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Research Paper

THE EFFECT OF DIFFERENT GROUPS OF FUNGICIDES IN CONTROLLING BLACK ROT (*Corticium spp.*) DISEASE AND YIELD OF TEA

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Abstract

An experiment was conducted at Bangladesh Tea Research Institute (BTRI), Srimongal to find out the potentiality of different groups of fungicides against black rot disease (*Corticium spp.*) of tea during mid-March to November 2015. The experiment was laid out using completely randomize block design (RCBD) with ten treatments consist of systemic and contact fungicides having three replications. The treatments were applied two times at fifteen days interval. Only two cases systemic and contact fungicides were alternately applied. Data were collected in terms of weekly green leaves and disease severity at monthly interval following scoring scale. Among all treatments Carbendazim 50WP @750 gm/ha gave the most effective result by increasing the production of made tea and also decrease disease severity, and Coperoxychloride 50WP @ 2.8 kg/ha gave lowest result in made tea production and also have lowest response to disease severity. Comparatively highest and similar yield was found by applying Carbendazim 50WP @750 gm/ha and Carbendazim 50WP+COC. From the result of the experiment it is concluded that carbendazim 50WP @750 gm/ha only and repeat spray with carbendazim followed by COC @ 2.8 kg/ha gave better result for controlling the black rot disease as well as decreasing the severity of the disease.

Key words: *Systemic and Contact Fungicide, Black rot disease*.

INTRODUCTION

Tea (*Camellia sinensis*(L). O. Kuntze*)* is the single most important cash crop that has been contributing a lion's share to the Bangladesh economy. Although it plays significant role in the economy of the country, but the cropsuffer from many problem. [1]

Tea, the most popular beverages in the world, obtained from the flush shoots of the plant *Camellia sinensis* (L). O. Kuntze. It has been cultivated in more than 50 countries.

Most of the tea world production is produced in Asia (81.4%), second is in Africa (15.5%), which is being followed by Latin America (2.0%) [2]

It is one of the largest agro-based industries in Bangladesh. There are 163 tea estates [4] having about 55.25 thousand hectares of land under tea plantation producing about 61.93million kg of made tea [3]

Tea sector contributes 0.11% of GDP and about 0.30 million people are employed in this industry which is about 0.22% of total national employment[5]. The average yield per hectare of tea in Bangladesh is 1,144 kg/ ha which is quit low as compared to some other tea growing countries of the world. Many factors are associated with the low yield of our tea. Crop loss due to diseases is one of the key factors.

Tea is a crop that is grown extensively under monoculture conditions. It has grown under varying climatic and soil conditions. Disease attack may be in a sporadic form or in an epidemic form. When the disease occurs in an epidemic form, it can cause colossal crop loss and can damage the national economy of a country. The majority of the diseases in tea are of fungal origin. More than 400 pathogens cause various diseases in tea [6] viz., foliage, stem and root all over the world.

The disease is persistent in tea ecosystem. The fungus overwinters as sclerotia on tea bushes, shade trees, green-manuring crops and weeds which serve as a source of infection. It grows actively in warm and damp conditions and the fructification starts during the rainy season. The basidiospores are wind-born and germinate only in wet weather or on a wet leaf surface. Therefore, the adaptive strategies, such as, cultural, mechanical or sanitary control methods are more useful than scheduled spray of fungus.[7].

Tea production in Bangladesh is greatly hindered due to a number of pests and disease. Various insects, mites, nematode, algae, fungi and weeds including 25 insects, 4 mites and 12 nematodes: and 1 algal and 18 fungal disease and 37 predominant weed species have been recorded from the tea gardens in Bangladesh. [8]

The disease spectrum of Bangladesh tea consists of one algal disease, 18 fungal diseases and few epiphytes. Since the leaves are the harvest product in tea, foliar diseases play an important role.

Black rot is most important, serious and endemic diseases in Bangladesh. The disease is caused by fungi *Corticiumtheae* and *Corticiuminvisum*. Both the fungi produce similar effect on the bush and sometimes occur together. They attack the maintenance leaves, causing gradual deterioration in the health of the bush and consequent loss of crop. Transformation in to sclerotial stage is a means for survival during the unfavorable weather condition. When favorable condition prevails, they germinate and re-infect. The pressure of diseases and pests on tea depends on the disease and pest control strategy of the plantation and also on the agro-ecological environment, which is different in specific tea growing regions and which varies at different altitudinal levels within the regions.

The disease became evident after about four weeks following the onset of rains. Mature leaves and adjacent stems are infected by the disease causing organisms. Infected leaves do not falloff but remain hanging and attached to the next leaf by means of small pads of mycelium at the point of contact. A white cord mycelium is found in case of *Corticiumtheae* which enters into the leaf through the under surface of the petiole. In case of *Corticiuminvisum* the mycelium is seen only at the petioler base. Reduces the photosynthetic potential of the plant in the mature leaf due to disease effectively.

Brown to blackish lesions noticed on stem. The affected stems failed callusing and rooting. In most cases, the bark of the affected cuttings peeled off easily. Water and nutrients conducting tissues i.e. xylem and phloem were damaged severely [9].

The disease spreads by the basidiospores, which are air- borne and also by contact through pluckers whereby the diseased leaves and spores get transferred onto the uninfected portions. August- September is the peak season for sporulating of pathogen during warm humid days with low sunshine hours. Most of the diseased parts are removed during pruning and hence there is a great opportunity to reduce the disease intensity during LP operations.

Over danse shade, improper air circulation, proximity to jungles and bamboo baries are the pre- disposing factors of the disease occurrence. There is no jat or clone of tea known to be immune to the disease attack under conditions favourable for the fungus.

More than 40% of tea bushes were found to be attached by disease. About 55-60% 0f the plants died due to disease. [10]

A loss in the yield up to 50% on a bush attacked by Black rot when left untreated for four seasons consequently. 27.65% crop loss was observed in 1999 and 37.63% crop loss was recorded in 2000 due to disease. It is assumed that unless any control measures are taken crop loss will gradually increase in case of this type of disease.

Though LP operation reduces the disease severity but it does not eradicate. Efficient chemical spraying is the only method by which the disease incidence can be significantly checked to almost eradication and yield increased. Fungicides when sprayed efficiently at twice using Knapsack type of sprayer, brings down the infection of disease significantly.

New generation fungicides are most frequently used in crops as seed treatment, soil drenching and foliar sprays. To develop an effective disease management programme, compatibility of potential bioagents with fungicides is essential. The combination of biocontrol agents with fungicides would provide similar disease suppression as achieved with fungicide use.It would eliminate the chance of resistance development and would reduce the fungicide application. Fungicide resistance problems, concerns regarding pesticide residues and revocation of registration of certain widely used fungicides have led to increased activity in the development of bioagents against the plant pathogens.so a study was undertaken to find out the efficacy of certain fungicides and their cost- effectiveness for control of Black rot disease.

Application of fungicides is mostly toxic and pollutes the atmosphere by spreading out in the air and accumulating in the soil[11].So, there need to choice the correct fungicides.

Objectives of the Study

- To evaluate efficiency of the different groups fungicides for controlling Black rot disease of Tea.
- To find out the potential group of fungicide for controlling Black rot disease of Tea.

MATERIALS AND METHODS

Site selection:

The experiment was carried out at the main farm of Bangladesh Tea Research Institute (BTRI), Bilashcherra Experimental farm of BTRI.

Duration:

The experiment covered for 8- 9 months during mid-March to November, 2015.

Treatments and Replication:
The experiments were along with a control ten treatments were adopted with three replication. The treatments with different groups of fungicides (systemic, contact, short strain systemic) alone and heterogeneous in repeat spray were applied at fortnight interval. The treatments were

T_1= Control
T_2= Carbendazim 50WP @ 750 gm/ha
T_3= Coperoxychloride 50WP @ 2.8 kg/ha
T_4= Hexaconazole 5 EC @750 ml/ha
T_5= Propiconazole 25EC @750 ml/ha
T_6= Mancozeb 72WP @ 2.0 kg/ha
T_7= Mancozeb+Metalaxyl 80WP @ 2.0 kg/ha
T_8= COC+ Carbendazim
T_9= Carbendazim+ COC
T_{10}= Azoxystrobin+ Difenoconazole 32.5 SC @750 ml/ha

Experimental Design: Complete Randomized Block Design (RCBD)[12].
Plot Size: The plot size was 5 × 3 m = 15 sqm.

Application of Treatments:
The treatments were applied two times in the experimental units at fifteen days interval. In treatment T_9 first spray was applied with systemic fungicide followed by a contact one as 2nd application. In treatment T_8 first spray was applied with contact fungicide followed by a systemic one as 2nd application.

Data collection:
Data collected in terms of disease incidence & severity at monthly interval, weekly yield of green leaves of each plot. Data collection on disease incidence and severity performed by using following 0-5 scoring scale. The standing infection was assessed with eye estimation. A total of 28 rounds data were collected on wt of green leaves of 28 rounds and disease severity
Number of bushes in each plot was counted. To minimize the variation in per rounds of yield data were collected.

Score	Infection
0	No infection
1	1-20% infection
2	21-40% infection
3	41-60% infection
4	61-80% infection

Data calculation:
The disease incidence and severity were calculated by the following two formula (Singh, 2000).

(i) % Disease incidence = $\frac{No.of\ infected\ plants}{Total\ plants} \times 100$

(ii) % Disease Index (PDI) = $\frac{Sum\ of\ total\ rating}{Total\ No.\ of\ plants \times Highest\ grade} \times 100$

Analysis of Data:
Collected data analyzed statistically by using MSTAT-C a computer package. Mean comparison was done following Duncan Multiple Range Test (DMRT) at 5% level of probability.

RESULTS
The experiment was conducted to find out the effect of different groups of fungicide over Black rot disease. A tabular presentation of the identification and treatment are discussed in this chapter.
All treatments caused significant reduction in severity of Black rot disease of tea in terms of PDI (Percentage of Disease Incidence) and increase of yield of made tea as compared to control.
Among the treatments, T_2 (carbendazim @ 750 gm/ha) showed better performance in increasing production of tea (2268.41 kg/ha). It is more or less statically (P = 0.05) similar to T_9 (carbendazim+COC)and T_5 (Propiconazole 25EC @750 ml/ha). There were also assigned by systemic fungicides. Accordingly decreasing PDI (Percentage of Disease Incidence) was found in the same treatments (Table 1 & 2).

Table 1: Showing the Effect of different groups of fungicides on the severity of Black rot disease.

Treatments	Disease Severity (PDI)
T_1= Control	4.79 a
T_2= Carbendazim 50WP @ 750 gm/ha	**2.08 e**
T_3= Coperoxychloride 50WP @ 2.8 kg/ha	4.41 a
T_4= Hexaconazole 5 EC @750 ml/ha	2.73 d
T_5= Propiconazole 25EC @750 ml/ha	2.73 d
T_6= Mancozeb 72WP @ 2.0 kg/ha	4.26 ab
T_7= Mancozeb+Metalaxyl 80WP @ 2.0 kg/ha	3.39 c
T_8= COC+ Carbendazim	2.66 d
T_9= Carbendazim+ COC	**2.55 de**
T_{10}= Azoxystrobin+ Difenoconazole 32.5 SC @750 ml/ha	3.73 bc

Values are expressed as mean of three observation, different letters are significantly different by DMRT (p>0.05)

By using fungicides we found height decrease of PDI (Percentage of Disease Incidence) in T_2 (Carbendazim 50WP @ 750 gm/ha) and T_9 (Carbendazim+ COC).

Table 2: Showing the Effect of different groups of fungicides to increase the yield of tea

Treatments	Made tea (Kg/ha)
T_1= Control	1863.15 h
T_2= Carbendazim 50WP @ 750 gm/ha	**2268.41 a**
T_3= Coperoxychloride 50WP @ 2.8 kg/ha	2071.07 g
T_4= Hexaconazole 5 EC @750 ml/ha	2226.09 bc
T_5= Propiconazole 25EC @750 ml/ha	2190.21de
T_6= Mancozeb 72WP @ 2.0 kg/ha	2156.48 f
T_7= Mancozeb+Metalaxyl 80WP @ 2.0 kg/ha	2194.20 de
T_8= COC+ Carbendazim	2207.54 cd
T_9= Carbendazim+ COC	**2248.94 ab**
T_{10}= Azoxystrobin+ Difenoconazole 32.5 SC @750 ml/ha	2175.64 ef

Values are expressed as mean of three observation, different letters are significantly different by DMRT (p>0.05)

By using fungicides we observed height yield in T_2 (Carbendazim 50WP @ 750 gm/ha) and T_9 (Carbendazim+ COC).

Figure 2 revealed the percent increased yield are the control against individual treatment. Height increased yield was found in T_2, which was 21.75% followed by T_9 (20.7%) and T_4 (19.47%). The treatment showed 25.35% effect in increasing the yield and defined 1.05 unit against per unit treatment as input.

The yield of made tea was linearly and negatively correlated with severity of black rot disease and yield of tea. Their relationship could be expressed by the regression equation Y= 1.0502× + 10.161, where Y represented yield of tea and x represented slop of the equation. The R^2 value indicated that the effect of chemical to increase yield is 25.35% (Fig 2). Here T_1 (control) is considered as zero.

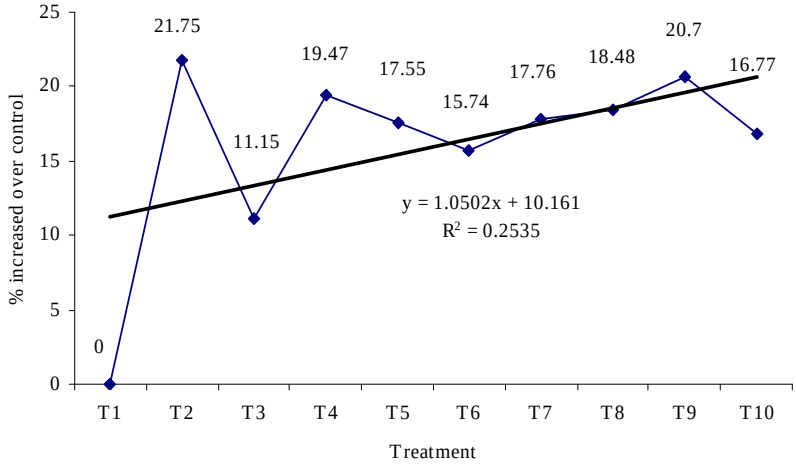

Figure 2: Increased of yield over control.

The relation between treatments and percent ecrease of PDI is positively direction. Their relationship could be expressed by the regression equation Y= 1.4529× + 22.42, where Y represented yield of tea and x represented slop of the equation. The R^2 value indicated that the effect of chemical to decrease PDI is 5.21% (Fig 3)

In figure 3, highest percent decrease of PDI was shown in T_2 (56.57%). There is a positive regration with treatments and decreasing PDI and it is defined as 1.45 units. Here T_1 (control) is considered as zero.

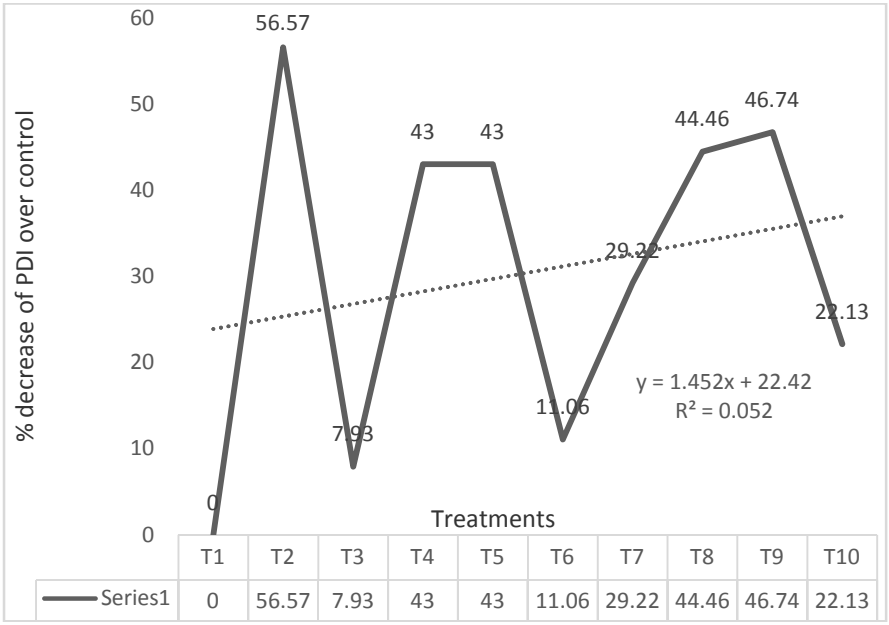

Figure 3: Decrease of PDI over control.

Figure 4 shows the tea plant before and after using of fungicide. This figure shows the different between infected and treated plant.

DISCUSSION

The Black rot infected tea field, 2 times of carbendazim 50WP based fungicide @ 750g/ha mixed in 1000 L of water at 15 days interval gave maximum performance in controlling the disease severity as well as increasing the yield of tea. Compare to contact fungicides, systemic fungicide showed better effect. It the repeat application is performed by contact fungicide followed by a systemic showed comparatively next to higher result. Only contact fungicide does not show result like systemic fungicide.

The application T_6 (Mancozeb 72WP @ 2.0 kg/ha) the surface of the host plant of fungicides which prevent the germination of spore one kill the germ tubes before they can enter the tissues is most widely used means of attack on plant pathogens.

After application of systemic fungicides these are translocated within the plant. The pathogen which entered into the host cell are killed and stopped to spread newly. It may also after the multiplication of the host so that the biochemical or physical resistance to pathogen may be increased.

Bavistin 50WP (systemic fungicide) than indofil 80WP in controlling the cercospora leaf spot of mungbear[13]. This research indicate that the present study is similar to this research. Because both Carbendazim and Bavistin are systemic fungicide.

The nematode population in the soil treated with Rynaxypyr 0.4G was the lowest due to the height mortality (85.80%) followed by Fipronil 3GR (82.00%) and Carbofuran 5G (81.71%)[14]. This study shows the similarity to the present experiment.

The performance as contact 5EC (systemic fungicide) to be the best in reducing the percent relative lesion height, percent (PDI) and tiller infection[15]. This study shows the similarity to the present experiment.

A systemic fungicide Carbendazim @ 750 g /ha gave the better result to minimize the Gall disease as well as to achieve higher yield over other treatments[16]. Which have supported the present experiment.
Carbendazim and Calixin were highly effective in completely inhibiting the growth of *Phomosistheae* at lowest concentration of 50 and 100 ppm, respectively[17]. Which is similar to current observation.

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