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Efficacy of salicylic acid on the incidence of MLB and grain yield of maize

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Abstract
A field experiment was conducted during *kharif*, 2016-17 to 2017-18 in experimental farm situated at Tirhut College of Agriculture, Dholi, Muzaffarpur, Bihar to evaluate efficacy of Salicylic acid on the incidence of Maydis leaf blight and grain yield of maize. The result indicated that all the treatments were found effective as compared to untreated check. Lowest PDI of Maydis leaf blight disease (35.0), maximum percent disease control (61.11%), maximum grain yield (40.44 q/h) and maximum percent increase in yield (18.29%) were recorded in Salicylic acid (SA) @ 200 mg/ liter as foliar spray before 24 hrs. inoculation followed by Salicylic acid (SA) @ 150 mg/ liter as foliar spray before 24 hrs. inoculation. No toxic synergetic effect could be observed on germination.

Keywords: Maize, maydis leaf blight**,** salicylic acid, disease management

Introduction
A maize (*Zea mays* L.) is an important cereal crop of the world and has great economic value in livestock and poultry production (Harris, 2007). It is a native of South America belongs to family, Poaceae. It is the most versatile crop, adapted to different agro-ecological and climatic conditions. Because of its high genetic yield potential it is known as queen of cereals. It is cultivated globally being one of the third most important cereal crops. It is widely grown in tropics, sub-tropics and temperate regions up to 50˚ N and S from the equator to more than 3000 m above mean sea level. Maize grains contain 10% protein, 4% oil, 70% carbohydrate, 2.3% crude fibre and 1.4% ash and minerals also which contribute the highest productivity of 4451 kg/ha. It is third after wheat and rice in world food production (Meena and Meena, 2006) [9]. In India, it is mainly grown in Andhra Pradesh, Maharastra, Karnataka, Bihar, Rajsthan, Uttar Pradesh, Madhya Pradesh and Punjab. The grains are rich in nicotine acid, vitamin A, riboflavin and vitamin E. Continuous growth of poultry and starch industry supported the higher consumption of maize in India (Kumar and Jhariya, 2013) [8]. In advanced countries, it is an important source of many industrial products such as corn sugar, corn oil, corn flour, starch, syrup, brewer's grit and alcohol (Dutt, 2005) [4].
Southern Corn Leaf Blight (SCLB) or Maydis Leaf Blight (MLB) caused by *Helminthosporium maydis* (Syn. *Bipolaris maydis* (Nisik.) Shoemaker), (teleomorph: *Cochliobolus heterostrophus*) is a serious foliar fungal disease of maize throughout the world where maize is grown under warm, humid conditions (White, 1999). Keeping in view of the above facts the study has been proposed to work out on the topic.

Maydis leaf blight
Southern Corn Leaf Blight (SCLB) or Maydis Leaf Blight (MLB) caused by *Helminthosporium maydis* (Syn. *Bipolaris maydis* (Nisik.) Shoemaker), (teleomorph: *Cochliobolus heterostrophus*) is a serious fungal disease of maize. Three races of *Cochliobolus heterostrophus* known as O, T and C which have been described by (Smith *et al.*, 1970 and Wei *et al.*, 1988) [14, 15]. In India, MLB occurs in Punjab, Haryana, Delhi, U.P, Bihar, M.P, Gujarat, J&K, Sikkim, Meghalaya, Rajasthan, A. P. and Maharashtra. In 1970's an epidemic was caused by race T in maize with Texas male sterile cytoplasm (Tcms) in most maize growing areas of the U. S. A. The disease is prevalent in warm humid temperate to tropical region, where the temperature ranges from 20-30 °C during cropping period. Damage is most critical if infection occurs prior to silking and if weather conditions are favourable for disease development during the reproductive growth stages. It is considered as one of the most destructive disease which results in reduction of grain yield up to 91 percent (Payak and

Sharma, 1980) [12]. As the pathogen is only able to overwinter in infected crop debris, management of crop debris between growing seasons can be helpful in reducing the initial amount of inoculums. Drechsler, (1925) [3] first time reported this pathogen (*H. maydis*) from U. S. A. Sharma *et al*., (1978) reported the outbreak of maydis leaf blight disease from Punjab and Rajsthan. Munjal and Kapoor, (1960) [10] for the first time reported it from Maldah district of West Bengal in India. Now it has been considered as one of the most devastating disease and finally attained the status of the economically important disease.

Symptoms are exhibited in the form of small diamond shaped spots (2-6×3-22 mm). The centre of each lesion was straw coloured to light brown, surrounded by a dark brown margin. These lesions elongate as they mature, although growth of the lesions is restricted by leaf veins. Hyphae were branched, septate and sub hyaline and ramified inside the tissues of the affected leaves. Conidia are 5-11 septate olivaceous brown, spindle-shaped with tapering to round ends and bipolar germination. Conidia originated on straight to flexuous, pale to dark brown conidiophores, appearing as single or in small groups. At, the base of conidia a small, protruding, slightly papillate hilum was observed.

Importance of salicylic acid (SA)

Salicylic Acid (SA) is known as an important signal molecule for modulating plant responses to environmental stresses (Shakirova *et al.*, 2003) [13]. Salicylic acid (SA) (2-hydroxybenzoic acid), as a natural plant hormone (Khan *et al.* 2010) [6]. Salicylic acid is a plant phenolic white compound and works in plant growth regulations and maintenance of certain plant hormones and enzymes. Salicylic acid enhances plant capacity and resistance to different stresses. It enhances the defensive compounds like betaine, glycine and proline. The small phenolic molecule salicylic acid (SA) plays a key role in plant defense. Salicylic Acid (SA) is known as an important signal molecule for modulating plant responses to environmental stresses (Shakirova, *et al*., 2003) [13]. Salicylic acid is also involved in endogenous signaling to trigger plant defense against pathogens (Barkosky & Einhelling, 1993) [2]. Application of salicylic acid may increase stress tolerance of plants by positively altering physiological phenomena in plants. Salicylic acid is also involved in endogenous signaling to trigger plant defense against pathogens. Application of salicylic acid may increase stress tolerance of plants by positively altering physiological phenomena in plants. (Barkosky RR and Einhelling FA (1993) [2], Arfan *et al.* (2007) [1] and Khan *et al.*, (2003) [7].

The present studies was undertaken to work out the efficacy of Salicylic acid on the incidence of MLB and grain yield of Maize under field condition for two seasons *Kharif* 2016 and 2017.

Production constraints

The damage can increase if the disease develops prior to silk emergence. Severe incidence at an early stage causes premature death of plant and blighted leaves thereby economically affecting the fodder quality also which is of great value under temperate agro-climatic conditions where it is used as fodder crop during lean season (Patil, 2000) [11].

Material and Methods

A field experiment laid out to study the Efficacy of Salicylic acid on the incidence of MLB and grain yield of Maize at experimental farm of Tirhut College of Agriculture, Dholi, Muzaffarpur (Bihar) during *kharif* 2016 and 2017. The experiment was laid out in Randomized Block Design (RBD) with four replications. The net plot size was 4.5 x 3.0 m and cultivar CML 186 was used with spacing of 60 x 20 cm. The Salicylic acid was used as in four treatments *viz*. Salicylic acid (SA) @ 50 mg/litre water as seed priming, seed priming of Salicylic acid @ 50 mg/liter and foliar spray @ 100 mg/liter after 24 hrs. of inoculation, foliar spray of Salicylic acid @ 150 mg/liter of water before 24 hrs. inoculation and foliar spray of Salicylic acid @ 200 mg/liter of water before 24 hrs. inoculation. Seeds dip in water & spray with plane water used as check.

Disease rating scale for maylis leaf blight

Disease Score (Av.)	Degree of infection (percent DLA*)	PDI**	Disease reaction
1.0	Nil to very slight infection ((≥10%)	< 11.11	R
2.0	Slight infection, a few lesions scattered on two lower l eaves (10.1-20%)	22.22	
3.0	Light infection, moderate number of lesions scattered on four lower leaves (20.1-30%)	33.33	
4.0	Light infection, moderate number of lesions scattered on lower leaves, a few lesions scattered on middle leaves below the cob (30.1-40%)	44.44	M R
5.0	Moderate infection, abundant number of lesions scattered on lower leaves, moderate number of lesions scattered on middle leaves below the cob (40.1-50%)	55.55	
6.0	Heavy infection, abundant number of lesions scattered on lower and middle leaves and moderate number of lesions on two to four leaves above the cob (50.1-60%)	66.66	MS
7.0	Heavy infection, abundant number of lesions scattered on lower and middle leaves and moderate number of lesions on two to four leaves above the cob (60.1-70%)	77.77	
8.0	Very heavy infection, lesions abundant scattered on lower and middle leaves and spreading up to the flag leaf. (70.0 to 80%)	88.88	S
9.0	Very heavy infection, lesions abundant scattered on almost all the leaves, plant prematurely dried and killed (>80%)	99.99	

Results

All the treatments were found effective as compared to untreated check. Treatment T4 i.e. Salicylic acid (SA) @ 200 mg/ liter as foliar spray (before 24 hrs. inoculation) was found most effective which gave 35.00% disease severity, 61.11% disease control with 18.29% increase in yield. This treatment was followed by Treatment T3 i.e. foliar spray of Salicylic acid (SA) @ 150 mg/liter of water before 24 hrs. of inoculation where recorded 60.00% disease severity, 33.33% disease control over check with 12.29% increase in yield. In the treatment check (seed dip in water & spray with plane water) observed maximum disease severity (90.00%) and

minimum grain yield (33.04 q/h). Germination of seeds was observed very good and no toxic synergetic effect could be observed on germination.

Table 1: Efficacy of Salicylic acid on the incidence of Maydis leaf blight and grain yield of maize during *Kharif* 2016 and 2017 (Pooled Data)

Treatments	Mean Germination (%)	Mean Disease score	PDI	(%) Disease control over check	Mean Grain yield (q/ha)	(%) Yield increase Over check
T1: Salicylic acid (SA) @ 50 mg/liter water as seed priming.	87.75	3.75	75.00 (60.00)	16.66	33.99	2.79
T2: Salicylic acid (SA) @ 50 mg/liter water as seed priming and foliar spray @ 100 mg/liter water (after 24 hrs. inoculation).	87.00	3.25	65.00 (53.73)	27.77	35.94	8.06
T3: Salicylic acid (SA) @ 150 mg/liter water as foliar spray (before 24 hrs. inoculation).	84.50	3.00	60.00 (50.77)	33.33	37.67	12.29
T4: Salicylic acid (SA) @ 200 mg/liter water as foliar spray (before 24 hrs. inoculation).	83.50	1.75	35.00 (36.27)	61.11	40.44	18.29
T5: Check (Seed dip in water & spray with plane water).	80.50	4.50	90.00 (71.56)	-	33.04	-
SEM+	1.29	0.64	-	-	0.34	-
CD (0.05)	4.02	2.02	-	-	1.05	-
CV%	3.05	12.72	-	-	1.86	-

Conclusion

Salicylic acid (SA) @ 200 mg/ liter as foliar spray was most effective which gave 61.11% *Maydis* leaf blight control with 18.29% increase in yield. Germination of seeds was observed very good and no toxic synergetic effect could be observed on germination.

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