THE EFFICACY OF MANCOZEB FUNGICIDE IN THE CONTROL OF FOLIAR DISEASES OF RUBBER IN MANCHOK, SOUTHERN KADUNA

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ABSTRACT

The incidence of foliar diseases in rubber plantation cannot be underestimated and can discourage farmers in a non-traditional rubber growing area like Manchok village. Therefore, a field survey was conducted to assess the status of Hevea foliar disease incidence in 26 ha farmers' fields at RRIN Experimental Station, Manchok (Lat. 09^0 41' 39.6, Long. 08^0 28' 18.5 and 939 m above Sea Level) Kaduna State, Nigeria. The farms were located in three separate areas comprising 13, 6, and 7 ha with 450 seedlings planted per hectare (representing 5850, 2700 and 3150 plants in the three areas respectively). Disease assessment was based on scale rating of 0=No infection, 1=Light infection, 2=Moderate infection, 3=Severe infection. Chemical fungicide- Mancozeb (Ethylene bisdithiocarbamate) (EBDC) was applied at the rate of 2 kg/ha using Knap sack sprayer. The treatment was repeated bi-weekly for eight weeks. Among the prominent foliar diseases found during the study were Colletotrichum leaf spot caused by Colletotrichum gloeosporioides, Birds eye spot caused by a fungus Bipolaris heveae (Drechslera heveae),Corynespora Leaf Fall Disease (CLFD). Effects of Mancozeb applications on the rubber seedlings in all the three farm locations were highly significant ($P<0.01$). In the three farm locations of 13, 6 and 7 ha, percentages of seedlings, which recovered from infection after fungicide treatment, ranged between 92.6 to 96.5%, 97.1 to 98.6%, and 89.6 to 96.4%, for the farm locations respectively. Records of the number of healthy seedlings after fungicide applications in all three farm locations were highly significant ($P<0.01$), and ranged between 348 to 2,500, 321 to 370, and 234 to 381 contrary to the number of healthy seedlings before fungicide application 15−460, 321−370, and 40−150, respectively. The study reports, for the first time, the efficacy of Mancozeb in controlling rubber foliar diseases at Manchok village, a marginal rubber growing area in Southern Kaduna, Nigeria.

Key words: Foliar diseases, *Hevea* seedlings, Chemical, Fungicide, Farmers' fields.

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INTRODUCTION

In Nigeria, the most serious diseases of rubber seedlings and budded plants in the nursery are the leaf diseases, while in the field plantations; root diseases may pose a serious problem especially in the first few years after planting. The important diseases that affect nursery plants include shoot and root diseases caused by Birds eye spot (*Drechslera heveae*), *Collectotrichum* leaf spot (*Colletotrichum gloeosporioides*), powdery mildew (*Oidium hevea*), *Corynespora* leaf Fall, *Phytopthora spp.*, *Fusicoccum* leaf blight, *Anthracnose*,

Chlorosis and Veining, Genetic yellows, Sun-scorch of leaves, shoot rot (MRB, 2009a; Begho, 1995). High atmospheric humidity, low temperature, rainfall, crowded canopy are predisposing factors for the initiation and spread of inocula that results in epiphytotic disease proportions.

The economic implications of the effects of foliar diseases can be serious depending on the environmental conditions. The impact of economic losses on the resource poor rubber farmers in Nigeria is enormous with yield adversely affected. Chemical control has not been feasible in Nigeria because of the difficulties of practically spraying tall trees from the ground contrary to spraying practice in the nursery. However, certain chemical fungicides such as Mancozeb, Captafol (Difolatan), can be effective as an aerial spray when applied using low volume ground mist sprayers or fogging machines (Webster and Baulkwill, 1989). Idicula *et al*. (1994) reported that addition of 0.5% zinc sulphate to 0.5% Bordeaux mixture could result in adequate protection of RRIM 600 and RR11 105. An alternative chemical to Bordeaux mixture is Copper oxychloride, which when added to oil and sprayed through low volume applicator has shown to be effective (MRB, 2009b). The use of Mancozeb as spray at 3.3kg a.i/ha is also known to be economically viable in the control of leaf diseases (Delabarre and Serier, 2000). The current study was conducted to survey and assess foliar incidence and use of chemical fungicides in the management of the diseases in farmers' fields. Para rubber (*Hevea brasiliensis*) (Willd ex. Adr. De Juss) (Muell. Arg.) is the species producing the raw material – the latex in which the natural rubber is produced. In Nigeria, land under rubber cultivation is estimated at over 200,000 hectares with small holders accounting for over 70% of the land area. The total production of Natural Rubber (NR) from the rubber tree is about 150,000 metric tonnes per year with about 75% of it for the export market (Shaib *et al.,* 1997). However, the highest production peak of 250,000 metric tonnes was recorded in 2002 but dropped significantly to 66,500 metric tonnes as well as a decrease in land area to 154,000 ha in 2005. The reason for the drop in production and land area is most likely due to farmers' preference for oil palm cultivation.

The *Hevea* tree, like any other commercial plantation crop in monoculture, is subject to a plethora of economically important diseases. In Nigeria, rubber diseases are usually caused by pathogens and parasites, the infective agent being mostly fungi (Igeleke, 1988). However, there are a few maladies of rubber that are attributable to such factors as adverse environmental conditions, such as nutritional deficiencies, genetic and physiological anomalies, otherwise described as disorders, rather than diseases.

The two major leaf diseases of rubber in the nursery (a place where improved, vigorous and uniform planting materials are raised) are the Bird's eye leaf spot and *Colletotrichum* leaf disease. Leaf diseases seldom cause the death of the plant. They do retard the growth of seedlings however, and give rise to secondary diseases such as dieback of stems and branches. Leaf diseases are common and more serious when plant growth is poor; hence the need for adequate fertilizer application in the nursery for the development of disease-resistant or disease-tolerant and vigorously growing rubber clones. However, excess nitrogen should be avoided as this is known to enhance susceptibility to *Colletotrichum* leaf disease (Rao, 1979). Also of importance is *Corynespora* leaf fall disease (CLF). Other nursery diseases include anthracnose, genetic yellows, chlorosis and veining, and sun scorch of leaves. In the mature rubber

plantations, the common leaf diseases are the powdery mildew (*Oidium heveae*), pathogenic die-back caused by *Colletotrichum gloeosporioides*, phytophora abnormal leaf fall caused by the fungus *Phytophthora botrysoa* and black stripe (*P. palmivora)*, Corynespora leaf fall disease (CLFD) caused by *Corynespora cassiicola*, Fusicoccum leaf blight, mistletoe (*Loranthus incanus* – yellow flowered type- and *Loranthus brunneus* – red flowered type), mouldy rot caused by a fungus *Cerotocystis fimbriata*, bark necrosis, Panel necrosis (*Fusarium solani*) etc.

Among different methods of disease control, chemical control is the most important. In rubber plantation, most diseases are caused by fungi. In other to protect rubber plants, appropriate chemicals fungicides and equipment are required in a plantation. The use of effective fungicides has contributed immensely to a reduction in crop losses for sustainable agriculture. There is an array of chemicals available for the treatment of leaf, stem and branch, panel, and root diseases. The aim of the study is to identify and assess the foliar diseases of rubber in farmers' fields and use fungicide to effectively control the diseases.

The objectives of the study were to assess level of rubber foliar diseases in farmers' fields, assist farmers to identify foliar diseases of rubber, determine the efficacy of Mancozeb fungicide in controlling the diseases and to ensure successful establishment of rubber trees in the marginal land.

METHODOLOGY

A field survey was conducted at RRIN Experimental Station, Manchok (Lat. 09^0 41" 39.6, Long. 08^0 28" 18.5 and 939 m above sea level), Southern Kaduna, a non-traditional rubber growing region in Guinea savannah of North Central Nigeria. Nineteen farmers' fields were assessed for the incidence of varying leaf spot diseases. A total of 26 hectares were evaluated for the incidence and treatment of leaf diseases in farmers' fields. The hectares comprised three farm locations with 13, 6 and 7 hectares, respectively. On each location or farm, in which 450 plants were planted per hectare, leaf disease incidence was scored according to the methods of Anegbeh (1997) and Parry (1990) on a scale of

0 = no infection,
1 = light infection,
2 = moderate infection and
3 = severe infection. The disease index was then calculated as follows:

$$\textbf{Disease Index (D.I)} = \frac{(0 \times a) + (1 \times b) + (2 \times c) + (3 \times d)}{a + b + c + d} \times \frac{100}{X}$$

Where,
0, 1, 2, 3, are infection categories; **a, b, c, d,** are numbers of plants that fall into the infection categories; **X** is the maximum infection category which is 4.

Procedure for assessment involved evaluating the plants of about 2-3 m in height for varying degrees of incidence. Leaflets were examined in each group plot. Number of plants that were generally infected under the disease categories (0-3), dead, healthy was evaluated as done by Anegbeh, (1997) and the data were collected as follows:

0 = No infections
1 = Light infections
2 = Moderate infections
3 = Severe infections

Experimental design: Treatments were applied with a knap-Sac Sprayer. Foliar applications of Mancozeb - Ethylene bisdithiocarbamate - (EBDC) at 2 kg/ha was used as the standard fungicide treatment. A non-treated control was included to measure disease incidence. Treatments were arranged in a randomized complete block design with each treatment replicated 4 times.

RESULTS

Treatment that included Mancozeb gave better consistent disease control over time. Results of effect of the test fungicide (Mancozeb) applications eight weeks after the initial applications on rubber seedlings are presented in Tables 1, 2 and 3. Effects of Mancozeb applications on the rubber seedlings in all the three location plots were highly significant ($p < 0.01$). In location I plot of 13 ha (Table 1), percentage of seedlings that recovered from infection after fungicide treatment, ranged from 92.59 to 96.53%. Initial number of infected seedlings was high compared to the number of healthy seedlings with a reduction in the number of survived plants (Figures 1 and 2). However, the number of healthy seedlings after fungicide application was high and highly significant ($P<0.01$), and ranged from 348 to 2,500 in contrast to the number of healthy seedlings in the control which ranged from 15 to 460 (Table 1).

Location plot II of 6 ha showed a similar trend of effect of Mancozeb application, however, but with a higher percentage of healthy seedlings ranging from 97.1 to 98.6%, indicating the efficacy of Mancozeb which was highly significant at $p < 0.01$. Number of healthy seedlings after fungicide treatment was high (321 to 370) as against the number of healthy plants in the control (40 to 150).

Effect of Mancozeb applications on rubber seedlings in location plot 111 (7ha) was highly significant ($p < 0.01$) as 89.6 to 96.4% plants recovered from the disease. Records of healthy seedlings after fungicide treatment were quite high with values ranging from 234 to 381 compared to those obtained in the control which ranged from 12 to 50. .

Table 1. Effect of Mancozeb application on rubber seedlings in location plot 1 (13 ha)

	Control					After Mancozeb Application	
Plot (ha)	No of seedlings planted out	No of Infected seedlings	No of healthy seedlings	No of dead seedlings	No of Treated seedlings	No of Healthy seedlings	% of seedlings recovered
6	2700	2130	460	110	2590	2500	96.53
3	1350	1,045	305	201	1149	1100	95.74
1	450	357	22	72	378	350	92.59
1	450	274	61	50	400	384	96.00
1	450	312	15	35	415	395	95.66
1	450	276	35	83	367	348	94.82

*($p < 0.01$)

Table 2: Effect of Mancozeb fungicide on rubber seedlings in location plot 11 (6 ha)

	Control					After Mancozeb Application	
Plot (ha)	No of Seedlings Planted out	No of Infected seedlings	No of Healthy Seedlings	No of Dead Seedlings	No of Treated Seedlings	No of Healthy Seedlings	% of Seedling Recovered
1	450	250	150	100	350	345	98.57
1	450	265	70	115	335	326	97.31
1	450	290	44	116	334	321	99.10
1	450	275	75	100	350	340	97.14
1	450	285	60	105	345	338	9797
1	450	340	40	70	380	370	97.37

*(P < 0.01)

Table 3: Effect of mancozeb application of rubber seedlings in location plot III (7 ha)

	Control					After Mancozeb Application	
Plot (ha)	No of Seedlings Planted out	No of Infected Seedlings	No of Healthy Seedlings	No of Dead Seedlings	No of Treated Seedlings	No of Healthy Seedlings	Seedlings Cured (%)
1	450	285	50	115	335	300	89.55
1	450	390	15	45	405	381	94.07
1	450	378	12	60	390	376	96.41
1	450	363	20	67	383	364	95.03
1	450	321	40	89	361	344	95.29
1	450	333	23	94	356	330	92.69
1	450	235	15	200	250	234	93.36

*(P < 0.01)

Figure 1: Infected seedlings in control treatment.

Figure 2: Recovery of seedlings from infections after Mancozeb treatment

DISCUSSION

After Mancozeb applications, there was adequate plant recovery in all the locations (I, II, and III) that were tested. Findings from all the locations were diseases of rubber. However, Ivors (2012) suggested the importance of using a combination of chemical fungicides in a spray program to optimize disease management. The use of chemical fungicides for the control of foliar diseases has been reported to be effective especially Mancozeb fungicide, and provides maximum protection for rubber plants in India and Malaysia (MRB, 2009a; 2009b; consistent with observed plant recovery (healthy seedlings) in fungicide treated seedlings in comparison with control seedlings, a reflection of the efficacy of Mancozeb against the important foliar Punnoose and Bakshi, 1997). In Nigeria, however, the use of chemical fungicides has been reported to be a short term solution, but generally most reliable and popular with farmers because of the effective and quick action (Adejumo, 2005). Other Authors have explored the use of plant extracts for the control of birds-eye disease and economic fungicides (Jaysinghe *et al*., 1995) for the management of white root disease of rubber.

CONCLUSION

- The foliar diseases represent major potential threats to rubber cultivation in Manchok and probably throughout Nigeria as different parts of the rubber seedlings were affected: roots, stems and leaves. These attacks and scale of damage affect rubber seedlings establishment.
- Mancozeb, a chemical fungicide, is effective in controlling foliar diseases of rubber seedlings. The efficacy of Mancozeb in the farmers' fields, therefore, highlighted the importance of chemical fungicides.
- Knowledge on formulation of fungicides, application periods, spraying intervals, safety precautions and cultural practices to reduce infectious diseases are crucial for the control of diseases. Fungicides will remain for the foreseeable future, the most common and often the only way to manage some foliar diseases of rubber.
- The most cost-effective application is preventative, which should be used in combination with cultural disease control such as the use of disease-free planting materials.

RECOMMENDATIONS

- Adequate nursery and field management operations are recommended preferably, an integrated approach to disease management.
- This should involve a holistic approach comprising expertise from research scientists (Pathologists, Soils and Plant Nutrition Scientists, Agronomists).
- Farmers should be trained on identification of symptoms of *Hevea* diseases for early alert of disease incidence.
- The optimum time of chemical application should be four weeks after field planting.
- Provision of protective kits together with adequate chemicals may be useful in controlling foliar diseases in farmers' fields.

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