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Effect of Herbicide and Fungicide Application to Curb *Corynespora cassiicola* Inoculum in Rubber Plantation

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Abstract *Corynespora* leaf fall (CLF) disease incited by *Corynespora cassiicola* (Berk & Curt) is the major constraints to rubber growing countries. As part of integrated disease management, the impact of ground application of herbicide and fungicide to reduce the inoculum load in rubber plantation was studied. The study revealed that ground application of herbicide and fungicide was not effective for management or suppression of inoculum of *Corynespora* leaf fall disease in the rubber plantation. The disease intensity ranged from 58.00 to 59.25% in the first season, 55.00 to 59.00 and 60.50 to 61.25% during the second and third seasons respectively. The leaf fall ranged from 419 to 432, 416 to 423 and 444 to 467 numbers per M^2 during first, second and third disease seasons respectively. Number of fungal spore catch per cm^3 did not differ much, conversely the plots treated with weedicide along with fungicide recorded less number of spores movement at just above ground level (H_1), but did not show any significant collision on the disease development at canopy level.

Keywords *Corynespora cassiicola*, Fungicide, Herbicide, *Hevea*, Inoculum.

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Introduction

Natural rubber trees suffer from several diseases at different growth stages. The abnormal leaf fall caused by *Phytophthora* spp. and colletotrichum leaf spot caused by *Colletotrichum* spp., powdery mildew caused by *Oidium heveae*, corynespora leaf fall disease caused by *Corynespora cassiicola*, pink disease caused by *Corticium salmonicolor* and patch canker caused by *Phytophthora* spp. are the major threats to rubber growers in the plain region of Karnataka. Abnormal leaf fall, colletotrichum leaf spot, pink and patch canker diseases appear during rainy seasons whereas, powdery mildew and corynespora leaf fall diseases occur regularly during dry season, just after the period of wintering along with re-foliation. Abnormal leaf fall is reported to cause a yield loss of 38 to 56% [1] and reduction in production of 7 to 45% due to *Colletotrichum* leaf spot disease also being reported [2]. Severe outbreak of powdery mildew was reported to cause a yield loss of 14 to 29% throughout the year [3].

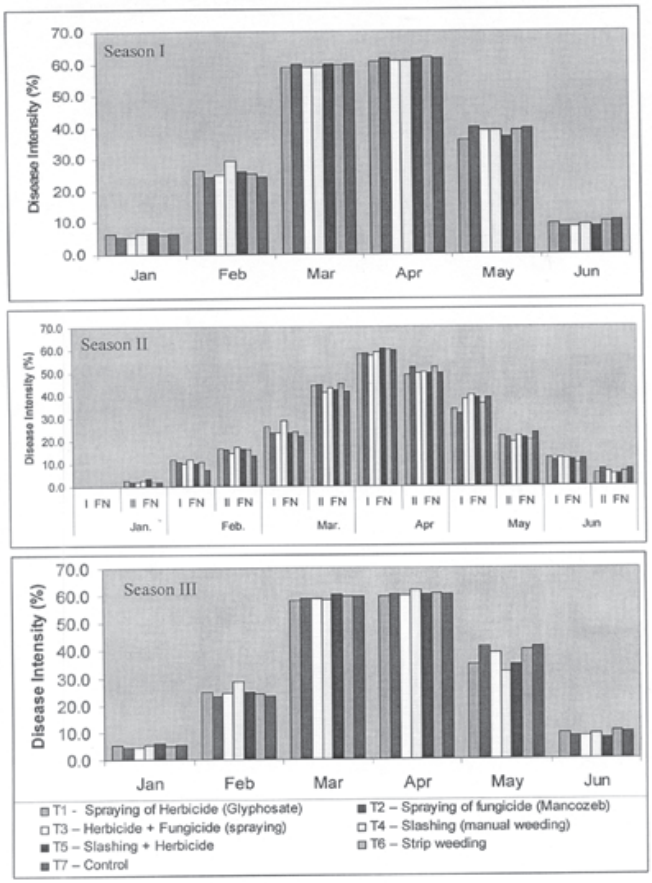

Fig. 1. *Corynespora* leaf fall disease progress in different treatments during the disease season.

Corynespora leaf fall (CLF) disease of rubber caused by the fungal pathogen *Corynespora cassiicola* (Berk & Curt) is a serious threat to rubber cultivation in traditional and non-traditional rubber growing nations of South and South East Asia. Occurrence of this disease causes the repeated post-wintering defoliation, adversely affecting the tree growth, loss of production and yield up to 45%. Outbreak of CLF disease on commercially cultivated clones during 1980^{s} had forced several rubber growing countries to eliminate some of their popular and high yielding clones from the list of recommended clones [4]. Since the CLF disease is reported to cause repeated leaf fall during the re-foliation period it requires extensive fungicides spraying for effective disease management, integrated disease management approaches were focused in many of the countries on planting of resistant clone, eradication of susceptible clones, restriction for introduction of susceptible clone, multiclonal planting and chemical control [5]. Current study was undertaken to cram the impact of some agronomic approaches to minimize inoculum potential in the rubber plantation. As a part of integrated disease management approach, role of ground spraying of herbicide and fungicide was tested against the buildup of *C. cassiicola* inoculum in the field.

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Table 1. Details of the treatments included in the study.

Treatments	Descriptions
T_1–Spraying of Herbicide (Glyphosate)	3 months interval
T_2–Spraying of fungicide (Mancozeb)	Fortnightly interval during the refoliation
T_3–Herbicide + Fungicide (spraying)	Three times in a year
T_4–Slashing (manual weeding)	Three times in a year
T_5–Slashing+Herbicide	Three times in a year
T_6–Strip weeding	Three times in a year
T_7–Control	Untreated

sary co-operation during the study).

Materials and Methods

The study was carried out in three consecutive seasons between 2009 and 2012 in private rubber plantations at Shirady, Puttur Taluk, Dakshina kannada, Karnataka, India. This place is recognized as a hot spot region for corynespora leaf fall disease. The experiments were laid out on six-year old immature RRII 105 rubber plantation with seven treatments and three replications, details of the treatments imposed and frequency of treatments repetition are furnished in Table 1. Application of herbicide and manual weeding and other agricultural operations in the experimental plots were done regularly as per the package of practice given by Rubber Research Institute of India. Recommended herbicide such as glyphosate @ 5 ml/liter of water was ground sprayed in the experimental plots using the backpack sprayer to achieve the total weed control. The cost-effective fungicide for CLF disease management, such as mancozeb 0.2% [6] was used for ground spray during the refoliation period to suppress inoculum build up in the rubber plantation. Periodic observations for disease intensity were recorded by using the 0—5 scale [7]. Leaf fall was recorded by fixing the nylon net (1 m × 1 m) and fallen infected leaves were counted. The intensity of *C. cassiicola* spore dispersal in the experimental plots was also recorded by hanging the Vaseline-gel coated microscopic glass slides at three different heights viz., H_1=Just above ground level, H_2=Below canopy level and H_3=Mid canopy level. The number of fungal spore catch per cm^2 was counted by using microscope. The data collected were subjected to statistical analysis.

Table 2. Efficacy of weedicide, fungicide and manual weeding in Corynespora leaf fall disease management.

Treatments	Disease intensity (%)		
	Season I	Season II	Season III
T_1–Spraying of Herbicide (Glyphosate)	58.60	59.00	60.57
T_2–Spraying of fungicide (Mancozeb)	59.00	57.50	61.00
T_3–Herbicide+Fungicide (spraying)	58.25	55.00	60.50
T_4–Slashing (manual weeding)	58.00	55.5	61.00
T_5–Slashing+Herbicide	58.00	56.5	60.55
T_6–Strip weeding	59.25	56.00	61.25
T_7–Control	58.00	57.90	61.00
CD (p=0.05)	2.29	4.76	1.97

Results and Discussion

Efficacy of ground application of herbicide, fungicide and manual weeding to suppress *C. cassiicola* inoculum load in rubber plantation was tested in field. It was observed that ground application of herbicide, fungicide and manual weeding were not helpful in management of corynespora leaf fall disease or suppression of *C. cassiicola* inoculum in the rubber plantation (Table 2).

Disease intensity recorded for different treatments had ranged from 58.00 to 59.25% in the first season, 55.00 to 59.00 and 60.50 to 61.25% during the second and third seasons respectively. The combination of treatments viz. herbicide and fungicide in the study did not show any significant variation in disease intensity as well as leaf fall in all the three disease seasons.

Disease progress recorded during the study period indicated that the imposed treatments recorded considerably similar pattern of disease development (Fig. 1) and were on par with each other. Corynespora leaf fall disease normally occurs during the refoliation after the regular annual leaf shedding, called annual wintering. The fresh infection was observed in the

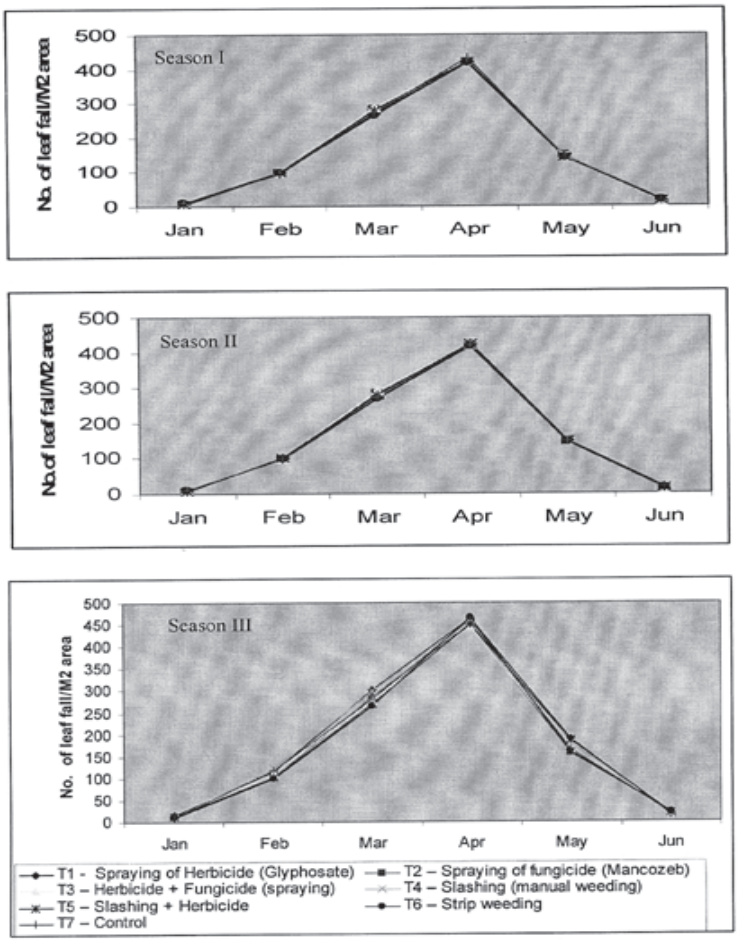

Fig. 2. Leaf fall caused by *Corynespora cassiicola* in different treatments.

rubber plantation from second fortnight of January and it was peaked during second fortnight of March to first fortnight of April [7]. The disease intensity had decreased considerably during May and remained mild or low during rainy season till the next re-flushing season. The prevailing weather conditions such as washout of spores in pre monsoon showers, low temperature and very high humidity may have reduced the inoculums level as well as disease intensity. This pathogen thrives well under mean relative humidity of 89% and temperature of 27°C [7, 8]. Corynespora leaf fall disease incidence was generally severe in the regions with low rainfall compared to that with relatively higher rainfall and in the areas where rainfall was distributed throughout the year or in the regions where there was a break between wet and dry seasons [9]. Further it was also reported that rubber planted regions in South India have essential prerequisites for the triggering and progress of the corynespora leaf fall disease such as a maximum temperature (34 to 36°C) and a minimum temperature (17 to 20°C), a morning humidity of more than 85%, an afternoon humidity of less than 40% and a mean sunshine duration of 8 hours/day [10].

Leaf fall recorded in the experimental plots in terms total leaf count and the results are illustrated in Fig 2. It was revealed that total number of leaf fall ranged from 419 to 432, 416 to 423 and 444 to 467 numbers per M^2 during first, second and third dis-

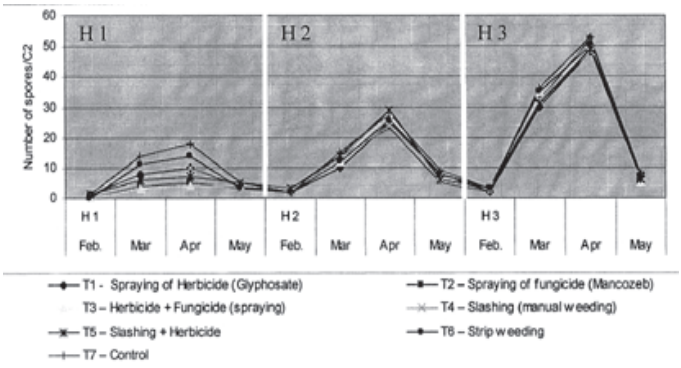

Fig. 3. *Corynespora cassiicola* spores dispersal pattern at different heights. H_1 : Height I (Above ground level), H_2 : Height II (Below canopy level), H_3 : Height II (Mid canopy level).

ease seasons respectively (2009–2012). The leaf fall in the infected plantation was noticed after two to three days of initiation of fresh infection and had reached maximum during the month of March and April. The leaf fall continued till the month of May, after that leaf fall was not noticed even though the disease symptoms were observed on matured leaves. The washout of fungal spores during pre monsoon showers and the survival of pathogen the infected trees during off seasons could be the reasons for decline in the disease and the surviving pathogen would serve as a primary source of inoculums during coming seasons under congenial conditions. It was also reported that corynespora leaf fall disease incidence occurs during dry as well as wet months but leaf fall does not occur throughout the year [9]. The pathogen also can survive during winters on infected roots, stems and infested soil for at least 2 years.

C. cassiicola spore dispersal in the experimental plots recorded at three different heights viz., H_1 (just above ground level), H_2 (below canopy level) and H_3 (mid canopy level) did not show much variation in the spore count among three heights. The plots treated with herbicide along with fungicide recorded less number of spores catch at H_1 level, this may be due to the ground spraying of fungicide which had reduced the inoculum in the leaf litters. However, less number of spores at H_1–level did not show any significant collision on the disease development (Fig. 3). The results clearly suggest that, application of herbicide and fungicides to rubber plants by ground spraying during the re-foliation period is not useful for the management of corynespora leaf fall disease.

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