



E-ISSN: 2278-4136

P-ISSN: 2349-8234

www.phytojournal.com

JPP 2020; 9(2): 1660-1663

Received: 04-01-2020

Accepted: 08-02-2020

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Eco-friendly management of northern Corn leaf blight of maize (*Zea mays* L.)

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DOI: <https://doi.org/10.22271/phyto.2020.v9.i2ab.11094>**Abstract**

Maize is known as 'Queen of cereals' and used for both as food and fodder purposes. In India its production and productivity in 2017-18 were 25,000MT and 2.63MT/Ha respectively. In enlist of some major diseases, Northern Corn Leaf Blight disease is more prevalent in India and high wide host range and yield losses upto 25-90% caused by *Exserohilum turcicum* Pass. As the diseases are incurable but can be prevented by seed treatments with chemicals. As the uses of chemicals are hazardous these days, therefore an experiment entitled "Eco-friendly management of Northern Corn Leaf Blight of maize (*Zea mays* L.)" was carried out with some essential oils of botanicals and bio-agent. In field condition treatments as seed treatments were: Neem oil, Eucalyptus oil, Clove oil, *Trichoderma viride*, Neem oil and *Trichoderma viride*, Eucalyptus oil and *Trichoderma viride*, Clove oil and *Trichoderma viride* and control (untreated). Results showed combination treatment of Clove oil + *Trichoderma viride* @ 5% followed by Neem oil + *Trichoderma viride* @ 5% were best effective for the increment of plant growth parameters, viz. plant height, number of leaves. Besides, promoting plant growth, the treatments were most affective in disease reduction with a highest reduction in Clove oil + *Trichoderma viride* @ 5% (17.99%) followed by Neem oil + *Trichoderma viride* @ 5% (19.74%).

Keywords: Botanicals, bio-agent, Northern Corn Leaf Blight, *Exserohilum turcicum* Pass., Eco-friendly**Introduction**

Maize is known as 'Queen of cereals' and 'Miracle crop' because of its immense potential. It is the 3rd major crop in India after rice and wheat (Reddy *et al.*, 2013) ^[10]. Maize is tall annual plant which grows to a height of 100cm-300cm. The nutritional requirement for maize, are N 60-120, P₂O₅ 60-70, K₂O 90-110 Kg ha⁻¹ (Sarvari and PEPO, 2014). Globally, Maize area, production and productivity in 2017-18 are 1,80,639 hectare (Ha), 10,33,664 Metric tonne and 5.72 million tonne/hectare respectively (NCoMM commodities report, 2017).

Maize can be used in many ways like as Maize flour, Corn syrup, Kitty litter, Cornstarch, and Maize mazes etc. Maize is generally used as food and fodder crop. Maize is cross-pollinated crop but self-pollination may occur 5-10 per cent (Singh *et al.*, 2014) ^[12]. It's origin is 'Mexico' and family is 'Graminea'. Nutritional value of maize on percentage dry matter basis are as following starch (71-72%), protein (9-10%), fat (4-45%), fibre (9-10%), sugar (2-3%), minerals (Ash) 1.4%. It is the single and largest source of calories and protein for the poor. Enlist of some major diseases in maize are northern corn leaf blight, southern corn leaf blight, gray leaf spot, curvularia leaf spot, brown spot, head smut, common rust, root rot, banded leaf and sheath leaf blight etc. (Dey *et al.*, 2015) ^[5]. It is rich in macronutrients and micronutrients like Calcium, Potassium, Zinc, Iron, Selenium, Manganese and Magnesium. It can be germinate in 21°C and for growth 32°C. The nutritional requirement for maize, are N 60-120, P₂O₅ 60-70, K₂O 90-110 Kg ha⁻¹ (Sarvari and PEPO, 2014).

NCLB or TLB is a foliar fungal disease caused by *Exserohilum turcicum* (Pass.) but this pathogen is early known as *Helminthosporium turcicum* Pass. This disease is more prevalent in humid areas with moderate temperatures. This pathogen has high wide host range and yield losses upto 28-91% in Tanzania (Nwanosike *et al.*, 2015) ^[9]. The pathogen and the disease were first reported by Passerini (1876) from Parma, Italy. Luttrell (1957) described the perfect stage of the fungus as *Trichometaspheria turcica*. The perfect state of *Exserohilum turcicum*, *Setosphaeria turcica* (Luttrell) is rarely found in nature (Leonard and Suggs., 2009).

NCLB or TLB has long, elliptical, gray-green lesions and as the lesions mature, they become tan with darkish zones of fungal sporulation. The lesions are 3-15 cm in length and lesions look like cigar shaped. This infection starts inhibiting photosynthetic activities on leaf surface. The lesions appear to dark grey, olive or black and the gray black mold layer is the pathogen's conidia and conidophores (K. S. Hooda *et al.*, 2017) ^[6].

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It is a heterothallic facultative parasitic fungus (Luttrell, 1957). It reproduces both sexually and asexually but the sexual/perfect stage rarely occurs in nature (Wani *et al.*, 2017)^[15]. The typical symptom of NCLB disease showed abundant lesions on the leaves of susceptible cultivars (5-20 cm long), greyish to tan in colour and elliptical in shape and colonies on PDA are dark grey to blackish brown in colour and grow faster (Bashir *et al.*, 2018)^[2].

Materials and Methods

A field experiment was carried out with various seed treatments during *Kharif* season (monsoon) 2018 at Central research farm, department of plant pathology, Allahabad School of Education, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. The experiment was conducted in a randomized block design with a plot size of 2 x 2 m² and replicated three times. Eight treatments were used as seed treatment for disease management in field condition *viz.*, T₀ (untreated control), T₁ (Neem oil @ 5%), T₂ (Eucalyptus oil @ 5%), T₃ (clove oil @ 5%), T₄ (*Trichoderma viride*@5%), T₅ (Neem oil + *Trichoderma viride* @ 5%), T₆(Eucalyptus oil + *Trichoderma viride* @ 5%), T₇ (Clove oil + *Trichoderma viride* @ 5%). The observations for growth parameters such as plant height, number of leaves and disease severity was recorded from five randomly selected plants using disease intensity calculated by using formula below:

$$\text{Percent Disease Index (\%)} = \frac{\text{Sum of all numerical rating}}{\text{Total no. of rating} \times \text{maximum disease grade}} \times 100$$

Results and Discussion

Field evaluation of Northern Corn Leaf Blight disease intensity of Maize:

The results of study entitled “Eco-friendly management of Northern Corn Leaf Blight Maize (*Zea mays* L.)” under field conditions were conducted at research field of Department of Plant Protection, Sam Higginbottom University of Technology and Sciences, prayagraj during *kharif* season 2018. The data shows that maximum shoot length (cm) was recorded in treatment T₇ Clove + *Trichoderma viride* (201.33)

followed by the T₅ Neem oil + *Trichoderma viride* (201.20), T₄ *Trichoderma viride* (200.60), T₆ Eucalyptus oil + *Trichoderma viride* (199.93), T₃ Clove oil (199.47), T₁ Neem oil (199.33), T₂ Eucalyptus oil (199.27) and T₀ untreated control (197.13) [Table 1, fig.1]

From the observations for no. of leaves, maximum number of leaves was recorded in treatment T₇ Clove oil + *Trichoderma viride* (13.53), followed by T₅ Neem oil + *Trichoderma viride* (13.47), T₄ *Trichoderma viride* (13.40), T₆ Eucalyptus oil + *Trichoderma viride* (13.33), T₃ Clove oil (13.27), T₁ Neem oil (13.20), T₂ Eucalyptus oil (13.13) and T₀ untreated control (12.40) [Table 2, figure 2]. The results were similar to Kakraliya *et al.* 2017^[8] where they recorded highest plant height (cm.) was observed in *T. viride* (78.82) followed by *T. harzianum* (78.27) as compared to control (70.04). Similarly, Chozin *et al.* 2018^[4] observed the antifungal effect of individual constituent extracts made from neem leaf, betel leaf, clove leaf, lemon grass leaf, and galangal rhizome on NCLB of Maize. They reported that clove leaf + neem leaf had similar effectiveness having maximum plant height and number of leaves.

Observations for Northern Corn Leaf Blight disease was recorded at 45, 60 and 75 days after sowing. The data reveals that minimum disease intensity (%) was greatly reduced in treatment T₇ Clove oil + *Trichoderma viride* (17.993), followed by T₅ Neem oil + *Trichoderma viride* (19.744), T₄ *Trichoderma viride* (19.900), T₆ Eucalyptus oil + *Trichoderma viride* (20.243), T₃ Clove oil (22.636), T₁ Neem oil (23.636), T₂ Eucalyptus oil (26.213) and T₀ untreated control (45.783). The results are similar to Sreenivasa *et al.* 2011 who studied the antifungal activity of essential oils from clove, cedar wood, *Cymbopogon* species, peppermint, *Eucalyptus* and neem against nine soil borne pathogens isolated from Maize and Sorghum. They reported that essential oils were antifungal at concentrations of 500–2500 ppm or higher.

Similarly, Kantapa *et al.* 2012; Beg and Ahmad 2002 showed that seeds coated with clove oil (CO) and basil oil (BO), clove oil (CO) and peppermint oil (PO) and basil oil (BO) and peppermint oil (PO) at ratio of 1:3, 1:1 and 3:1 were effective against seed-borne and air borne fungi of Maize.

Table 1: Effect of treatments on plant height (cm) of maize (*Zea mays* L.) at 30, 45, 60 and 75 DAS

Treatments		15 DAS	30 DAS	45 DAS	60 DAS	75 DAS
T ₀	Control	25.266	77.533	180.000	192.000	197.133
T ₁	Neem oil	25.666	80.666	181.666	193.066	199.333
T ₂	Eucalyptus oil	25.466	80.200	181.533	192.266	199.266
T ₃	Clove oil	25.933	80.733	181.733	193.800	199.466
T ₄	<i>Trichoderma viride</i>	26.133	82.000	183.066	194.600	200.600
T ₅	Neem oil + <i>Trichoderma viride</i>	26.266	82.200	183.200	195.333	201.200
T ₆	Eucalyptus oil + <i>Trichoderma viride</i>	26.066	81.466	182.133	193.933	199.933
T ₇	Clove oil + <i>Trichoderma viride</i>	26.333	83.400	184.000	195.400	201.333
F- test		NS	S	S	S	S
C. D. (P = 0.05)		----	2.389	2.055	2.294	2.246

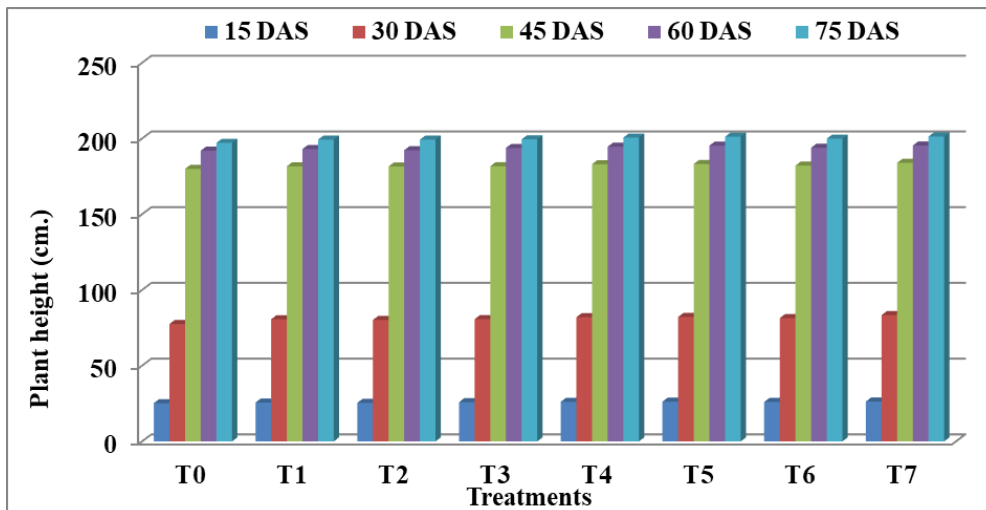


Fig 1: Effect of treatments on plant height (cm.) of maize (*Zea mays* L.) at 15, 30, 45, 60 and 75 DAS

Table 2: Effect of treatments on Number of leaves in maize at 15, 30, 45, 60 and 75 DAS

Treatments		15 DAS	30 DAS	45 DAS	60 DAS	75 DAS
T ₀	Control	4.400	9.000	10.866	11.200	12.400
T ₁	Neem oil	4.533	9.333	11.266	11.933	13.200
T ₂	Eucalyptus oil	4.466	9.266	11.200	11.866	13.133
T ₃	Clove oil	4.666	9.400	11.333	12.000	13.266
T ₄	<i>Trichoderma viride</i>	4.733	9.533	11.466	12.133	13.400
T ₅	Neem oil + <i>Trichoderma viride</i>	4.800	9.600	11.533	12.200	13.466
T ₆	Eucalyptus oil + <i>Trichoderma viride</i>	4.666	9.466	11.400	12.066	13.333
T ₇	Clove oil + <i>Trichoderma viride</i>	5.000	9.666	11.600	12.333	13.533
F- test		S	S	S	S	S
C. D. (P = 0.05)		0.266	0.309	0.410	0.608	0.584

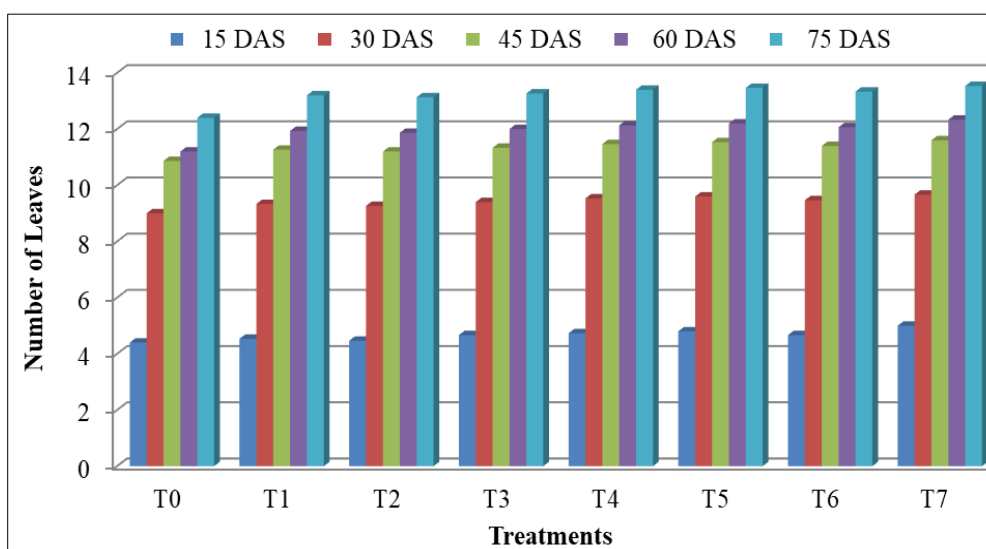


Fig 2: Effect of treatments on Number of leaves of maize (*Zea mays* L.) at 15, 30, 45, 60 and 75 DAS.

Table 3: Effect of treatments on Northern Corn Leaf Blight disease intensity (%) at 45, 60 and 75 DAS of Maize (*Zea Mays* L.)

Treatments		45 DAS	60 DAS	75 DAS
T ₀	Control	24.048	34.803	45.783
T ₁	Neem oil	15.024	21.703	23.636
T ₂	Eucalyptus oil	15.133	23.683	26.213
T ₃	Clove oil	14.446	19.823	22.636
T ₄	<i>Trichoderma viride</i>	13.813	17.286	19.900
T ₅	Neem oil + <i>Trichoderma viride</i>	12.906	16.353	19.744
T ₆	Eucalyptus oil + <i>Trichoderma viride</i>	14.304	17.394	20.243
T ₇	Clove oil + <i>Trichoderma viride</i>	12.046	15.026	17.993
F- test		S	S	S
C. D. (P = 0.05)		1.635	1.530	1.282

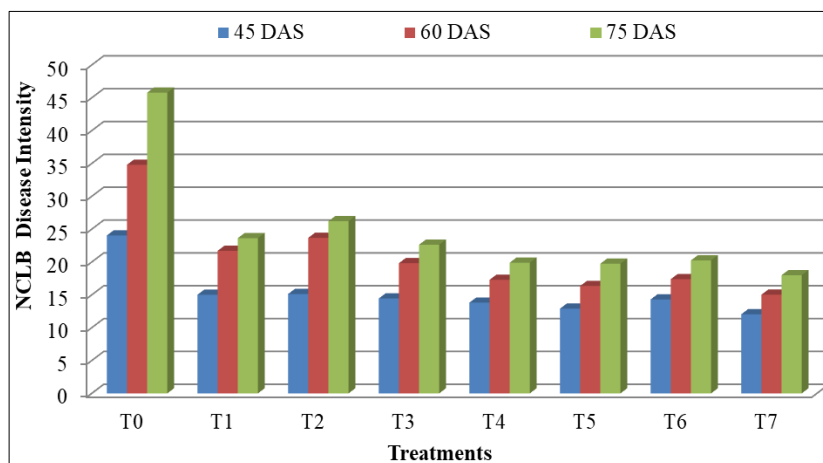


Fig 3: Effect of treatments on Northern Corn Leaf Blight intensity at 45, 60 and 75 DAS

Conclusions

In the present experimental study entitled “Eco-friendly management of Northern Corn Leaf Blight of Maize (*Zea mays* L.)” under field condition, was conducted at department of plant protection in Agricultural Research Farm of “Sam Higginbottom University of Agriculture, Technology and Sciences” Prayagraj, Uttar Pradesh, Prayagraj during *kharif* season 2018-19. The treatments was given as seed treatment and sowing was done as layout in randomized block design with in 8 treatments combination one varieties each replicated 3 times.

The treatments were Control, Neem oil, Eucalyptus oil, Clove oil, *Trichoderma viride*, Neem oil + *Trichoderma viride*, Eucalyptus oil + *Trichoderma viride*, Clove oil + *Trichoderma viride*. It was recorded that maximum shoot length (cm) was recorded in treatment T₇ Clove + *Trichoderma viride* (201.33) followed by the T₅ Neem oil + *Trichoderma viride* (201.20). Also, similar trend was found for number of leaves having maximum in T₇ Clove + *Trichoderma viride* (13.53) followed by the T₅ Neem oil + *Trichoderma viride* (13.47).

Disease intensity was highly minimized in treatment T₇ Clove + *Trichoderma viride* (17.99%) followed by T₅ Neem oil + *Trichoderma viride* (19.74) which were at par to untreated control (T₀) [45.78%].

Hence, it can be recommended that T₅ Neem oil + *Trichoderma viride* @ 5% as seed treatment can be effectively used for management of Northern Corn leaf blight instead of using harmful chemicals.

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