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Revitalizing of Cyclone affected Coconut Plantations

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Introduction

Cyclones are powerful natural disasters that can have devastating effects on agricultural landscapes, particularly in regions where coconut cultivation is a primary livelihood. Coconut palms, though resilient, are vulnerable to the high winds, heavy rainfall, and storm surges associated with cyclones. These extreme weather events can cause significant damage, from uprooting trees and defoliating canopies to disrupting the delicate balance of soil nutrition. The aftermath of a cyclone in a coconut garden often leaves farmers facing not only immediate losses but also long-term challenges in restoring their plantations to full productivity. Addressing these challenges requires a comprehensive approach to rejuvenation, incorporating both traditional practices and modern agricultural techniques to ensure the recovery and future resilience of coconut gardens.

Cyclone affected Coconut seedlings of 1 to 3 years age, which are free from damage and

are in a slanting position, they can be restored to original position by providing with support. If affected trees are broken at the base of stem with root damage, replanting is not advocated. If replanted, the chance for recovery is meagre. The uprooted trees of less than 20 years old palms without root damage may be straightened and replanted in the same pit, after harvesting the tender

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coconut and ripe coconuts and removing the affected leaves. Those trees replanted will take 2-3 years for establishment with emergence of new leaves and take long period for bearing.

Impact of cyclone

Palms that are exposed in the bole region with shallow planting and inappropriate earthing up were broken off at the collar region and were completely detached from the root system. Tissues of trunk portion were completely damaged and roots were also cut in these palms

In the affected gardens, many of the palms were also broken at the trunk region which were constricted by moisture stress during earlier years or at weakened spots due to damage by pests and diseases such as red palm weevil, rhinoceros beetle damage, basal stem rot and stem bleeding diseases. Heavy yielded coconut palms even with appropriate planting were broken in the middle of the trunk due to high-speed wind.

Due to the heavy wind velocity of the cyclonic storm, the palms along thewindward side had been completely uprooted at the base which cannot be revived. The uprooted palms were fallen on the ground.

The crown region of certain affected palms was completely blown away by the high velocity wind. The crown of affected palm remains as decapitated palm without further growth. The cyclone affected coconut palms were slanted in different angles. The crown had been twisted in the juvenile and adult palms with reduced crown weight depending upon the wind direction. In the crown of affected palms, bruising of leaves, petiole breakage, spindle leaf breakage to severe tearing of leaves, various levels of defoliation occure. Complete shedding of buttons, immature and mature nuts was observed in the affected garden.

Management of Cyclone affected coconut garden

Nutrient management

From 5th year onwards, apply 50 kg of FYM or compost or green manure. 1.3 kg urea (560 g N), 2.0 kg super phosphate (320 g P2O5) and 2.0 kg muriate of potash (1200 g K2O) in two equal splits during June – July and December – January. Apply manures and fertilizers in circular basins of 1.8 m from the base of the palm, incorporate and irrigate. During 2nd, 3rd and 4th year ¼, ½ and ¾ doses of the above fertilizer schedule should be adopted respectively. Sufficient moisture should be present at the time of manuring. Fertigation may be done at monthly intervals with 75% of the recommended dose of the above fertilizers. Phosphorus may be applied as super phosphate in the basins. For nut bearing coconut, root feeding of TNAU coconut tonic @200ml/palm once in six months is recommended.

Biofertilizers viz., 50 g of Azospirillum, 50 g of Phosphobacteria(or) 100 g Azophos and 50 g of VAM are recommended. Mix all the contents in sufficient quantity of compost or FYM and apply near feeding roots once in 6 months / palm starting from planting. Don't mix with

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chemical fertilizers and pesticides. Green manure crops like sunnhemp, wild indigo, calapagonium or daincha may be sown and ploughed *in situ* at the time of flowering as a substitute of compost to be applied. Sow sunnhemp @ 50 g/palm in the basin and incorporate before flowering.

Irrigation Management

Proper irrigation to affected palms through basin method of application or micro irrigation is highly essential for the recovery of palms. Excessive irrigation or flood irrigation should be avoided. A quantity of 60-80 litres of water per palm per day is required for adult coconut palms of more than 5 years old. Soil moisture conservation with mulching techniques can be followed. For conserving moisture during the severe summer and drought, 150 numbers of coconut husk in concave shape for 3 cm height can be done in basin region

Pest Management

Ground clearance of these fallen trees was not carried out by the farmers even six months after the cyclone. The rotten fallen tree parts *viz*., cut crown, stem logs, stem base and damaged spear attracted the red palm weevil which further attacked the surviving trees. These coconut parts served as inoculum for carry over population to surviving partly damaged and healthy trees. Prior to clearance of fallen trees, the farmers unknowingly stocked the coconut seedlings immediately after the cyclone in their farm yard or backyard of the house for taking up new planting in the affected gardens which is being carried out now. Damage symptom of rhinoceros beetle is being observed in the stocked seedlings. Incidence of rhinoceros beetle could also be observed in young newly planted coconut gardens.

A. Rhinoceros beetle, *Oryctes rhinoceros*

Symptoms of damage

The adult beetle bores into the unopened fronds and spathes. Damage by the pest leads to 10 to 15% loss in yield. The attacked frond when fully opened shows characteristic triangular cuts. Central spindle appears cut or toppled. Fully opened fronds showing characteristic diamond shaped cuttings. Holes with chewed fibre sticking out at the base of central spindle.

Management

(i) Cultural method

Remove and burn all dead coconut trees in the garden (which are likely to serve as breeding ground) to maintain good sanitation. Collect and destroy the various bio-stages of the beetle from the manure pits (breeding ground of the pest) whenever manure is lifted from the pits.

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(ii) Mechanical method

During peak period of population build up, the adult beetle may be extracted from the palm crown using GI hooks. Set up light traps following the first rains in summer and monsoon period to attract and kill the adult beetles.

(iii) Chemical method

Placement of naphthalene balls in the innermost leaf axils @ 12g/palm –once in 4 motnhs (June, October, February) or Placement of Chlorantraniliprole 0.4 % GR (in perforated sachets) in the innermost leaf axils @ 6 g per palm once in 4 months (June, October, February)

(iv) Biological method

Application of green muscardine fungus, *Metarrhizium anisopliae* @ 5 x 1011 spores / m3 - spray 250ml *Metarrizhium* culture + 750ml water in manure pits to check the perpetuation of the pest. Field release of Baculovirusoryctes inoculated adult rhinoceros beetle @ 15 beetles/ha reduces the leaf and crown damage caused by this beetle. Apply mixture of either neem seed powder + sand (1:2) @150 g per palm or neem seed kernel powder + sand (1:2) @150 g per palm in the base of the 3 inner most leaves in the crown.

(v) Behavioral method

Set up Rhino lure pheromone trap @ 5 traps/ha to trap and kill the beetles. The dispenser may be hanged in a plastic bucket having 2 liter of insecticide solution once in a week. Trapped beetles can be disposed off. Soak castor cake at 1 kg in 5 liter of water in small mud pots and keep them in the coconut gardens to attract and kill the adults.

B. Red Palm weevil, *Rhynchophorus ferrugineus*

Symptoms of damage

The hole can be seen on the stem with chewed up fibres protruding out. Many times, reddish brown liquid can be seen oozing out from the hole. The grubs cause damage inside the stem or crown by feeding on soft tissues and often cause severe damage especially when a large number of them bore into the soft, growing parts. In case of severe infestation, the inside portion of trunk is completely eaten and become full of rotting fibres. In case of young palms, the top withers while in older palms the top portion of trunk bends and ultimately breaks at the bend (wilting). Sometimes the gnawing sound produced by the feeding grubs inside will also be audible. In the advanced stage of infestation yellowing of the inner whorl of leaves occur. The crowns fall down or dry up later when palm is dead.

Management

(i) Cultural method

Remove and burn all wilting or damaged palms in coconut gardens to prevent further perpetuation of the pest. Avoid the cutting of green leaves. If needed, they should be cut about

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120 cm away from the stem in order to prevent successful inward movement of the grubs through the cut end.

(ii) Behavioral method

Coconut log traps: Setting up of attractant traps (mud pots) containing sugarcane molasses 2½ kg or toddy 2½ litres (or pineapple or sugarcane activated with yeast or molasses) + acetic acid 5 ml + yeast 5 g + longitudinally split tender coconut stem/logs of green petiole of leaves of 30 numbers in one acre to trap adult red palm weevils in large numbers. Incorporate any of the insecticide to each trap to kill the weevils trapped.

Install pheromone trap @ one trap per ha Step 1: Specialized buckets with 3 of 4 holes are made, the bucket is wound with coconut fibre/ jute sack, so that the pests can enter. Step 2: The lure (Ferrolure +) is suspended inside the bucket and one lit of water is added along with 100g pineapple/ sugarcane Step 3: The bait buckets are placed at sites in the farm, where infestation is seen most. Step 4: After a week the water is checked for the catch & re filled to prevent mosquitoes from breeding.

Pheromone trap

Chemical method

In attacked palms, observe for the bore- holes and seal them except the top most one. When the pest infestation is through the crown, clean the crown and slowly pour the insecticidal suspension. In case of entry of weevil through the trunk, the hole in trunk may be plugged with cement / tar. Fill the crown and the axils of top most three leaves with a mixture of fine sand and neem seed powder or neem seed kernel powder (2:1) once in three months to prevent the attack of rhinoceros beetle damage in which the red palm weevil lays eggs.

Root feeding

Select a fresh and live root. Cut sharply at an angle and insert the root in the insecticidal solution containing monocrotophos 36 WSC 10 ml + water 10 ml in a 7 x 10 cm polythene bag. Secure the bag tightly to the root with a cotton thread. Twenty-four hours later, check whether there is absorption. If there is no absorption select another root. These methods should not be resorted to as a routine practice and it is suggested only for cases of severe epidemic outbreak of the pest and when the survival of the tree is threatened.

C. Coconut Eriphyid Mite, *Aceria guerreronis*

Symptoms of damage

The earliest symptom on 2–3-month-old buttons is pale yellow triangular patches seen below the perianth. Later, these patches become brown. Severely affected buttons may fall. As the buttons grow, brown patches lead to black necrotic lesions with longitudinal fissures on the husk. Oozing of the gummy exudation from the affected surface of the nuts. Uneven growth

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results in distortion and stunting of nuts leading to reduction in copra yield. In severe cases, the nuts are malformed with cracks and hardened husk.

Management

(i) Cultural method

Collect and destroy all the fallen buttons of the affected palm. Grow intercrop (sun hemp, four crops/year) and shelter belt with casuarinas all-round the coconut garden to check further entry. Providing adequate irrigation. Apply urea 1.3 kg, super phosphate 2.0 kg and muriate of potash 3.5 kg/palm/year. Increased quantity is recommended to increase the plant resistance to the mite. Soil application of micro nutrients like, Borax 50 g + gypsum 1.0kg + Manganese sulphate 0.5 kg/palm/ year

TNAU Micronutrient solution 200 ml/tree.

(ii) Chemical method

Root Feeding

Triazophos 40 EC @ 15 ml or carbosulfan 25EC @ 15 ml / 15 ml of water . After root feeding, next harvest should be done 45 days later.

Note: Pluck nuts before root feeding

Spot application of ecofriendly botanicals

Round 1: Azadirachtin 1% (5 ml in one lit. of water)

Round 2: Neem oil + Teepol (30 ml in one lit. of water)

• Triazophos 40 EC 5 ml/lit or monocrotophos 36 WSC @ 2 ml / lit or carbosulfan 25 EC 2 ml/ lit in alternation with Azadiractin 1% @ 5ml/lit as spot application

• Neem cake application @ 5 kg per palm per year

Method of Application

The botanicals should be applied in the sequence indicated above at 45 days interval using a one litre hand sprayer. Rocker or Pedal sprayer can be used for spraying small trees. The spray should be applied at the crown region by a climber covering only the top six bunches during non-rainy season.

Precautions and Safety Measures

Spraying should be avoided during windy season to prevent contamination. At the time of spraying, protective mask and clothing should be used. Wash face and hands cleanly with soap after spraying.

Biological Method: Entomofungal pathogen *Hirsutella thompsonii* and *Verticillium lecanii* are reported to be promising in managing the mites.

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D.Mealy bug, *Pseudococcus longispinus*

Symptoms of damage

Mealy bugs colonize on all tender plant parts like bases of spear leaf, spadix and inflorescence and beneath the perianth of the nut. Mealy bugs infest the unopened heartleaf and inflorescence. It feed plant sup. Leaves are yellowing and dry up. As a result, the leaves become highly stunted, suppressed, deformed and present a crinkled appearance. It is often confused with the leaf rot symptoms. The affected inflorescences are malformed and do not open. Even if they open, they do not bear nuts.Button mealy bugs colonize under the perianth lobes of tender nuts. Infested nuts harbouring gravid mealy bugs remain on the spadix, which serve as inoculum for further spread.

Management

Cultural method: Remove leaflets harbouring these insects and destroy them.

Chemical method

Spray any one of the following; Dimethoate 30 EC @ 1 ml/lit (or) Methyl demeton 25 EC @1 ml/lit (or) Phosphamidon 40 SL @1.25 ml / lit (or) Methomyl 25 EC @2 ml/lit (or) 3% Neem oil.

E. Rugose Spiralling Whitefly, *Aleurodicus rugioperculatus*

Recently an invasive alien species of Rugose Spiralling Whitefly (RSW), *Aleurodicus rugioperculatus. The* invasion and establishment of RSW will further affect the coconut industry in terms of reduction in coconut production, quality of nuts and increased production cost due to more insecticides application for management of the pest. Besides, such accidental entry of invasive pests would pose quarantine restrictions for export of value-added coconut products from our country.

Symptoms of damage

Nymphs and adults are prolific feeder especially on underside of the leaflets/leaves of its host plants. Adults produce the large quantities of honey dew excretion which in turn completely darken by sooty mold development on the upper surface of leaves. The infestation leads to the premature drying of coconut leaflets and leaves of banana.

The typical concentric waxy spiraling symptoms on various parts of host plants. Waxy flocculent material produced by adults causing nuisance to human being were heavily infested areas. In coconut, RSW prefers to colonize on hybrid and dwarf varieties, especially Chowghat orange dwarf, Malaysian orange dwarf and Ganga Bondam semi-dwarf.

Management

Monitoring the pest by light trap @ 2 nos./acre during 7 pm- 11 pm. Installation of yellow sticky trap @ 10 nos./acre . Forcible water spray on the under surface of leaves by using rocker

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sprayer . Release of predator, *chrysoperla zastrowi sillemi* eggs @ 1000/ha . Release of nymphal parasitoid, *Encarsia gudaloupae* Viggiani . Spraying of maida flour @ 25 g/lit to flake out the sooty mould on the upper surface of leaves . Balanced application of nutrients (NPK) and water. Maintenance of orchard free from weed plants and any other host plants . Continuous monitoring of pest and natural parasitism in field on different host plants. Re-distribution of *E. guadeloupae* to affected areas through "Field insectary technique" foraugmentation natural enemies. Declaration of "Pesticide holiday" in parasite released gardens.

Disease management

Basal Stem Rot

Basal Stem Rot disease of coconut, hitherto called as Thanjavur wilt, Ganoderma wilt, Ganoderma disease, bole rot and Anabe disease, is a major disease limiting coconut production in Tamil Nadu. Basal Stem Rot is evident in its severe form at one place or the other in almost all coconut growing areas that are poorly maintained.

Symptoms

The pathogen first infects the root system and during the very early stage of infection no external disease symptoms are clearly visible. Initially a few roots get infected and became rotten. Extensive rotting and discoloration of root system is a characteristic symptom of the disease and the rotting proceeds towards the bole thus, cortical tissues disintegrate and turns brown. The production of new roots decreases in the infected palm. From the roots, the infection slowly progresses up the stem leading to internal disintegration of cortical tissues. Exudation of reddish-brown viscous fluid from the basal portions of the stem is the first visible symptom of the disease in the affected palm. The internal tissues of the affected stem turn brown in color and rotting in the stem can be seen up to the height of the bleeding. Bleeding on the stem begins at the base and may extend up to 15 feet in severe cases.

The infestation of bark beetle is also seen in severely infected palms. The fungal sporophore may be present in the basal part of the tree prior to wilting or just after the death of the palm. The leaflets exhibit wilting symptoms and outer one or two whorls of leaves turn yellow. Later, they exhibit light to moderate broning followed by drooping and drying. As the disease advances, the remaining leaves also droop down in quick succession and the spindle alone remains. The spindle leaves which emerge subsequently are reduced in size and do not unfold properly. Later stem shrivels and dries up. As the disease progresses, all the leaves drop off leaving decapitated stem. Favourable conditions like high soil temperature, less soil moisture and drought condition can easily predispose the palms to BSR. Pathogen spread from infected tree to healthy palms by root contact.

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Management

Removal of dead palms, palms in advanced stage of the disease as well as destruction of the boles and root bits of the diseased palms to remove disease inoculum. Isolation of neighbouring healthy palms, by digging isolation trenches (90 cm deep and 30 cm wide) around the affected palm. Adopt basin method of irrigation or drip method of irrigation to irrigate the individual palms. Irrigate the palms in summer months once in 7-10 days regularly, depending upon the soil type.

Intercropping in coconut with banana may reduce the disease severity. Growing of green manures like sun hemp and *Kolingi* and the ploughed in situ may reduce the disease severity with the increased soil health. The disease affected trees should be treated by soil drenching with 40 litres of 1% Bordeaux mixture in the basin area. In addition to the soil drenching, root feeding with 2 ml of hexaconazole in 100 ml of water. The chemical treatment should be given at quarterly interval as 3-4 times in a year. Root feeding with 10 ml of monocrotophos in 10 ml of water may be given for the bark beetle infested trees after harvesting matured nuts. Swabbing with suitable insecticide in infested areas may also be done. Soil application of bio agents 200 g of *Trichoderma viride* and 200 g of *Pseudomonas fluorescens* along with 50 kg of farm yard manure and 200g each of Acetobactor and Phosphobacteria may reduce the disease and increase the nut yield

B. Bud rot

The fungal disease attacks the crown region, mostly in young seedlings and young trees below 20 years old. The occurrence of the disease more during monsoon season. Hybrid palms are more prone to this disease.Initially yellowing, drooping and wilting of young leaves in crown region. Appearance of brown leaf spots in older leaves and basal part will be affected and spreads to the terminal portion. Subsequently, the slight browning of leaves and dried at basal portion. Sometimes, the terminal shoot may rot in crown region and can easily be pulled off from the crown region and also emit unpleasant odour. Rotting may spread to nearby leaves and yellowing progress in the affected leaves. No new leaf formation from the affected inner part due the severe rotting and outer leaves are present for a few months. Finally, bud rot disease affected tree will ultimately die.

Management

Adopt control measures immediately after noticing the initial stage of disease development to save the crop. Cutting off below the affected rotten portion of the young leaves and burn them. Apply Bordeaux paste and cover with pot to protect the crown from the rain till the emergence of new leaves. Spray 1% Bordeaux mixture or 0.3% Copper oxy chloride to the other leaves and nearby trees of bud rot affected trees. Add sticking agent teepol @1ml in 1 litre

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of fungicide. In case of the regular occurrence of bud rot in any of the coconut gardens, adopt preventive fungicidal spray before monsoon and during monsoon.

Conclusion

Managing a cyclone-affected coconut garden requires a proactive and well-planned approach to restore its health and productivity. Immediate actions, such as clearing debris, assessing damage, and providing emergency care to surviving palms, are crucial in the initial recovery phase. Following this, implementing strategies like replanting, soil restoration, and pest management will support long-term rehabilitation. It is also important to adopt resilient agricultural practices that can mitigate future cyclone impacts, such as selecting cyclone-resistant coconut varieties, improving drainage systems, and diversifying crops. By combining traditional knowledge with modern techniques, farmers can not only recover from the devastation but also build more resilient coconut gardens capable of withstanding future environmental challenges.

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