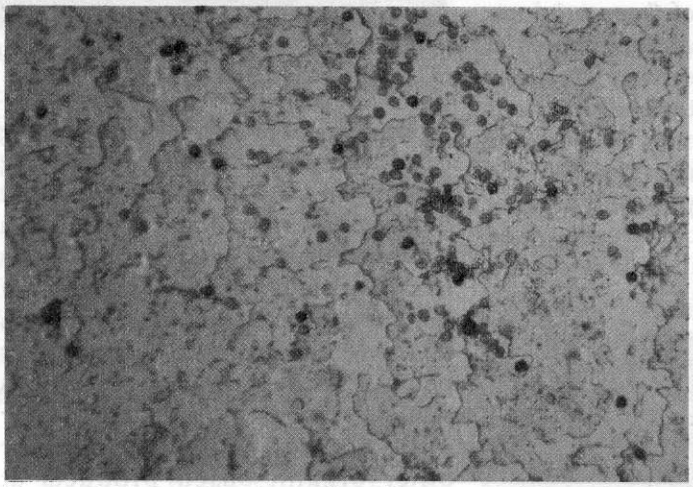
Inflorescence revealing speedy shedding of buttons from the neem-sprayed portion

Inflorescence showing unnatural drying due to spraying with neem oil

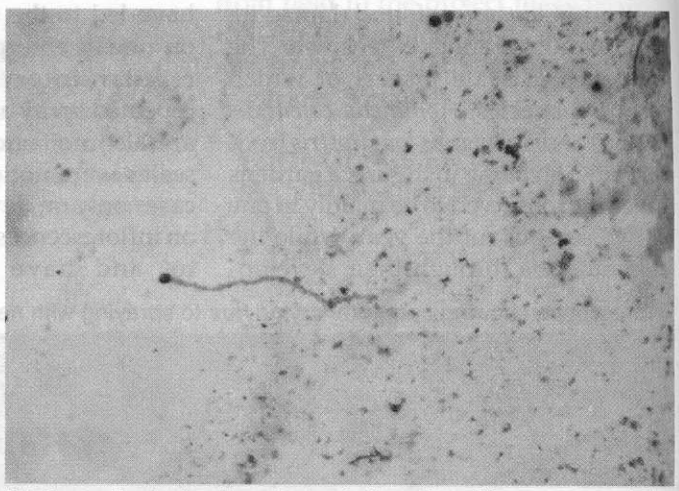


A simple study involving following treatments was undertaken at the Regional Station, Vittal of the Central Plantation Crops Research Institute, with an objective of confirming this adverse impact of neem and organo-pesticides on areca inflorescences. Two unbranded combination products –one containing

Dakshina Kannada and Kasargod coastal areca belts have been silent victims for adverse effect of neem on arecanut production since 1997. Neem and similar plant-based pesticides have been used as a prophylactic spray against scale infestation from the day of opening of areca spathe at regular intervals. This comes in the way of natural pollination, which otherwise is wind mediated by: (i) making the male flowers not to open or dry up fast, (ii) aggravating the temperature effect, and (iii) mechanically blocking the entry of pollens into the receptive female flowers. An observatory study in the field and in the laboratory comprising 3 spray liquids, viz. ***2 unbranded but in vogue with farmers (1 neem-based and the other cashewnut shell liquid-based) and another branded (10 000 ppm azadirachtin) at 3 concentrations in a CRD model, conducted during 1999 at the Regional Station of the Central Plantation Crops Research Institute, Vittal, has confirmed the negative impact of these pesticides on arecanut pollination . Pollens deposited on the control agar media with no spray solution only germinated and hence the phyto-toxicity on the areca inflorescence is indicated.***



Ungerminated pollens in media with spray solution observed under 50x magnification



Well germinated pollens in control media with no spray solution under 50x magnification

neem as the main and the other cashewnut shell liquid (CNSL)-based spray liquid being projected as anti-fungal along with another branded product (azadirachtin). have been used in the trial since these are the major ones in vogue with the areca growers. Hirehalli dwarf palms were utilized from the convenience point of view.

The methodology followed can be briefed as follows. Two sets of yet to unfurl inflorescences were labeled and utilized for the study with each of the spray combinations. Normally, the locally prepared neem sprays are recommended at 4% concentration, while CNSL-based spray solution is sprayed at varying concentrations from 4 to 10 %. Azadirachtin is usually sprayed @ 2 ml/litre of spray solution. Each inflorescence under test was sprayed at fourth week after spathe opening, since the female flowers attain receptivity only by that age onwards. The female phase in each inflorescence was confirmed by looking at the parameters like attainment of amber colour, appearance of Y-shaped crevice at flower apex and oozing of sticky substance.Only in the fifth treatment, the inflorescence was sprayed at first week of opening repeated by another spray at fourth week, so as to enable the observations on the male flowers also. In total six sets of treatments were imposed in a randomly replicated design (3 replications) and observed for the effects in the field, in addition to the laboratory studies.

The following parameters were observed for at specified time after imposition of treatments.

Anthesis of male flowers has been noted from the very first week of the inflorescence opening. This has been confined to the last sets of treatments.

Drying of female flowers has been observed by looking at the change in the colour of flowers after the pollination and that of male flowers have been noted since first week of spray (WAS).

Button shedding in each of the treatments has been noted since a week after the pollination(WAP) and same has been expressed as per cent of

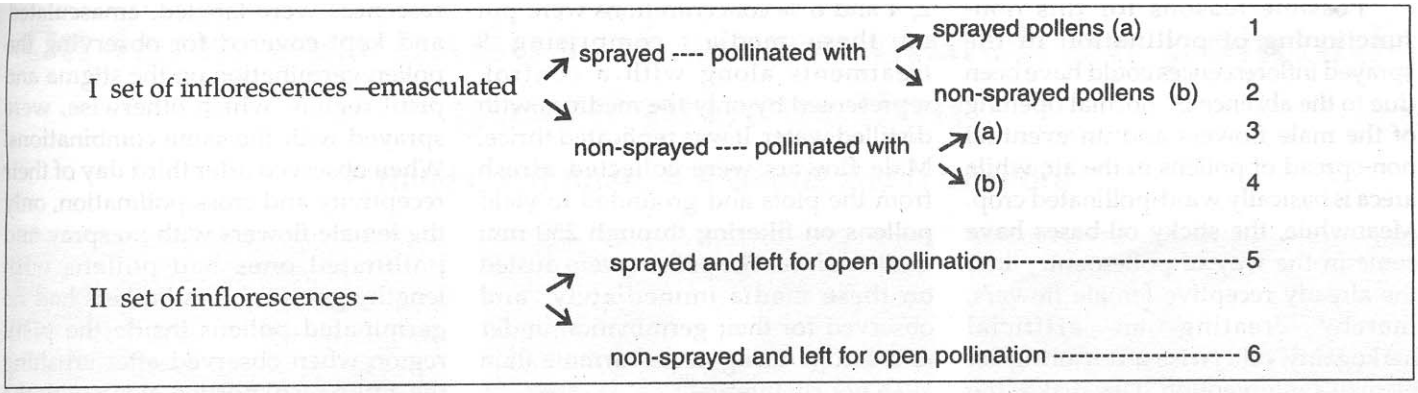


Table 1. Observations made on the treated inflorescences

Character	Set of inflorescences					
	1	2	3	4	5	6
Anthesis of male flowers					Not normal	Normal
Drying-up of male flowers					Within 10 days	Completed in 25 days
Drying-up of female flowers	Quick and within 4 days	Fast and within 4 days	Fast and took 6 days	Negligible	Fast and within a week	Negligible
Button shedding (%)	100	100	100	10	90	10
Colour change in female flowers	From initial pale green to amber and yellow tinged	From initial pale green to amber and yellow tinged	From initial pale green to amber and yellow tinged	From initial green to dark green in 10 days with blackening of the crevice portion	From initial pale green to amber and yellow tinged	From initial green to dark green in 10 days with blackening of the crevice portion
Fruit setting	Nil	Nil	Nil	90	10	90

female flowers on the inflorescence.

Fruit-setting has been observed in the sixth week after inflorescence opening (WAO) and the same is expressed as per cent of total female flowers.

Salient observations can be summed up as below.

- Female flowers when sprayed with the pesticides and then pollinated did not set the fruits irrespective of pollens, either sprayed or non-sprayed.
- Female flowers when pollinated with no spray and normal pollens set the fruits normally and with sprayed pollens, there was no fruit set.
- Inflorescences when sprayed with these pesticides and left for open-pollination did not set fruits.
- Inflorescences with no spray and on open-pollination did set fruits.
- Male flowers dried-up very fast when the inflorescences were sprayed with the pesticides.
- Female flowers exhibited a normal colour change from the initial pale green (at receptive stage) to dark green on normal pollination with the clear darkening of apical crevices, while the un-fertilized flowers dried-up within a week's time.
- Button shedding was very fast from the sprayed inflorescence.

Table 2. Pollen measurements in control treatment

Total number of pollens counted (a)	Number of pollens successfully germinated (b)	Proportion of germinated to non-germinated pollens (P) = (a) / (b)	Standard error
439	228	0.5193	0.0238

Average pollen tube length (μ)

Range	Mean length	Standard error
3.88 –155.12	47.01	10.402

Possible reasons for this non-functioning of pollination in the sprayed inflorescences could have been due to the absence of normal opening of the male flowers and an eventual non-spread of pollens in the air, while areca is basically wind-pollinated crop. Meanwhile, the sticky oil-bases have come in the way of pollen entry into the already receptive female flowers, thereby creating an artificial herkogamy, otherwise a censoring act by man's intervention. This makes the female flowers to shed-off with no fertilization within a week or two. This has been the prevailing situation in and around Dakshina Kannada causing the havoc in the growers' circle.

A confirmatory study on the inhibition of pollen germination was undertaken by the following test at laboratory

Agar media of 0.1 % were prepared with boric acid (100 ppm) and sucrose (0.75%). And then a layer of: (*i*) azadirachtin in 3 concentrations, viz. 0.02, 0.04 and 0.06 %, (*ii*) unbranded neem-oil combination, and (*iii*) cashew-nut shell oil spray combination each at 2, 4 and 6 % concentrations were put on these media comprising 9 treatments along with a control, represented by only the medium with distilled water. It was replicated thrice. Male flowers were collected afresh from the plots and grounded to yield pollens on filtering through 250 mm meshed sieve. The pollens were dusted on these media immediately and observed for their germination under microscope using aceto-carmine stain at an hourly interval.

The observations revealed the facts that pollens dusted on the control medium had germinated in abundance within 3 hr of deposition, while none of the pollens from any of the other treated-media did germinate even after 24 hr. Within the first 4 hr of deposition 51.93% of pollens germinated in the control (Table 1) with a pollen germ tube length ranging from 3.88 µ to 155.12 µ (Table 2). The average pollen tube length was 47.01 µ when observed from 15 fields at random under LP (10×) of a microscope with a calibrated ocular micrometer.

Meanwhile, some more inflorescences were labeled, emasculated and kept covered for observing the pollen germination on the stigma and pistil region which otherwise, were sprayed with the same combinations. When observed after third day of their receptivity and cross-pollination, only the female flowers with no spray and pollinated ones had pollens with lengthy germ tube. All others had no germinated pollens inside the pistil region when observed after crushing the entire pistil portion along with the stigmatic surface after washing with distilled water.

All these speak very clear and confirmed verdict of neem-based pesticide on areca inflorescence and hence a strong caution to the concerned farming community, so as to beware of the repercussions of unscrupulous use of any such kind of plant-based and oil-based preparations on the delicate and healthy areca inflorescence. There have been dozens of unabated neem- and other plant-based combinations with claims of controlling various pests and diseases from non-scientific groups.

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