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SCREENING OF FUNGICIDES AND PLANT EXTRACTS FOR CONTROLLING BLIGHT DISEASE OF *TAGETES* SPP.

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Abstract

A field experiment was conducted in the Botanical research garden, Department of Botany, University of Dhaka during 2015, 2016 and 2017 to evaluate the efficacy of two fungicides and two plant extracts against blight disease of *Tagetes erecta* L. and *T. patula* L. Both the fungicides Bavistin 50 WP and Tilt 250 EC and leaf extracts of *Azadirachta indica* A. Juss. and *Citrus medica* L. showed effective management of the disease over the untreated check. However, among the treatments, Bavistin 50 WP and Tilt 250 EC at 100 ppm concentration and *A. indica* and *C. medica* L. at 10% concentration were found significantly superior in controlling percent disease index and increasing number of healthy flowers. The number of healthy flowers was highest per plant, 17.13 in *T. erecta* in 2017 and 25.00 in *T. patula* in the year 2016.

Key words: Screening, Fungicides, Plant extracts, Blight, *Tagetes* spp.

Introduction

Tagetes erecta and *Tagetes patula* belong to Asteraceae (Compositae) family, and it is native to North and South America, but some species now become naturalized worldwide. *Tagetes erecta* are sometimes known as American or African marigolds, and *Tagetes patula*s is French marigold. French Marigolds are commonly planted in butterfly gardens as a nectar source. The florets of *Tagetes* spp. are rich in orange, yellow carotenoid, lutein and are used as a food color. The essential oil of the flower contains antioxidants (Politi *et al*. 2016). Seeds of *T. erecta* is a natural pesticide. Leaves are used as blood clotting agents in Ayurbedhic treatment. Plants has antifungal properties also. The plant is also used against fever, dysenteries, indigestions, ulcers, and eczemas (Ahmed *et al*. 2008, Ghani 2003 and Yusuf *et al*. 2009). It is most effective against the nematode species *Pratylenchus penetrans* (Olabiyi and Oyedunmade 2000 and Politi *et al*. 2012). The plant also has mosquitocidal potentiality (Rajasekaran *et al*. 2004). In Bangladesh, flowers are very popular for decorative purposes. Marigold is now a profitable cultivated crop to the farmers, but socioeconomic data and information of this

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flower is very scarce in Bangladesh. Diseases were major problems for marigold cultivation. Fungal or bacterial to the diseases are the main obstacles to the rapid expansion of commercial marigold cultivation in Bangladesh. In many cases, disease occurrence is an important threat for commercial cultivation of marigold, blight and leaf spot are two common diseases of *Tagetes* spp. Mukerji and Bhasin (1986) reported blight inflorescence leaf spot, gray mould, powdery mildew, flower and bud rot diseases of *Tagetes* spp. from India. Powdery mildew, gray mold, white mold (Bakr *et al*. 2010, Sultana and Shamsi 2011 and Rahman *et al*. 2015), and blight disease of marigold have been reported from Bangladesh (Aktar and Shamsi 2014, 2015, 2016, 2018a).

However, reports on the management of blight disease of *Tagetes* spp. are inadequate in Bangladesh (Rahman *et al*. 2015). Therefore, the present study was undertaken to evaluate the efficacy of selected fungicides and plant extracts against blight disease of *T. erecta* and *T. patula*. Though, as control measures, chemical fungicides and leaf extracts are reported to control blight diseases of various plant spp (Yasmin and Shamsi 2019). So, it is necessary to find out the effective and sustainable control measure of blight disease of *Tagetes* spp. in our country.

Materials and Methods

The field experiments were conducted in the field plots of Botanical research Garden, Dhaka University, during 2015, 2016, and 2017. Efficacy of selected fungicides and plant extract were studied on *T. erecta* and *T. patula*. The pathogenic potentiality of *Alternaria alternata*, the causal agent of blight symptom, was determined by the methods of Aktar and Shamsi (2014). The concentration of fungicides and plant extract was prepared following Aktar and Shamsi (2018b). Particulars of the fungicides and plant extracts are presented in Tables 1 and 2. The experimental design was followed by Islam *et al*. (2015-16).

The field plots were prepared in November of each experimental year. Biofertilizer was used during field preparation. Three weeks old, fifteen seedlings were transplanted in each sub-plot measuring 1.5 × 1 m. Spacing between sub-plots was 1 m. The plants were spaced 25 cm by 25 cm. Ten plants were randomly selected to record disease severity and production of healthy flowers.

The experimental design was random block design (RBD), having three replications. Data were recorded after 15 days of each spray. Final data were recorded after 15 days of the last spray. The percent disease index (PDI) was calculated by the formula of Rahman

and Rashid (2008). The disease severity was recorded by using 0-9 scale. For visual estimation of severity, a 0-9 point DS scale was used for rating of all foliar diseases studied (PDI=McKinney's Index, Ghos *et al.* 2009).

No infection = 0, 0-10% leaf area infected = 1, 10-20% leaf area infected = 2, 20-30% leaf area infected = 3, 30 – 40% leaf area infected = 4, 40 – 50% leaf area infected = 5, 50-60% leaf area infected = 6, 60-70% leaf area infected = 7, 70-80% leaf area infected = 8, 80-90% or more leaf area infected = 9.

The incidence and severity of blight of *T. erecta* and *T. patula* were recorded from the plants grown in gardens of Curzon Hall Campus, Dhaka University. Each plot was visited and data were recorded twice a month. Data were expressed in percentage. Similarly percent disease incidence (PDI) was recorded using the following formula:

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

Two fungicides, Bavistin 50 WP and Tilt 250 EC at 100 ppm concentration and leaf extracts of *A. indica* and *C. medica* at 10% concentration, were applied on *T. erecta* and *T. patula* (Tables 1 and 2). Control plants were treated with water. A total of four sprays were done at 15 days intervals.

Table 1. Particulars of the fungicides used in the experiment.

Sl. No.	Trade name	Formulation	Recommended dose (ppm)	Ten times lesser of recommended dose (ppm)	Manufacturers
1.	Bavistin	50 WP	500	100	BASF Bangladesh Ltd.
2.	Tilt	250 EC.	1000	50	Syngenta (BD) Ltd.

Table 2. Particulars of the plant extracts used in the experiment.

Sl. No.	Plant species	Used part	Family
1.	*Azadirachta indica* A. Juss	leaves	Meliaceae
2.	*Citrus medica* L.	leaves	Rutaceae

Analysis of data: Data on different parameters were analyzed following computer package MSTAT-C and means were compared using DMRT. The data were collected and evaluated by analysis of variance (ANOVA) by using STAR statistical program.

Results and Discussion

In 2015-2017, out of four treatments, Tilt 250 EC showed promising results in controlling blight of *T. erecta.* Percent disease (PDI) value was lowest 3.27 in 2015, 3.27 in 2016 and 3.41 in 2017. The number of infected flowers/plant was lowest 1.57 in 2015, 2.93 in 2016, and 5.50 in 2017, respectively. The number of healthy flowers/plant was a maximum 10.13 in 2015, 14.93 in 2016, and 17.13 in 2017 (Table 3)

Bavistin 50 WP showed 6.08 in 2015, 5.65 in 2016, and 6.04 in 2017 PDI in blight infected plants. Infected flowers per plant were 4.13 in 2015, 4.53 in 2016, and 7.23 in 2017. Healthy flowers per plant were 9.17 in 2015, 9.40 in 2016, and 10.10 in 2017 (Table 3).

Table 3. Screening of fungicides and leaf extracts for controlling blight disease of *T. erecta.*

Experiment year	Treatment	PDI	No. of infected flower/plant	No. healthy flower per plant
2015	Bavistin 50 WP	6.08 b*	4.13 ^{ab}	9.17 ^{ab}
	Tilt 250 EC	3.27 ^{d}	1.57 ^{d}	10.13 ^{a}
	Azadirachta indica	4.76 ^{c}	3.17 ^{c}	8.40 ^{b}
	Citrus medica	6.04 ^{b}	3.30 ^{bc}	6.30 ^{c}
	Control	7.54 ^{a}	4.53 ^{a}	5.23 ^{c}
	CV (%)	10.18	13.27	8.96
2016	Bavistin 50 WP	5.65 ^{ab}	4.53 ^{ab}	9.40 ^{d}
	Tilt 250 EC	3.27 ^{d}	2.93 ^{c}	14.93 ^{a}
	Azadirachta indica	4.77 ^{c}	3.33 ^{c}	12.67 ^{b}
	Citrus medica	5.03 ^{bc}	4.07 ^{b}	11.07 ^{c}
	Control	6.37 ^{a}	4.83 ^{a}	7.80 ^{e}
	CV (%)	7.58	7.30	4.72
2017	Bavistin 50 WP	6.04 ^{a}	7.23 ^{ab}	10.10 ^{c}
	Tilt2 50 EC	3.41 ^{d}	5.50 ^{d}	17.13 ^{a}
	Azadirachta indica	4.58 ^{c}	6.57 ^{bc}	16.53 ^{a}
	Citrus medica	5.18 ^{b}	6.13 ^{cd}	13.67 ^{b}
	Control	6.27 ^{a}	7.83 ^{a}	8.60 ^{d}
	CV (%)	3.17	8.06	5.89

*Means followed by the same letter within a column did not differ significantly at the 5% level by DMRT.

Leaf extract of *Azadirachta indica* showed 4.76 in 2015, 4.77 in 2016, and 4.58 in 2017 PDI in blight infected plants. Infected flowers per plant were 3.17 in 2015, 3.33 in 2016 and 6.57 in 2017. Healthy flowers per plant were 8.40 in 2015, 12.67 in 2016, and 16.53 in 2017 (Table 3).

Citrus medica showed 6.04 in 2015, 5.03 in 2016 and 5.18 in 2017 PDI in blight infected plants. Infected flowers per plant were 3.30 in 2015, 4.03 in 2016, and 6.13 in 2017. Healthy flowers per plant were 6.30 in 2015, 11.07 in 2016, and 13.67 in 2017 (Table 3).

Whereas the control plant showed 7.54 in 2015, 6.37 in 2016, and 6.27 in 2017 PDI in blight infected plants. Infected flowers per plant were 4.53 in 2015, 4.83 in 2016, and 7.83 in 2017. Healthy flowers per plant were 5.23 in 2015, 7.80 in 2016, and 8.60 in 2017 (Table 3 and Plate 1, A-E).

In 2015-2017, out of four treatments, Tilt showed the promising result in controlling blight of *T. patula,* Percent disease index (PDI) value was lowest at 2.91 in 2015, 4.27 in 2016, and 3.23 in 2017, respectively. The number of infected flowers/plant was lowest at 3.30 in 2015, 1.70 in 2016, and 2.80 in 2017, respectively. The number of healthy flowers/plant, was maximum 15.30 in 2015, 25.00 in 2016, and 23.17 in 2017, respectively. Whereas Bavistin showed 5.28 in 2015, 5.31 in 2016, and 5.29 in 2017, respectively PDI in blight infected plants (Table 4).

Infected flowers per plant were 4.40 in 2015, 3.67 in 2016, and 3.63 in 2017, respectively. Healthy flowers per plant were 12.97 in 2015, 11.07 in 2016, and 15.73 in 2017, respectively (Table 4).

In 2015, plants treated with leaf extracts of *A indica* showed 3.48 PDI, number of infected flowers per plant 4.10, and number of healthy flower per plant 15.17 respectively. In 2016, plants treated with extracts of *A. indica* showed PDI 4.96, number of infected flowers per plant 6.33, and number of healthy flower per plant 23.47, respectively. Moreover, in the 2017 experimental year, PDI 4.36, the number of infected flowers per plant 2.90, and the number of healthy flower per plant 21.43 were recorded (Table 4).

Whereas, in the experimental year 2015, plants treated with showed leaf extract of *C. medica* showed PDI 4.45, the number of infected flowers per plant 4.57, and the number of healthy flower per plant 12.17, respectively. In the 2017 experimental year, PDI 5.03, the number of infected flowers per plant 3.30, and the number of healthy flowers per plant 15.53 were recorded (Table 4).

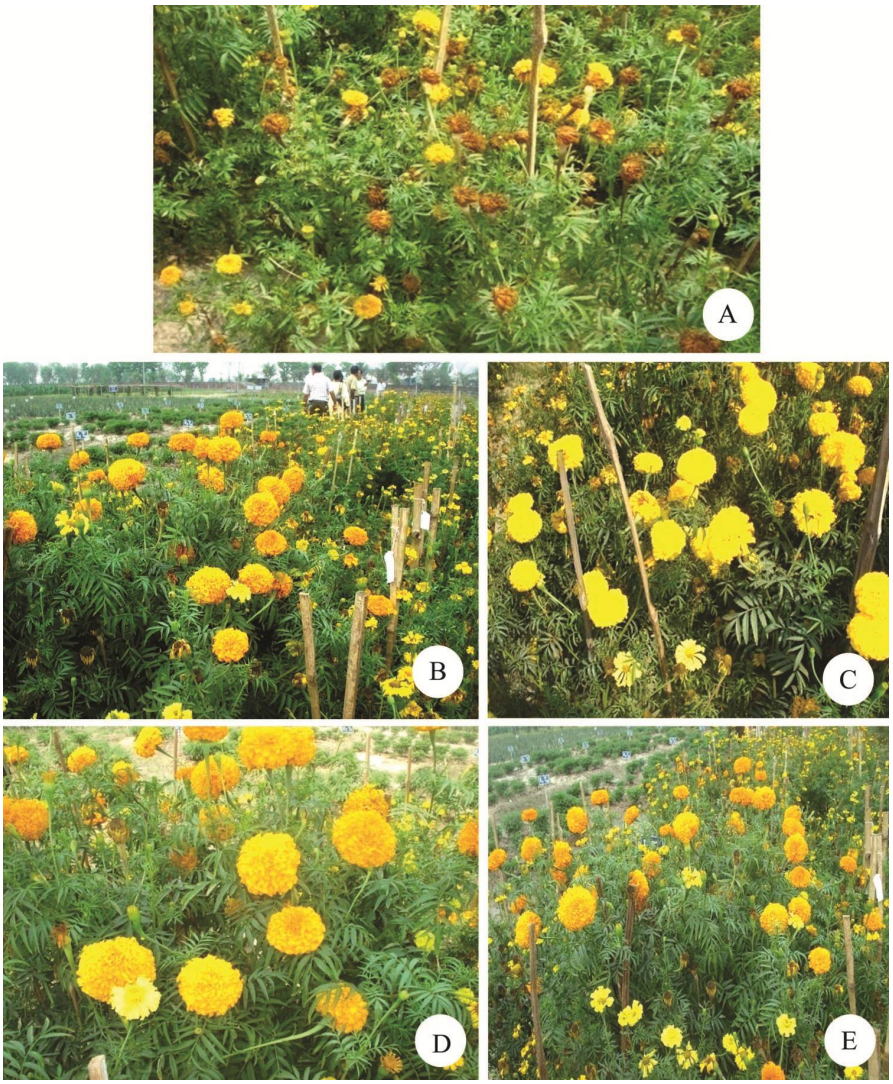

Plate 1. Effects of fungicides and leaf extracts on the yield of flowering of *T. erecta*: A. Control, B. Bavistin, C. Tilt, D. *A. indica* and E. *C .medica.*

Subsequently, Control plants treated with water showed 5.44 in 2015, 6.20 in 2016, and 5.80 in 2017 PDI in blight infected plants. Infected flowers per plant were 6.17 in 2015, 6.80 in 2016, and 4.63 in 2017. Healthy flowers per plant were 9.53 in 2015, 8.33 in 2016, and 7.77 in 2017 (Table 4 and Plate 2, A.E).

Table 4. Screening of fungicides and leaf extracts for controlling light disease of *T. patula.*

Experiment year	Treatment	PDI	No. of infected flower/plant	No. healthy flower per plant
2015	Bavistin 50 WP	5.28 [a*]	4.40 [b]	12.97 [b]
	Tilt 250 EC	2.91 [d]	3.30 [c]	15.30 [a]
	Azadirachta indica	3.48 [c]	4.10 [b]	15.17 [a]
	Citrus medica	4.45 [b]	4.57 [b]	12.17 [b]
	Control	5.44 [a]	6.17 [a]	9.53 [c]
	CV (%)	6.02	21.62	3.87
2016	Bavistin 50 WP	5.31 [b]	3.67 [b]	11.07 [b]
	Tilt 250 EC	4.27 [c]	1.70 [c]	25.00 [a]
	Azadirachta indica	4.96 [b]	6.33 [a]	23.47 [a]
	Citrus medica	5.08 [b]	6.50 [a]	20.10 [a]
	Control	6.20 [a]	6.80 [a]	8.33 [b]
	CV (%)	6.39	10.67	20.89
2017	Bavistin 50 WP	5.29 [ab]	3.63 [b]	15.73 [b]
	Tilt250 EC	3.23 [d]	2.80 [c]	23.17 [a]
	Azadirachta indica	4.36 [c]	2.90 [c]	21.43 [a]
	Citrus medica	5.03 [b]	3.30 [bc]	15.53 [b]
	Control	5.80 [a]	4.63 [a]	7.77 [c]
	CV (%)	6.68	10.50	8.46

*Means followed by the same letter within a column did not differ significantly at the 5% level by DMRT.

Various workers in different countries of the world evaluated the efficacy of other fungicides against *Colletotrichum* spp., *Phomopsis vexans*, *Macrophomina phaseolina*, *Rhizopus nodosus*, *Fusarium* spp., *Phoma* spp., *Botryodiplodia theobromae*, *Colletotrichum gloeosporioides*, *Sclerotium rolfsii* and *Alternaria* spp., under laboratory and field conditions (Stirling *et al.* 2004,Chowdhury *et al*. 2015, Mamun *et al*. 2016 and Hosen *et al*. 2016). But fungicide's toxicity is not always restricted to the target pest organism, also observed in mammals, including humans (Belpoggi *et al.* 2002). Most fungicides can cause acute toxicity, and some cause chronic toxicity as well (Goldman 2008). The World Health Organization (WHO) and the United Nations Environment Program (UNEP) estimates that each year, three million workers in agriculture in the developing world experience severe poisoning from pesticides, about 18,000 of whom die (Panday *et al.* 1983). However, care should be taken during the use of the fungicides.

Some pest management researchers have focused on developing alternative inputs to synthetic chemicals for controlling diseases (Pal and Gardener 2006 and Baker 1987). One of them is the use of biological antagonists and plant extracts. Biological control presents a better alternative with relatively low cost, no side effects, and reduced resistance development in the pathogen (Okigbo and Nmeka 2005).

Plate 2. Effects of fungicides and leaf extracts on the yield of flowering of *T. patula*: A. Control, B. Bavistin, C. Tilt, D. *A. indica* and E. *C. medica.*

Islam *et al.* (2015-2016) observed that in field trial Tilt 200 EC (Propiconazole, Dose 0.1 ml/l) and Secure 600 WG (Mancozeb + Fenamidone, Dose 2 g/l) were significantly reduced the severity of *Botrytis* blight of marigold. Autostin and Tilt at 100 ppm concentration and *Azadiractaindica* and *Citrus limon* at 10% concentration were found significantly superior in controlling the disease severity, PDI (Percent disease index), and increasing number of healthy leaves.

As control measures, chemical fungicides, leaf extracts are successfully reported to control leaf spot and anthracnose diseases (Yasmin and Shamsi 2019).

The present study also reported that the fungicides Bavistin 50 WP and Tilt 250 EC and leaf extracts showed effectively manage the disease over control. However, among the treatments Bavistin 50 WP and Tilt 250 EC at 100 ppm concentration and *Azadirachta indica* A. Juss. and *Citrus medica* L. at 10% concentration was found significantly superior in controlling PDI and increasing number of healthy flowers.

Conclusion

Blight disease drastically damaged the plants of *Tagetes*. Considering the importance of the plant, it is necessary to save the plaat immediately. The present investigation is the first approach to controlling the blight disease of the plants mentioned above in Bangladesh. The findings of this research work will be helpful for designing a proper management of blight disease. Application of Bavistin and Tilt at 100 ppm concentration may be commercially used for managing blight disease of *T. erecta* and *T. patula*. For more confirmation, the above mentioned fungicides also need to 2-3 years trial in field condition. In small-scale gardening or those persons who want to maintain the plants in the yard for medicinal or recreation purposes, *A. indica* and *C. medica* at 10% concentrations can be useful for controlling blight disease.

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