Fig. 1

Scorching of Cocoa Leaves in Coconut Gardens

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Coconut Research Station, Aliyarnagar is conducting various experimental trials at its station spreading across fifty acres of land. Farming System trial is a perfect example of Cumbu Napier Hybrid and Desmanthus growing along with , Glyricidia, Agathi, Moringa. Trial on High Density Planting System with Coconut, Cocoa, Banana, Pineapple and Pepper undertaken in the station is a perfect scientific illustration of a cropping system effectively harnessing the plentiful natural resources available in the Trophosphere. Cocoa leaves almost competing with plantain leaves in its area, intercropped in the High Density Cropping System trial of Aliyarnagar centre were drying, drooping and wilting (Fig. 1). An analysis was made on the causes for the drying of cocoa leaves and the following observations were made.

1. Vascular streak die-back

Vascular streak dieback caused by the fungus *Ceratobasidium theobromae* is cited as the primary cause for scorching of cocoa plants. The disease is reportedly caused due to an air-borne fungal pathogen, which ejects spores into the air during night time. The spores penetrate the epidermal tissues, take their route deep into the stem where they remain for three to five months before expressing the symptoms.

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Fig. 2

Symptoms and Pathogenesis

First indication of the disease is chlorosis of a single leaf with scattered green tissues on the second or third flush (Fig. 2.). The youngest and oldest leaves remain intact whilst all the middle leaves fall off from the affected shoot. The disease progresses eventually through colonized xylem vessels to the stem causing a dieback leading to the death of the plant. Wet moisture regime favours basidiophore production and the disease is very common in high rainfall regions. On longitudinal splitting of the stem, a brown streaking of the wood is observed, which is the characteristic diagnostic symptom of the disease.

The pathogen has Rhizoctonia-like, binucleate hyphae with dolipore septa and hyphal constrictions adjacent to right angled branches when growing in infected xylem vessels. Hyphae can be observed asymptomatically colonizing xylem vessels several centimeters beyond the visible streaking. Basidia develop after evening rainfall and basidiospores are discharged after midnight but lose viability when exposed to morning sunshine. Basidiophores remain viable for about a week on attached branches, but only for a day or two on cut branches (Marelli et al., 2019). However, a factor of satisfaction in the cocoa plants of Aliyarnagar centre was that the longitudinal splitting of stems of the affected fields did not reveal any brown discoloration, oozing or mycelial growth. Hence scorching due to vascular streak die- back was ruled out. *(Adopted from Marelli et al., 2019)*

2. Cocoa Swollen Shoot Virus

Cocoa swollen shoot virus belonging to the family Caulimoviridae is yet another reason for marginal scorching. The virus infects cocoa plantations, pulling down the productivity during the first year and killing the entire plant within few years. Discoloration of leaves, necrosis of root, swelling of stem, red vein banding and die-back are the common symptoms of the disease. The disease is transmitted through mealy bugs and increased light intensity inhibits the development of the disease. The disease is very common in Africa especially under shaded conditions and as red vein banding is not witnessed in the cocoa plants of Aliyarnagar Centre, the possibility of viral infection in the affected cocoa plants has been excluded.

The most common abiotic factor attributing for marginal scorching is potassium deficiency. The deficiency expresses itself as irregular chlorosis spreading from the outer edge towards the leaf base. Necrotic lesions center within the yellow tissues of leaves and in extremities older leaves fall off and show terminal die-back. As the cocoa plants received Muriate of Potash @ 120 g per plant, the 1NNH4OAc- K content of the soil was 218 kg /ha, possibility of potassium deficiency was also overruled.

Agro Meteorology Record

Agro Meteorological Record gave the perfect answer for the reason behind marginal scorching and drying of cocoa leaves. Weather variables of the Meteorological Standard Weeks 31 and 32 recorded in the Agro Meteorological Observatory of Aliyarnagar Centre is furnished in Table 1 and Figure 3. Prominent peaks were observed in wind velocity which laid the foundation for the havoc.

Table 1. Weather variables of the Meteorological Standard Weeks 31 and 32.

Date	Max. Temp (°C)	Min. Temp (°C)	Rainfall (mm)	Wind Velocity (kmph)
Standard Week 31				
30.07.2020	32.0	24.0	3.4	2.2
31.07.2020	32.5	26.0	0.0	3.0

FIG. 4

Fig. 4

01.08.2020	33.5	27.0	0.0	4.8
02.08.2020	31.5	26.5	0.0	3.8
03.08.2020	35.0	25.5	5.0	3.5
04.08.2020	33.5	26.0	12.0	43.3
05.08.2020	30.5	25.0	13.3	52.9
Standard Week 32				
06.08.2020	30.5	27.5	0.0	3.8
07.08.2020	31.5	25.0	35.3	7.5
08.08.2020	31.0	26.5	0.0	5.5
09.08.2020	33.0	25.5	22.2	2.4
10.08.2020	32.5	24.5	0.0	1.5
11.08.2020	32.0	25.0	0.0	3.0
12.08.2020	32.5	24.5	2.3	4.4

High wind velocity experienced three days before the expression of symptoms at the centre was the cause of the mechanical injury in cocoa plants. As structural pruning was done by the end of July 2020, the heavy winds blown through the pruned branches resulted in non-dimensional damages as tearing of leaves, abrasion and damage of plant tissues through rubbing, together with breaking of branches. Winds also lifted the loose sand particles resulting in surface creep. As the pruned branches provided space for the winds to pass through physical knock down of the plants was prevented.

Remedy for the Malady

To protect the exposed ends from fungal infection, immediately the plants were sprayed with copper oxy chloride solution @ 3 g per litre of water (Fig.4.). Two days later, scorching and drying of the leaves ceased and the plants responded positively to the fungicidal spray. Black and infected pods were cleared off from the plants, broken twigs were removed carefully with secateur and the cut ends were smeared with slurry of copper oxy chloride solution. Copious irrigation was given to prevent water stress. Now, the dried leaves withered down, the plants started giving off new reddish flushes and regained completely from the mechanical injury (Fig. 5).

During the same period, high wind velocity left its foot prints on the cocoa plantations in farmers' holdings also. Several enquiries were received at the centre by the farmers pronouncing their fear about the fate of their cocoa plants, conceiving these symptoms as the manifestation of a deadly disease. Even some were prepared to clear off the cocoa plantations, fearing it may spread to coconut also. Having pinned out the exact cause of the issue the curative measures were extended to the farmers and all the succumbed cocoa plantations have started blooming.

Conclusion

Lesson taught by Nature is that a pest or a pathogen need not always be victimized for the maladies occurring in crops. Weather variables viz., temperature, relative humidity, wind velocity, dew point also contribute equally for any disorder in crop system. Whenever cocoa is intercropped in heavy-wind prone areas, wind breaks or shelter belts may be provided along the periphery of the coconut gardens to restrain the turbulence of winds and to save the plants from mechanical injuries. Scrupulous application of organic manures is imperative to stimulate root growth and provide better anchorage as a means of preventing uprooting of plants. Structural pruning is imperative to allow the breeze to pass through the branches. Balanced fertilization is imperative to impart tolerance to diverse stress factors. From the experience of Aliyarnagar Centre, marginal scorching and drying in cocoa plants is not always due to biotic factors but occasionally due to abiotic factors too.

References: *Marelli Jean – Philippe, David I.guest, Bryan A.Bailey, Harry C.Evans, Judith K.Broan, Muhammad Junaid, Robert W.Barreto, Daniela O.Lisboa and Alina S.Pui. 2019. Chocolate under threat from old and new cacoa diseases. Phytopathology Review. https://doi.org/10.1094/PHYTO -12-18-0477-RVW https://en.wikipedia.org/wiki/Cacao_swollen_shoot_virus*

Rerirement

Shri. M.P Gangadharan Pillai retired from the services of Coconut Development Board on 31st October 2020 on superannuation. He has served the Board around for 30 years.