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Effect of Planting Methods and Management Practices on Maydis Leaf Blight of Maize

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ABSTRACT

Maydis leaf blight caused by Biopolaris maydis is highly destructive disease of maize crop worldwide including India. It causes the significant yield reduction ranging from 9.7 to 11.7% in maize crop, depending upon weather conditions. Maydis leaf blight is found in all tropical and temperate maize growing regions where the growing season is characterized by warm and wet conditions. Growing conditions creating such condition are most favourable for the development of the disease. An experiment was carried out by integrating planting methods like- paired row planting, ridge planting and flat planting along with different management approaches like- chemical, biological and integrated for the management of maydis leaf blight of maize under tarai condition of Uttrakhand. Ridge planting and paired row planting methods as well as chemical control and integrated management practices were found equally good in minimizing disease severity but ridge planting and chemical control provided significantly higher yield over paired row planting and integrated management practices.

Keywords: *Maydis leaf blight, Planting methods, Chemical control, Biological control, Integrated management.*

INTRODUCTION

Maydis leaf blight (MLB) is found almost everywhere maize is grown. It is also called as Southern corn leaf blight (SCLB) and caused by fungus *Bipolaris maydis* (Y. Nisik., & C. Miyake) Shoemaker, (Teleomorph: *Cochliobolus heterostrophus* (Drechsler) Drechsler. This disease is highly destructive in hot and humid, tropical and temperate climates of the world. Drechsler (1925) reported the fungus *Helminthosporium maydis* first time from United States. In India, *H. maydis* was first reported from Maldah district in West Bengal by Munjal and Kapoor (1960). Sharma et al., (1978) reported the outbreak of *Helminthosporium maydis* from Ludhiana and Rajasthan.

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Now it has become a serious problem particularly in Jammu & Kashmir, Himachal Pradesh, Sikkim, Meghalaya, Uttarakhand, Punjab, Haryana, Rajasthan, Delhi, Uttar Pradesh, Bihar, Madhya Pradesh, Gujarat, Maharashtra, Andhra Pradesh, Karnataka, Tamil Nadu and Uttarakhand states of India. Generally MLB causes yield reduction ranging from 9.7 to 11.7% in maize crop, depending upon weather conditions (Bera & Giri, 1979; Harlapur et al., 2000; Sharma et al., 2003; Sharma & Sharma, 2006; Kumar & Saxena, 2007). However yield loss up to the extent of 70 percent have been reported due to this disease (Wang et al., 2001; Ali et al., 2011).Survival and spread of disease depends critically on amount of rainfall, relative humidity and temperature of the area (Sumner and Littrell, 1974). Warm temperatures (20 to 32^0C) and a high humidity level are particularly conducive to MLB (Anonymous, 1997). Long and sunny growing seasons with dry conditions are highly unfavorable for disease development (Schenck & Stelter, 1974). The pathogen can survive in infected maize debris on the soil surface or in seed, but not in debris buried at 5-20 cm (Ullstrup, 1972). The MLB pathogen found on seed and sporulates on seedlings from infected seeds (Boothryod, 1971; Kulik, 1971; Singh et al., 1974). White and Ellett (1971) concluded that severely infected seeds from MLB failed to germinate and loss in plant population is directly correlated with the percentage of infected seed. Aylor (1975) reported that the relationship between temperature and conidial germination *in vitro*. Optimum temperature for growth and conidial germination is nearly 28°C. The temperature for conidial sporulation is 20-28°C under continuous light and 28°C in total dark for race O, while for race T it is 20°C and 24°C, respectively. He also concluded that conidia of *Helmithosporium maydis* are removed only by wind with speeds of more than 18 km/h.

Cultivation practices favoring high humidity and moderate temperature conditions may influences the development of maydis blight. Bisht (2015) suggested that the seed treatment with vitavax followed by spray of Mancozeb and biocontrol agents with appropriate application methods can be used for the management of Maydis leaf blight. concluded that the Integration of early sowing, seed treatment and foliar spray with propiconazole was the best combination in controlling maydis leaf blight and increasing maize yield (Kumar, 2010). Several fungicides have been reported in the literature for management of this disease but only few have label claim for maize in India. Further due to their environmental hazards, high cost and sometime unavailability in the local market, limits the wide spread use of these chemicals by the maize growers. Keeping in view the importance of this disease in the region an integrated strategy involving sowing methods and management practices like chemical, biological and integrated were evaluated for devising an integrated approach for the management of Maydis leaf blight of maize under *tarai* conditions of Uttarakhand.

MATERIAL AND METHODS

Field experiment was conducted during *kharif* 2017 and 2018 in Maize Pathology block at Norman E. Borlaug Crop Research Centre, G.B. Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar, Uttarakhand. It has sub tropical climate with hot and humid summer and cold winters. Field experiments were conducted using moderately susceptible variety Pant sankul makka 3 to develop the integrated disease management practice for maydis leaf blight of maize. Plot size was 3.0 meter x 4.05 meter with three replication of each treatment. Trail was laid out in split plot design with three types of sowing methods *viz,* Paired row planting (PRP), ridge planting (RP) and flat planting (FP) as in main plot and four sub plot *viz,* Chemical control (CC), biological control (BC), integrated management (IM) and untreated control (UC). In Paired row planting (PRP) row to row spacing was 45 cm and plant to plant 20 cm with continuous sowing of two rows with one skipped row, in Ridge planting (RP) and flat planting (FP) spacing were 67.5

x 20 cm. Under sub plot, in Chemical control (CM) seed was treated with Carbendazim + Thiram (1:2) @ 3 g/kg seed, followed by two prophylactic spray of Propiconazole 25 % EC @ 500 ml/ha. In biological control (BC) seed was treated with *Trichoderma harzianum* (Pant bioagent-1) @ 10 g/ kg seed followed by two spray of *Trichoderma harzianum* (Pant bioagent-1) @ 1.0 %, In Integrated management (IM) seed was treated with *Trichoderma harzianum* (Pant bioagent-1) @ 10 g/kg seed followed by first spray of Propiconazole 25 % EC @ 500 ml/ha and second spray of Carbendazim 50 % WP @ 500 g/ha. In all treatments two sprays were applied at 30 and 45 days after sowing. In untreated control (UC) seeds, were sown without treatment and water was used in both sprays. Field was ploughed 20-25 cm deep with soil turning plough, two to three cross harrowing and planking were done to make field smooth and well leveled. One pre planting irrigation was given to ensure good moisture. NPK and Zn fertilizers were applied @ 100, 60, 40 and 25 kg/ha, respectively. Plots were hand weeded with the help of hoe regularly. Observations on disease severity were recorded at 40, 50, 60 and 70 days after sowing using 1-9 rating scale (Hooda et al., 2018). Per cent disease Index (PDI) was calculated using formula given by Wheeler (1969).

$$\text{PDI} = \frac{\text{Sum of all disese ratings}}{\text{Total no. of observation x Highest disease ratting scale}} x100$$

Per cent disease control (PDC) were calculated using following formula:

$$\text{PDC} = \frac{\text{PDI in control} - \text{PDI in treatment}}{\text{PDI in Control}} x100$$

Grain yield (kg/plot) was calculated and expressed as grain yield in (kg/ha). Per cent avoidable loss (PAL) in yield was calculated using formula given by Pradhan (1969).

$$\text{PAL} = \frac{\text{Yield in treatment} - \text{Yield in control}}{\text{Yield in treatment}} x100$$

Data was statistically analyzed using online programme "OPSTAT" a Statistical Software Package for Agricultural Research Workers developed by Sheoran et al. (1998).

Maydis leaf blight (MLB) rating scale

Scale	Degree of infection (% Diseased leaf area)
1.0	Nil to very slight infection (≤10%).
2.0	Slight infection, a few lesions scattered on two lower leaves (10.1-20%).
3.0	Light infection, moderate number of lesions scattered on four lower leaves (20.1-30%).
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%).
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%).
6.0	Heavy infection, abundant number of lesions scattered on lower leaves, moderate infection on middle leaves and a few lesions on two leaves above the cob (50.1-60%).
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%).
8.0	Very heavy infection, lesions abundant scattered on lower and middle leaves and spreading up to the flag leaf (70.1-80%).
9.0	Very heavy infection, lesions abundant scattered on almost all the leaves, plant prematurely dried and killed (>80%).

RESULT AND DISCUSSION

3.1 Effect of sowing methods and disease management measures on severity of maydis leaf blight

Disease severity measured in terms of Percent Disease Index (PDI) at different interval showed that different sowing methods taken as main plot and different disease management practices as sub plots were significantly different but their interaction was found statistically significant (Table 1).

Disease severity recorded 40 days after sowing (DAS) varied from 16.94 to 22.41. Minimum PDI (16.94) was recorded in ridge planting followed by 18.70 in paired row planting while highest in flat planting (normal method followed by farmers considered as control to calculate percent disease control). Similar trend was noticed 50 and 60 DAS. Disease severity recorded 70 DAS ranged from 28.33 to 35.74 being minimum (18.33) in ridge planting and maximum (35.74) in flat planting. Highest percent disease control (20.73%) at terminal observation (70 DAS) was recorded in ridge planting and 12.42% in paired row planting (Table 1).

In disease management practices pooled PDI recorded at 40 DAS varied from 17.04-27.16. Similar trends were observed in every observation. At terminal observation (70DAS) PDI ranged from 26.05 to 39.88 being minimum (26.05) in chemical control and maximum (39.88) in untreated control. Next best treatment was integrated management where 28.40 PDI was recorded followed by 32.84 in biological control. Percent disease control was 34.68, 28.79 and 17.65 in chemical control, integrated management and bio-control, respectively (Table 1). In raised bed and paired row planting methods disease severity was found to be at par similar observation under disease management practices chemical control and integrated management were observed.

3.2 Effect of sowing methods and disease management measures on yield of maize

Grain yield in different sowing methods as well as under different disease management practices differed significantly but their interaction was found in significant.

Pooled yield under different sowing methods ranged from 3012-3657 kg/ha. Higher pooled yield (3657 kg/ha) was recorded in ridge planting followed by paired row planting (3279 kg/ha) while lowest (3012 kg/ha) in flat planting ridge planting provided 21.41% percent available loss and 8.14% in paired row planting method (Table 2).

Among different disease management practices highest pooled yield (3745 kg/ha) was recorded in chemical control followed by 3404 kg/ha in integrated management. Biological control provided least yield (3153 kg/ha) while lowest yield (2887 kg/ha) was recorded in untreated control. Percent avoidable loss was highest (22.91%) in chemical control followed by 15.19% in integrated management while lowest (10.54%) in biological control (Table 2).

Result of our study is similar to the earlier reports (Bisht, 2015; Kumar, 2010 and Singh, et al., 2011) who have reported the efficacy of propiconazole in managing the maydis leaf blight of maize. Our findings are also matching with Jha et al. (2004) with respect to the efficacy of carbendazim.

Bioagents like *Trichoderma* spp. have been tested by and reported effective against Maydis blight pathogen many workers (Bisht, 2015, Jha et al., 2005, Kumar et al., 2009). But these studies were conducted *in vitro*. Ma *et al.* (2014) have reported the control of maydis leaf blight by foliar spray of *Trichoderma harzianum*. In our field evaluation though *Trichoderma harizianum* was found effective in minimizing the maydis leaf blight and enhancing the yield as compared to untreated control however as compared to chemical control and integrated management practices it was found least effective.

Table 1: Effect of sowing methods and disease management practices on severity of maydis leaf blight (PDI)

Sowing methods (SM)/ Management practices (MP)		40 DAS			50 DAS			60 DAS			70 DAS			
		2017	2018	Pooled	2017	2018	Pooled	2017	2018	Pooled	2017	2018	Pooled	Per cent diseases control
PRP	CC	14.07	16.30	15.18	15.56	17.78	16.67	21.48	23.70	22.59	24.44	26.67	25.56	36.10
PRP	BC	17.78	20.00	18.89	20.00	22.22	21.11	25.92	28.15	27.04	30.37	33.33	31.85	20.38
PRP	IM	15.56	17.78	16.67	17.78	20.00	18.89	22.96	25.19	24.08	26.67	28.89	27.78	30.55
PRP	UC	22.96	25.19	24.08	26.67	28.89	27.78	31.11	33.33	32.22	37.78	42.22	40.00	0.00
RP	CC	12.59	14.82	13.70	14.07	16.30	15.18	18.52	20.74	19.63	21.48	23.70	22.59	39.62
RP	BC	15.56	17.78	16.67	18.52	20.74	19.63	22.22	24.44	23.33	28.15	30.37	29.26	21.79
RP	IM	13.33	15.56	14.44	15.56	17.78	16.67	20.74	22.96	21.85	22.96	25.19	24.08	35.63
RP	UC	21.48	24.44	22.96	25.19	27.41	26.30	28.15	30.37	29.26	35.56	39.26	37.41	0.00
FP	CC	18.52	20.74	19.63	21.48	23.70	22.59	26.67	28.89	27.78	28.89	31.11	30.00	28.94
FP	BC	21.48	23.70	22.59	24.44	26.67	25.56	29.63	32.59	31.11	35.56	39.26	37.41	11.39
FP	IM	18.52	20.74	19.63	22.22	24.44	23.33	27.41	29.63	28.52	31.85	34.81	33.33	21.06
FP	UC	26.67	28.89	27.78	29.63	31.85	30.74	34.07	37.04	35.55	40.00	44.44	42.22	0.00
Sowing method														
PRP		17.59	19.82	18.70	20.00	22.22	21.11	25.37	27.59	26.48	29.82	32.78	31.30	12.42
RP		15.74	18.15	16.94	18.33	20.56	19.44	22.41	24.63	23.52	27.04	29.63	28.33	20.73
FP		21.30	23.52	22.41	24.44	26.67	25.56	29.44	32.04	30.74	34.08	37.41	35.74	00.00
SE(m)		0.71	0.74	0.72	0.90	0.90	0.90	1.21	1.40	1.30	1.08	1.32	1.20	-
CD @ 5%		2.88	2.97	2.92	3.62	3.62	3.62	4.86	5.63	5.24	4.34	5.33	4.83	-
Disease Management Practices														
CC		15.06	17.29	16.17	17.04	19.26	18.15	22.22	24.44	23.33	24.94	27.16	26.05	34.68
BC		18.27	20.49	19.38	20.99	23.21	22.10	25.92	28.40	27.16	31.36	34.32	32.84	17.65
IM		15.80	18.03	16.91	18.52	20.74	19.63	23.70	25.93	24.82	27.16	29.63	28.40	28.79
UC		23.70	26.17	24.94	27.16	29.38	28.27	31.11	33.58	32.34	37.78	41.97	39.88	00.00
SE(m)		0.99	0.99	0.99	1.15	1.15	1.15	1.09	1.13	1.11	1.26	1.39	1.32	-
CD @ 5%		2.96	2.96	2.96	3.44	3.44	3.44	3.25	3.39	3.31	3.78	4.17	3.97	-

* DAS days after sowing, PRP paired row planting, RP ridge planning, FP Flat planting, CC Chemical control, BC Bio-control, IM Integrated management and UC Untreated control.

Table 2: Effect of sowing methods and disease management practice on yield of maize

Sowing methods (SM)/ Management practices (MP)		Grain Yield (Kg/ha)			Per cent avoidable loss		
		2017	2018	Pooled	2017	2018	Pooled
PRP	CC	3731	3715	3724	21.92	26.16	24.03
PRP	BC	3259	3098	3178	10.62	11.46	10.98
PRP	IM	3422	3345	3384	14.87	18.00	16.40
PRP	UC	2913	2743	2829	0.00	0.00	0.00
RP	CC	4058	4058	4058	19.02	20.16	19.59
RP	BC	3595	3533	3564	8.60	8.29	8.45
RP	IM	3857	3626	3742	14.80	10.65	12.80
RP	UC	3286	3240	3263	0.00	0.00	0.00
FP	CC	3538	3369	3454	24.19	27.04	25.59
FP	BC	3045	2829	2937	11.92	13.11	12.50
FP	IM	3233	2936	3085	17.04	16.28	16.69
FP	UC	2682	2458	2570	0.00	0.00	0.00
Planting Methods							
PRP		3331	3225	3279	6.18	10.14	8.14
RP		3699	3614	3657	18.37	24.71	21.41
FP		3125	2898	3012	0.00	0.00	0.00
SE(m)		24	40	28	-	-	-
CD @ 5%		98	159	113	-	-	-
Disease Management Practices							
CC		3776	3714	3745	21.61	24.23	22.91
BC		3300	3153	3227	10.30	10.75	10.54
IM		3504	3303	3404	15.53	14.80	15.19
UC		2960	2814	2887	0.00	0.00	0.00
SE(m)		29	30	22	-	-	-
CD @ 5%		86	91	65	-	-	-

* DAS days after sowing, PRP paired row planting, RP ridge planning, FP Flat planting, CC Chemical control, BC Bio-control, IM Integrated management and UC Untreated control.

CONCLUSION

Results of present study indicated that ridge planting and paired row planting methods and under management practice chemical control and integrated management were found equally good with respect to Percent Disease Index but ridge planting and chemical control provided significantly higher yield over paired row planting and integrated management practices. Biological control was found least effective.

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