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Research Article

Management of maize ear rot complex caused by Fusarium species in field using host resistance and seed treatment chemicals

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Abstract: Maize genotypes were screened for host resistance and seed treatment chemicals were evaluated in field to manage Fusarium ear rot complex of maize at high- and mid-hill environments in Nepal during 2003 and 2004. Seven popular maize genotypes along with a susceptible check were used in the host resistance study. The maize genotypes adopted from exotic sources, Manakamana-3 and Deuti, performed superior for ear rot resistance. Three seed treatment chemicals, Vitavax® 200B, Captan 75 WP, and Bavistin® were tested in Fusarium susceptible cultivar. Seed treatment chemicals, Vitavax® 200B, Captan 75 WP and Bavistin®, significantly ($P < 0.05$) reduced ear rot incidences of maize. This study suggests that cultivation of resistant varieties and applications of seed treatment chemicals can be integrated to prevent crop loss from ear rot complex and reduce potential health hazards due to mycotoxins contamination in maize grains.

Keywords: *Zea mays*, *Fusarium* species, ear rot complex, management, seed treatment

Introduction

Maize *Zea mays* L. is the second important crop in Nepal. It is a staple food crop especially in hilly regions and demand for this crop as food and feed is increasing nationwide. The crop is grown in diverse geographic regions from 60 to 3000 m above sea level in the country. Hilly regions contribute the majority of maize production in the country (Ransom *et al*., 2003; Nayav and Gurung, 2010). However, the average yield of the crop is very low, about 2 t/ha (Nayav and Gurung, 2010). Biotic and abiotic constraints as well as socio-economic problems are the major causes of low yield in maize. Crop diseases, including foliar diseases, ear rot, and stalk rot are the major limiting factors for maize production in the country (Desjardins *et al*., 2000; Manandhar *et al*., 2010, 2011).

Fusarium ear rot complex, caused by several *Fusarium* species including *F. graminearum*, *F. verticillioides* and *F. proliferatum*, is a major disease on maize in the hilly regions (Desjardins *et al*., 2000, 2008; Manandhar *et al*., 2010). These fungal species may also contaminate maize grain and produce several mycotoxins. Mycotoxins such as deoxynivalenol (DON) and nivalenol (NIV) were detected in maize grain samples collected from several fields and storages from hills of Nepal (Desjardins *et al*., 2000, 2008). Contamination of maize grains with these mycotoxins is a serious concern for human health in rural parts of Nepal.

The primary infection path of *Fusarium graminearum* in maize kernels is silk channel (Reid and Hamilton, 1996). After the fungus

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enters through silks during flowering period, subsequent infection happens and mycotoxins are produced which may continue until maturity of the grain and in the storage. Rainfall during flowering and grain filling to maturity periods favors the fungal infection and mycotoxins production in maize grains (Vigier *et al*., 2001). In hilly areas of Nepal, main-season maize is planted in April/May and harvested in July/August. The reproductive growth stages of the crop occur at monsoon season when about 70 to 90% of annual rainfall occurs and warm and humid condition exist (Nayav and Gurung, 2010).

Management of ear rot of maize is very challenging in developing countries like Nepal. Foliar sprays of fungicide are not effective and not economically feasible for maize growers of Nepal. Integrated use of cultural practices, seed treatments, and cultivation of resistant maize varieties is more effective to manage the disease and reduce mycotoxin contamination in maize grains. Evaluation of the maize varieties and genotypes for Fusarium ear rot complex at field level with artificial inoculation may help to identify host resistance for the disease. As *Fusarium* spp. associated with ear rot are also seed-borne and seed transmitted (Sutton, 1982; Nayaka *et al*., 2009), treating seed with effective seed treatment chemicals may also help in reducing the inoculum levels at field. The objectives of this study were: (i) to evaluate commonly used and promising maize varieties/genotypes in hilly regions of Nepal for field resistance to Fusarium ear rot complex (ii) to assess the potential seed treatment chemicals to manage ear rot in the field.

Materials and Methods

Experimental sites

Field experiments for evaluating maize genotypes and assessing seed treatment chemicals for controlling ear rot complex were conducted in main season of maize production (April to September) in 2003 and 2004 at research farm of Nepal Agricultural Research Station located at Lumle, Kaski, Gandaki, Nepal. The experimental site with a latitude and longitude of 28˚18'N and 83˚48'E respectively, and an elevation of 1675 m above sea level, represents the maize growing areas of high-hills of Nepal and is a very suitable location to screen maize genotypes for ear rot resistance without artificial misting. The site is the highest rainfall occurring area in Nepal and rainfall occurred almost all days during June to August in 2003 and 2004. The total rainfalls in these three months were 3590 mm in 2003 and 4334 mm in 2004.

Field experiments for assessing seed treatment chemicals were conducted at farmers' field at Deurali, Palpa, Lumbini, Nepal in 2003 and 2004. The location is situated at latitude 25˚53'N and longitude 83˚27E with an elevation of 1200 m above sea level. The location represents maize growing areas of mid-hills of Nepal.

Experimental design and crop management

The field plot arrangement and crop management practices were the same in both genotype evaluation and seed treatment trials. Maize was sown in experimental plots arranged in a randomized complete block design with 4 replicates in genotype evaluation and 6 replicates in seed treatment evaluation trials. Individual experimental plots were four rows of 0.60 m width and 0.25 m row spacing (total size = 4.8 m^2). Seeding rate was 20 kg ha^{-1} and final plant population of 53,333 ha^{-1} was maintained after thinning at three leaf stage. Farm yard manure (FYM) at the rate of 15 t ha^{-1} and inorganic fertilizers of N, P_2O_5, and K_2O were applied at the rates of 120, 60, and 40 kg ha^{-1}, respectively. NPK fertilizers were also applied through Urea, Diammonium phosphate and Murate of potash. FYM, a 60 kg of N and full dose of P_2O_5 and K_2O was applied during land preparation prior to planting. Remaining 60 kg ha^{-1} N was applied during intercultural operation when maize plants were at V5-6 stages. Plots were kept free of weeds with hand weeding and intercultural operations.

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Field evaluation of maize genotypes for ear rot

Seven open pollinated maize genotypes from national and international sources along with a susceptible check were evaluated in field for Fusarium ear rot at Lumle, Kaski high hill of Nepal during 2003 and 2004 (Table 1). *Fusarium graminearum* strains isolated from ear rot-infected maize grain samples from 2002 crop season at Lumle, Kaski were used to inoculate the genotypes. The fungal isolates were preserved in 10% (w/v) glycerol and stored at -20°C freezer. The preserved isolates were revived in potato dextrose agar (PDA) growing them for 4 to 5 days at 25˚C at 12 h alternate light and dark periods. The freshly grown fungal culture from PDA were transferred to mung bean liquid media and grown for 4 to 5 days shaking at 100 rpm to produce fungal conidia for field inoculation. The fungal suspensions were filtered via sterile cheese cloth and counted by a hemocytometer. The final spore suspension of 1×10^5 spore ml^{-1} was prepared and 2 ml was injected in each ear through silk channel at mid-silking (R1) stage on Ritchie's scale (Ritchie *et al*., 1986). A total of 64 plants of each genotype (16 plants in one experimental plot × 4 replicates) were inoculated with the pathogen in one experiment. The susceptible check variety Ganesh-2, was also inoculated with mung bean liquid media without the fungus. The maize ears were rated for Fusarium ear rot at the harvest. They were hand harvested, husked, and scored for the disease. Disease incidence was calculated as percentage of infected ears out of total ears inoculated. Disease severity was estimated based on the 1-7 scale described by Reid *et al*. (1993), where 1 = 0%, 2 = 1-3%, 3 = 4-10%, 4 = 11-25%, 5 = 26-50%, 6 = 51-75%, and 7 =76-100% of maize grains covered with mold. Grain yield and moisture percentages were also recorded. The final yield was adjusted at 13% harvest moisture.

Evaluation of seed treatment chemicals

Three seed treatment chemicals were evaluated in farmer's field plots during 2003 and 2004 at two environments, Deurali, Palpa and Lumle, Kaski. Seed treatment chemicals were: Vitavax® 200B (UniRoyal Chemical, Middlebury, CT, USA; a. i. carboxin 19.5 w/v + thiram 19.5 w/v), Captan 75 WP (CAPTRA, Indofil Chemical Company, New Delhi) and Bavistin® (BASF India Ltd, Mumbai, India; a.i. carbendazim). The maize kernels and seed treatment chemicals were mixed well (at the rate of 2.5 g/kg) in the closed container before sowing in the field. Non-treated maize kernels were also sown as the check. The treated and non-treated maize seeds were planted in the field plots in a randomized complete block design with six replicates. The number of plants germinated was recorded. In addition, the maize ears were hand harvested and husked, and the numbers of total and infected ears were recorded to determine disease incidence. Ear rot severity ratings were estimated based on the 1-7 scale (Reid *et al*. 1993). Disease index was also calculated as: (Disease incidence% × disease severity%) /100 (Stack and McMullen, 1998). Grain yield and moisture percentages were also recorded. The final yield was adjusted at 13% harvest moisture.

Statistical analyses

As the data on the three disease parameters (incidence, severity, and index) were not normal, arcsine-square root transformations were applied to these data to make them normalized. Statistical analyses were performed using SAS version 9.2 (SAS Institute, NC, USA) to determine the differences among treatments in the ear rot incidence, severity, and index as well as grain yield. The ANOVA was performed with mixed model (PROC GLIMMIX) of SAS. The maize genotypes and seed treatment chemicals were considered as a fixed effect and replicates were considered as a random effect. Data was analyzed separately for each year since genotype × year interaction was significant. If an overall treatment effect was found significant at $P < 0.05$, mean groupings between treatments were performed using a LSMEANS statement. After analyses, the arcsine-square roots transformed data were back-transformed for final presentation.

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Results

Field evaluation of maize genotypes

Maize genotypes showed significant differences ($P < 0.05$) on ear rot severity and index, and grain yield at high-hill Lumle, Kaski, Gandaki, Nepal during 2003 and 2004 (Table 2). Most of the genotypes evaluated in both years were moderately resistance (MR) to moderately susceptible (MS) to ear rot and none of them were highly susceptible. The varieties, Manakamana-3 and Deuti (ZM-621), had consistently low ear rot severity and index in both years, showing moderately resistance to resistance reactions. Grain yield was also consistently high in these two varieties. Hill Pull White and Ganesh-2 had higher disease severity and index (MS to S reaction) than other varieties in both years. Shitala, Manakamana-1 and Hill Pull Yellow had low ear rot severity and index (MR and R) in 2003; however, these genotypes had relatively higher ear rot severity (MS) in 2004 indicating genotype × environment interaction for ear rot resistance.

Table 1 Information on maize genotypes tested for ear rot resistance at field level.

Variety	Year released	Origin	Parentage	Recommended area
Hill Pull Yellow	Pre release	Nepal	13 Varieties and 2 local landraces	Mid-hill
Hill Pull White	Pre release	Nepal	10 varieties and lines and 1 local landrace	Mid-hill
Ganesh-2	1989	Nepal	Composite of 18 lines between exotic and local lines of Nepal	Mid- and high-hills
Kakani Yellow	1966	India	Antigua G2 × Guatemala	High-hill
Manakamana-1	1986	Nepal	Composite of 19 lines between exotic and local lines of Nepal	Mid-hill
Manakamana-3	2002	CIMMYT, Mexico	Population 22-c8	Mid-hill
Shitala	2006	CIMMYT, Mexico	Population 44 (AED) Tuscpino	Mid-hill
Deuti	2006	Zimbabwe	ZM621(SAD V1F1)	Mid-hill

Table 2 Reaction of maize genotypes to Fusarium ear rot complex and yield performance at high-hill Lumle, Kaski, Gandaki, Nepal in 2003 and 2004.

Genotypes	2003				2004			
	Ear rot Severity (%)	Ear rot index (%)	Reaction[1]	Yield (t/ha)	Ear rot Severity (%)	Ear rot index (%)	Reaction[1]	Yield (t/ha)
Hill pull white	16.8 abc	7.6 ab	MR	4.7 bc	19.5 a	15.1 a	MS	6.3 c
Hill pull yellow	12.5 bc	7.1 ab	MR	4.5 bc	20.8 a	16.0 a	MS	6.2 c
Ganesh- 2	25.8 a	14.9 a	S	4.2 c	18.0 ab	14.6 a	MS	6.9 bc
Kakani yellow	19.8 ab	10.3 ab	MS	4.8 bc	11.0 bc	6.1 b	MR	6.3 c
Mankamana-1	10.5 bc	4.9 b	R	4.1 bc	21.0 a	16.7 a	MS	6.2 c
Manakamana-3	13.3 bc	5.3 ab	MR	5.2 ab	10.8 c	5.3 b	R	8.4 ab
Shitala	12.5 bc	4.7 b	MR	4.1 bc	19.3 ab	15.3 a	MS	8.2 a
Deuti	7.5 c	3.4 b	R	6.4 a	15.5 abc	11.2 ab	MR	8.7 ab
P value	0.0006	0.0072		< 0.001	0.0012	< 0.001		< 0.001

[1] R = Resistance, MR = moderately resistance, MS = moderately susceptible, S = susceptible to Gibberella ear rot of maize, respectively.

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Evaluation of chemicals for ear rot in high-hill experiments

Maize seed treated with all three chemicals (Vitavax® 200B, Captan 75 WP, Bavistin®) showed significantly ($P < 0.05$) reduced incidence, severity, and index of ear rot of maize compared to the plots with non-treated seeds in both 2003 and 2004 experiments (Table 3). Seed treatment chemicals reduced ear rot incidence by 40-50% in both years. The ear rot index was about 5-fold lower in 2003 and about 2.5 lower in 2004 in seed treated plots than in non-treated plots. However, these seed treatment chemicals did not increase the number of plants and grain yield significantly compared to non-treated plots.

Evaluation of chemicals in mid-hill experiments

The disease pressure was lower in mid-hill experiments in both years than in high-hill environment (Tables 3 and 4). In non-treated plot, the disease incidence was 20.7% in 2003 and was 42.5% in 2004. Seed treatment chemicals reduced disease incidence, severity and index in both years. However treatment effects were less effective in 2004 than in 2003. Seed treatment chemicals reduced about 40% disease incidence and severity in 2004, and reduced the disease pressure about 3-4 folds in 2003. Seed treatment chemicals did not increase the yield significantly compared to non-treated plot.

Table 3 Effect of seed treatment chemicals on the incidence and severity of Fusarium ear rot complex of maize and yield performance high-hill Lumle, Kaski, Gandaki, Nepal in 2003 and 2004.

Treatment[1]	2003				2004			
	Ear rot incidence (%)	Ear rot severity (%)	Ear rot Index (%)	Yield (t/ha)	Ear rot incidence (%)	Ear rot severity (%)	Ear rot Index (%)	Yield (t/ha)
Vitavax® 200B	23.8 b	12.5 b	4.2 b	8.2 a	28.4 b	13.6 b	3.7 b	6.2 a
Captan 75 WP	23.8 b	16.3 b	3.2 b	7.9 a	28.2 b	14.5 ab	4.1 b	6.5 a
Bavistin®	26.1 ab	19.0 b	4.0 b	8.3 a	30.8 b	13.6 b	4.1 b	5.6 a
Control	42.6 a	46.2 a	20.4 a	7.5 a	47.0 a	20.7 a	9.7 a	5.3 a
P value	0.020	0.0004	< 0.0001	0.5321	< 0.0001	0.018	< 0.0001	0.267

[1] Vitavax® 200B (a. i. carboxin 19.5 w/v + thiram 19.5 w/v), Captan 75 WP (a. i. captan) Bavistin® (a. i. carbendazim).

Table 4 Effect of seed treatment chemicals on the incidence and severity of Fusarium ear rot complex of maize and yield performance at mid-hill Deurali, Palpa, Lumbini, Nepal in 2003 and 2004.

Treatmen[1]	2003				2004			
	Ear rot incidence (%)	Ear rot severity (%)	Ear rot index (%)	Yield (t/ha)	Ear rot incidence (%)	Ear rot Severity (%)	Ear rot index (%)	Yield (t/ha)
Vitavax® 200B	5.7 b	9.8 a	0.6 b	7.7 a	26.7 a	9.5 a	2.5 b	6.7 a
Captan 75 WP	6.2 b	3.7 b	0.3 b	7.4 a	28.3 a	8.5 a	2.5 b	7.5 a
Bavistin®	6.8 b	5.2 b	0.6 b	6.9 a	22.9 b	8.9 a	2.1 b	7.4 a
Control	20.7 a	21.3 a	4.3 a	6.5 a	42.5 a	13.3 a	5.5 a	7.3 a
P value	0.0001	0.0001	< 0.0001	0.6021	0.0005	0.1393	0.0009	0.216

[1] Vitavax® 200B (a. i. carboxin 19.5 w/v + thiram 19.5 w/v), Captan 75 WP (a. i. captan) Bavistin® (a. i. carbendazim).

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Discussion

The evaluated maize genotypes are popularly grown varieties or promising pre-released varieties in hilly regions of Nepal. Ganesh-2, Kakani Yellow, Manakamana-1 are old varieties released prior to 2000 and still popular in hilly regions of Nepal. Three recently released varieties, Manakamana-3 (released in 2002), Shitala, and Deuti (released in 2006) are adopting rapidly by maize growers in mid-hills and high-hills (Sharma *et al*., 2008; Tiwari *et al*., 2009). The origin of Manakamana-3 and Shitala is Mexico, CIMMYT, and Deuti is Zimbabwe (Table 1). The field trial site Lumle represents the high-hill environment and is very suitable location to screen maize genotypes for ear rot resistance without artificial misting. The site is the highest rainfall occurring areas in Nepal. Rainfall occurred almost all days during June to August (25 to 31 rainy days in one month) in 2003 and 2004. Average monthly temperature ranged between 17 to 21 ºC in 2003 and 19 to 21 ºC in 2004, which is favorable for the infection of ear rot. Moderate temperature and long rainfall duration during silking and grain development periods favors Fusarium ear rot complex in maize (Sutton, 1982; Reid and Hamilton, 1996; Vigier *et al*., 2001).

Maize genotypes Manakamana-3 and Deuti (ZM-621), which were resistant to ear rot complex and had high grain yield attribute in our experiments, are widely adopted by farmers in mid- and high-hills of Nepal (Sharma *et al*., 2008; Tiwari *et al*., 2009). These two varieties were evaluated in participatory variety selection trials (PVTs) in 300 field trials over 50 locations across the hilly regions of the country during 2004 to 2006 (Tiwari *et al*., 2009). Among the eight different varieties evaluated in these PVTs, growers ranked Manakaman-3 as a most preferable variety followed by Deuti based on yield, quality, marketability, disease resistance, and stay-green traits. Both varieties had high tolerance to drought stress and showed resistance to turcicum leaf blight and gray leaf spot (Tiwari *et al*., 2009). In addition, both genotypes have white grain and the color is preferred by hill farmers (Tiwari and Sinclair, 2002). Our findings support to promote these varieties in hilly regions since ear rot is very problematic in rainy season in hilly regions. The main season maize is planted in early summer and reproductive stages of the crop occur in monsoon months (June to August). The rainfall during these periods favors the ear rot epidemics in most of maize growing areas in hills of Nepal. The ear rot pathogen also produces several mycotoxins in maize seeds. Desjardins *et al*. (2000, 2008) detected deoxynivalenol (DON), nivalenol (NIV) above tolerance limit (> 1 ppm) in 16-75% maize grain samples collected from field and storage from hills of Nepal. Since maize is a major staple food in hilly regions of Nepal, contamination of maize grains with these mycotoxins poses serious health threats to humans. Finding ear rot resistance in popularly grown varieties would also help to reduce the mycotoxins contamination in the maize grains.

Few genotypes, Shitala, Manakamana-1 and Hill Pull Yellow, showed variable results in ear rot resistance over two years indicating the genotype × environment interaction. Schaafsma *et al*. (1997) and Vigier *et al*. (2001) also reported inconsistent results among maize genotypes on the resistance of Fusarium ear rot complex over years and locations. The inheritance of Gibberella ear rot resistance is complex and the resistance mechanism has not been clearly understood (Mesterhàzy *et al*., 2012). The maize genotypes with quantitative or partial resistance show variable reactions to ear rot in different environments (Reid *et al*., 1993; Mesterhàzy *et al*., 2012).

Vitavax® 200B (a. i. carboxin 19.5 w/v + thiram 19.5 w/v), Captan 75 WP (a. i. captan) Bavistin® (a. i. Carbendazim) are commonly used seed treatment chemicals in Nepal to protect the field and vegetable crops from seed-borne diseases as well as soil-borne seedling diseases. Captan is broad spectrum

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protective fungicide; Vitavax® and Bavisitn® have both protective and systemic actions. In Nepal, ear rot complex of maize is caused by several seed and soil-borne *Fusarium* species including *F. graminearum*, *F. verticillioides* and *F. proliferatum* (Desjaridns *et al*., 2000, 2008; Manandhar *et al*., 2010). These seed treatment chemicals can kill the seed-borne *Fusarium* spp. or protect the plants from soil-borne infection of the pathogen, which eventually might help to reduce the ear rot incidence. Seed treatment chemicals have impact for limited period of time, particularly during seedling stages (Mueller and Bradley, 2008); therefore, these chemicals are generally recommended for controlling seedling diseases. However, the impact of seed treatment chemicals was also evident at later growth stages until harvest (Rodriguez-Brljevich *et al*., 2010). They found that maize seed treated with fludioxonil + azozystrobin + mefenoxam + thiamethoxam suppressed the colonization of *Fusarium* spp. and also reduced the crown and stalk rot at 2-leaf, 4-leaf and 6-leaf stages. Rodriguez-Brljevich *et al*. (2010) evidenced that these chemicals enhanced the photosynthesis in maize plants and improved the plant vigor. These findings support our finding that seed treatment chemicals have positive impact in reducing ear rot complex in field.

No effective chemical fungicides are available for foliar application to control ear rot complex of maize (Reid *et al*., 2001; Vigier *et al*., 2001). In developing countries like Nepal, control of ear rot complex by fungicide spray is not economically feasible. Few studies reported that foliar applications of biocontrol agents (*Pseudomonas fluorescens* or *Trichoderma harzianum*) reduced the ear rot of maize caused by *F. verticillioides* significantly (Nayaka *et al*., 2009, 2010). They reported that use of *Pseudomonas fluorescens* or *Trichoderma harzianum* as seed treatment and foliar applications significantly reduced Fusarium ear rot and fumonisin contamination on maize grains. However, several studies showed inconsistent results of biocontrol agents in controlling crop diseases at field scale level (Tjamos *et al*., 2010). Reid *et al*., (2001) reported that application of nitrogen fertilizer and crop rotation with non-cereal crops reduced Gibberella ear rot and deoxynivalenol content in maize.

In conclusion, two recently released maize varieties, Manakamana-3 and Deuti, showed moderately resistance to resistance reactions to Gibberella ear rot. These two varieties are widely cultivated in hilly regions of Nepal. Seed treatment chemicals also significantly reduced ear rot complex than non-treated plots indicating seed treatment is an important component of ear rot management. However, substantial ear rot incidences (~20-25%) were also observed in plots planted with treated maize grains suggesting that seed treatment only is not sufficient to manage the disease. Cultivation of ear rot resistant varieties and treating seed with effective chemicals in combination with other cultural practices would be effective to manage ear rot complex.

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مدیریت پوسیدگی بلال ذرت ناشی از گونه‌های فوزاریوم در مزرعه با استفاده از گیاهان مقاوم و ضدعفونی بذر با ترکیبات شیمیایی

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چکیده: در این مطالعه مقاومت ژنوتیپ‌های ذرت به کمپلکس پوسیدگی بلال در شرایط مزرعه مورد بررسی قرار گرفت. هم‌چنین روش ضدعفونی بذر با ترکیبات شیمیایی در نواحی مرتفع و نیمه‌مرتفع نپال در طی سال‌های ۲۰۰۳ و ۲۰۰۴ ارزیابی شدند. هفت ژنوتیپ معروف ذرت همراه با یک شاهد حساس در مطالعات مقاومت میزبانی استفاده شدند. ژنوتیپ‌های ذرت با منابع خارجی شامل ماناکامانا-۳ و دوتی بالاترین مقاومت را در برابر پوسیدگی بلال داشتند. سه ترکیب شیمیایی مورد استفاده برای تیمار بذر شامل ویتاواکس، کاپتان و باویستین به‌صورت معنی‌داری شیوع پوسیدگی بلال را کاهش دادند. این مطالعه نشان داد که استفاده از گیاهان مقاوم و ضدعفونی بذر با ترکیبات شیمیایی برای مدیریت بیماری پوسیدگی بلال در مناطق ذرت‌کاری در نواحی کوهستانی نپال و نواحی مشابه مؤثر است.

واژگان کلیدی: ذرت، گونه‌های فوزاریوم، پوسیدگی بلال، مدیریت، تیمار بذر

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