

Effect of Tillage and Nutrient Management Practices on Bacterial Stalk Rot

Bhuwan Chandra Sharma^{1*}, Rajesh Pratap Singh² and Amit Bhatnagar³

¹Department of Plant Pathology, Collage of Agriculture,

²Professor, Department of Plant Pathology, Collage of Agriculture,

³Senior Research Officer. Department of Agronomy Collage of Agriculture,
Govind Ballabh Pant University of Agriculture & Technology, Pantnagar, Udham Singh Nagar -
263145, Uttarakhand, India

*Corresponding Author E-mail: bhuwanreena@gmail.com

Received: 15.07.2020 | Revised: 13.08.2020 | Accepted: 17.08.2020

ABSTRACT

Bacterial stalk rot caused by *Dickeya zeae* (*Erwinia chrysanthemi* pv. *zeae*) is highly destructive diseases of maize crop worldwide including India. Depending upon weather conditions it cause the significant yield reduction ranging from 21 to 98 % in maize crop. Hot and humid conditions preferred by Bacterial stalk rot. It is present in all tropical maize growing regions. Growing conditions creating hot and humid condition are most favourable for the development of the disease. Under tarai condition of Uttrakhand an experiment was carried out by integrating tillage practices like- permanent raised beds, zero tillage and conventional tillage along with different nutrient management approaches like- RDF, SSNM and Farmer's practices for the management of maize diseases. Results of present study indicated that conventional tillage followed by permanent raised bed and zero tillage and in nutrient management SSNM followed by RDF management practices were found equally good with respect to diseases incidence but significantly higher grain yield was recorded in permanent raised beds (58.17 q/ha) which was found at par with conventional tillage (57.48 q/ha) whereas minimum yield was recorded in zero tillage (56.17 q/ha). But significantly higher hundred grain weight was recorded in conventional tillage (30.6 g) which was at par with permanent beds (30.5 g) followed by zero tillage (28.2 g).

Keywords: Bacterial stalk rot, Tillage management, Nutrient management, Maize.

INTRODUCTION

Maize is an important food crop which is affected by several diseases. These diseases are classified mainly on the basis of plant part affected. Among them stalk rots are

considered as most serious as it affects flow of nutrients from root to upper plants parts and often whole plant either get dry or broken from the base resulting in huge yield losses.

Cite this article: Sharma, B.C., Singh, R.P., & Bhatnagar, A. (2020). Effect of Tillage and Nutrient Management Practices on Bacterial Stalk Rot, *Ind. J. Pure App. Biosci.* 8(4), 696-701. doi: <http://dx.doi.org/10.18782/2582-2845.8337>

Bacterial stalk rot (BSR) is an important disease of maize, which topple down maize plant under severe conditions and emit foul odor. This disease resulted in severe grain yield losses which can range from 21 to 98 per cents (Thind & Payak, 1978). In India bacterial stalk rot was reported for the first time by Prasad (1930). Burkholder et al. (1953) reported that the *Erwinia chrysanthemi* a phytopathogenic bacterium induces soft rot and wilting. The pathogen has been re classified as *Dickeya zea*. The infestation of the bacterial soft rot have been reported from various parts of the world (Hingorani et al., 1959; Pauer, 1964; Prasad, 1930; Sabet, 1954; Volcani, 1961; Zachos et al., 1963; Martinez-Cisneros et al., 2014). During the recent year bacterial stalk rot has emerged as one of most important disease in *kharif* sown maize crop in India (Kumar et al., 2015 a). The pathogen spreads from plant to plant and field to field through rain water and its runoff. This bacterium has a wide host range which makes it difficult to manage (Bradbury, 1986; Goto, 1979). Chemicals have been found ineffective against this disease. Kumar et al. (2015b) found minimum disease incidence and severity in raised bed planting as compared to flat sown method during survey of farmer's field condition of Punjab. This indicates that agronomical manipulations to reduce the congenial conditions for disease development can be a viable option for the management of bacterial stalk rot. Therefore keeping in view the importance of this disease in the region an integrated strategy involving tillage practices and nutrient management practices like Recommended Dose of fertilizers, Site Specific Nutrient Management and Farmer's practices were evaluated for devising an integrated approach for the management of Bacterial stalk rot of maize under *tarai* conditions of Uttarakhand.

Materials and Methods

Field experiment was conducted during *kharif* 2017 and 2018 in Maize Agronomy 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 hybrid DH 296 to develop the integration of tillage and nutrient management practice for the management of maydis leaf blight of maize. Plot size was 3.0 meter x 4.00 m² with three replication of each treatment. Trial was laid out in split plot design with three types of tillage practices viz, Permanent Raised Beds (PRB), Zero tillage (ZT) and Conventional tillage (CT) as main plot with three sub plot viz, Recommended Dose of fertilizers (RDF), Site Specific Nutrient Management (SSNM) and Farmer's practices (FP). The spacing was 60 cm × 25 cm. There were 5 rows in each plot. Permanent bed and zero tillage treatment were initiated in year 2012. Permanent bed were made at 60 cm with the help of tractor drawn FIRBS. These permanent beds were reshaped every year before sowing of maize. In permanent beds and zero tillage sowing was done manually. In conventional tillage there were four harrowing followed by leveling and sowing was done by tractor drawn furrow opener. Recommended dose of nutrient was 120:60:40 N:P₂O₅:K₂O kg/ha. In farmer practices, their thirty maize growing farmers were selected and their nutrient dose was used for farmer's practices treatment. This was 93: 64: 32 N: P₂O₅:K₂O kg/ha. In Site specific nutrient management nutrient dose was calculated by a computer software programme developed by International Plant Nutrition Institute in India (Majumdar et al., 2013) was 120:30:46 N: P₂O₅: K₂O kg/ha. In year 2017 crop was sown on 19th July and harvested on 2nd November while in 2018 sowing was done on 19th July and harvested on 29th October. Plots were hand weeded with the help of hoe regularly. Observations on disease severity were recorded at 40, 55, 70 and 85 days after sowing using 1-9 rating scale (Hooda et al., 2018).

Percent incidence was calculated using following formula.

$$\text{Disease incidence} = \frac{\text{No. of disease plant}}{\text{total no of plant observed}} \times 100$$

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

RESULTS AND DISCUSSIONS

Effect of tillage practices on incidence of bacterial stalk rot

Disease incidence at different interval showed that different tillage practices taken as main plot and different nutrient management practices as sub plots were significantly different but their interaction was found statistically insignificant (Table 1).

After 40 and 55 days of sowing, in the year 2017, 2018 and on pooled basis no significant difference was found among treatments.

in the year 2017 significantly lower disease incidence was recorded in conventional tillage (2.12%) followed by zero tillage (3.06 %) which was at par with permanent beds (3.51 %). after 70 days of sowing, While in 2018 significantly lower incidence of bacterial stalk rot was observed in conventional tillage (2.19 %) followed by zero tillage (3.09 %) was at par with permanent beds (3.81 %). On pooled basis significantly lower incidence of bacterial stalk rot was observed in conventional tillage (2.17 %) followed by zero tillage (3.07 %) which was at par with permanent beds (3.66 %).

Significantly lower disease incidence was recorded in conventional tillage (6.79 %) followed by zero tillage (8.03 %) and permanent beds (8.64 %). after 85 days of sowing, in the year 2017, In 2018 significantly lower incidence of bacterial stalk rot was observed in conventional tillage (6.97 %) followed by permanent beds (9.86 %) which was at par with zero tillage (8.50 %). On pooled basis significantly lower incidence of BSR was observed in conventional tillage (6.87 %) followed by zero tillage (8.27 %) which was at par with permanent beds (9.26 %). Sharma and Singh (2019) reported

minimum disease incidence of bacterial stalk rot (3.32 %) in ridge planting followed by paired row planting 5.87 % while highest (7.26 %) in flat planting method followed by farmers.

Effect of nutrient management on incidence of bacterial stalk rot

After 55 days of sowing in year 2017 lower incidence of bacterial stalk rot was noticed in Recommended dose of fertilizer (1.89 %) which was at par with Site specific nutrient management (1.89 %), followed by Farmers practices (2.61 %), while, In 2018 no significant difference was noticed among treatments. Similarly on pooled basis lower incidence of bacterial stalk rot was noticed in Site specific nutrient management (2.13 %) which was at par with Recommended dose of fertilizer (2.19 %) followed by Farmers practices (2.82 %).

After 70 days of sowing in year 2017, 2018 and on pooled basis difference between treatments were found non-significant.

After 85 days of sowing in year 2017 lower incidence of bacterial stalk rot was noticed in Site specific nutrient management (7.24%) which was at par with Recommended dose of fertilizer (7.37 %), followed by Farmers practices (8.86 %). While, in 2018 no significant difference was observed between treatments. Similarly on pooled basis lower incidence of bacterial stalk rot was noticed in Recommended dose of fertilizer (7.64 %) which was at par with Site specific nutrient management (7.67 %) followed by Farmers practices (9.08 %). (Table 1)

Effect of tillage and nutrient management practices on yield

The data on yield parameters of maize as influenced by different Tillage practice revealed that In year 2017 and on pooled basis no significant difference was found in grain yield as well as hundred grain weight Table 2 whereas in the year 2018 significantly higher grain yield was recorded in permanent beds (58.17 q/ha) which was found at par with conventional tillage (57.48 q/ha) whereas minimum yield was

recorded in zero tillage (56.17 q/ha). In year 2018 significantly higher hundred grain weight was recorded in conventional tillage (30.6 g) which was at par with permanent beds (30.5 g) followed by zero tillage (28.2 g). After comparing various tillage practices it is clear that conventional tillage practices gave maximum grain yield, followed by minimum tillage and zero tillage. These results are supported by findings of Khurshid et al. (2006) and Khan et al. (2001) elucidated that thousand grain weight of maize significantly increased in conventional till plots rather than no tilled plots.

Nutrient management significantly influence grain yield (Table 2). Grain yield recorded in RDF (60.06 q/ha) was at par with SSNM (59.05 q/ha) followed by FP (52.71 q/ha). In year 2018 no significant difference was found in grain yield. On pooled basis significantly higher grain yield was recorded in RDF (55.91 q/ha) which was found with at par SSNM (54.20 q/ha), followed by FP (50.36 q/ha). In year 2017, 2018 and on pooled basis no significant difference was found on hundred grains weight.

Nutrient management practices significantly influence the yield which was found higher in RDF, but at par with SSNM followed by FP in both the year. The higher grain yield of maize was mainly due to SSNM approach was ascribed due to higher but balanced nutrient application. This was evident through the

findings of Jayaprakash et al. (2006), Kumar et al. (2007) and Umesh (2008) who reported higher grain yield of maize with application of SSNM and STCR.

No significant difference was found on thousand grain weight due nutrition management. The result confirms the findings of Sharar et al. 2003, who reported that the yield attributes increased with increased levels of fertilizer. While, Sivamurugan et al. (2017) reported that RDF registered the highest hundred seed weight and it was comparable with STCR but superior to SSNM.

Conclusion

Results of present study indicated that conventional tillage practice with Site specific nutrient management was found good with respect to incidence of bacterial stalk rot but permanent raised beds and recommended dose of fertilizer provided highest yield than conventional tillage and site specific nutrient management which was at par. Zero tillage and farmer's practice was found least effective with respect to Percent Disease Incidence and yield, respectively.

Acknowledgement

Support provided by Directorate of Research of GBPUAT, Pantnagar and AICRIP on Maize for conducting the field experiment is duly acknowledged.

Table 1: Effect of tillage practices and nutrition management on incidence of Bacterial stalk rot

Main Plot	Sub plot	55 DAS			70 DAS			85 DAS		
Tillage practices	Nutrition management	2017	2018	Pooled	2017	2018	Pooled	2017	2018	Pooled
Permanent beds	Recommended dose of fertilizer	2.30	2.93	2.57	3.43	3.50	3.43	8.03	9.37	8.70
	Farmer's practice	3.03	3.70	3.37	3.67	4.33	4.00	9.80	10.53	10.17
	Site Specific nutrient management	2.30	3.00	2.63	3.43	3.60	3.53	8.10	9.67	8.90
Conventional tillage	Recommended dose of fertilizer	1.70	1.77	1.73	1.70	1.77	1.73	6.23	6.47	6.33
	Farmers practice	1.80	2.43	2.13	2.40	2.43	2.43	7.83	7.90	7.87
	Site Specific nutrient management	1.70	1.80	1.77	2.27	2.37	2.33	6.30	6.53	6.40
Zero tillage	Recommended dose of fertilizer	1.67	2.87	2.27	2.80	2.87	2.83	7.83	7.97	7.90
	Farmers practice	3.00	2.97	2.97	3.57	3.53	3.53	8.93	9.47	9.20
	Site Specific nutrient management	1.67	2.30	2.00	2.80	2.87	2.83	7.33	8.07	7.70
Tillage										
Permanent beds		2.54	3.21	2.86	3.51	3.81	3.66	8.64	9.86	9.26
Conventional tillage		1.73	2.00	1.88	2.12	2.19	2.17	6.79	6.97	6.87
Zero tillage		2.11	2.71	2.41	3.06	3.09	3.07	8.03	8.50	8.27
CD @ 5%		NS	NS	NS	0.51	0.62	0.52	1.23	1.67	1.36
Nutrition										
Recommended dose of fertilizer		1.89	2.52	2.19	2.64	2.71	2.67	7.37	7.93	7.64
Farmer's practice		2.61	3.03	2.82	3.21	3.43	3.32	8.86	9.30	9.08
Site Specific nutrient management		1.89	2.37	2.13	2.83	2.94	2.90	7.24	8.09	7.67
CD @ 5%		0.63	NS	0.59	NS	NS	NS	1.20	NS	1.15

Table 2: Effect of tillage practices and nutrition management on yield

Main Plot	Sub plot	Grain yield (q/ha)			100 Grain weight (g)		
		2017	2018	Pooled	2017	2018	Pooled
Permanent beds	Recommended dose of fertilizer	60.97	53.61	57.29	28.8	30.2	29.5
	Farmer's practice	53.50	50.49	52.00	28.0	30.9	29.5
	Site Specific nutrient management	60.04	51.36	55.70	28.6	30.5	29.6
Conventional tillage	Recommended dose of fertilizer	59.92	55.21	57.56	28.2	30.9	29.5
	Farmers practice	53.12	50.29	51.71	28.0	30.6	29.3
	Site Specific nutrient management	59.39	51.96	55.68	29.0	30.3	29.7
Zero tillage	Recommended dose of fertilizer	59.29	46.49	52.89	28.9	28.0	28.4
	Farmers practice	51.49	43.27	47.39	28.3	28.2	28.3
	Site Specific nutrient management	57.74	44.71	51.23	28.4	28.4	28.5
Tillage							
Permanent beds		58.17	51.82	55.00	28.5	30.5	29.5
Conventional tillage		57.48	52.49	54.98	28.4	30.6	29.5
Zero tillage		56.17	44.82	50.50	28.5	28.2	28.4
SE(m)		1.44	1.07	1.18	0.3	0.4	0.3
CD @ 5%		NS	4.32	NS	NS	0.16	NS
Nutrition							
Recommended dose of fertilizer		60.06	51.77	55.91	28.6	29.7	29.2
Farmer's practice		52.71	48.02	50.36	28.1	29.9	29.0
Site Specific nutrient management		59.05	49.35	54.20	28.7	29.7	29.2
SE(m)		1.44	2.29	1.11	0.4	0.5	0.3
CD @ 5%		4.48	NS	3.45	NS	NS	NS

REFERENCES

- Bradbury, J.F. (1986). *Guide to plant pathogenic bacteria*. Farnham Royal, Slough, UK: CAB International Mycological Institute, Pp. 61-101.
- Burkholder, W.H., Mc Fadden, L.H., & Dimock, A.W. (1953). A bacterial blight of chrysanthemums. *Phytopathology*, 43:522-25.
- Goto, M. (1979). Bacterial foot rot of rice caused by a strain of *Erwinia chrysanthemi*. *Phytopathology*, 69:213-16.
- Hingorani, M.K., Grant, U.J., & Singh, N.J. (1959). *Erwinia carotovora* sp. *zeae*, destructive pathogen of maize in India. *Indian Phytopathology*, 12, 151-57.
- Hooda, K.S., Bagaria, P.K., Khokhar, M., Kaur, H., & Rakshit, S. (2018). Mass Screening Techniques for Resistance to Maize Diseases. ICAR-Indian Institute of Maize Research, PAU Campus, Ludhiana- 141004, 93pp.
- Jayaprakash TC, Nagalikar VP, Pujari BT and Setty RA. Effect of organics and inorganics on growth and yield of maize under irrigation. *Karnataka Journal Agriculture Science*, 2006: 18(3), 798.
- Khan, F.U.H., Tahir, A.R., & Yule, I.J. (2001). Intrinsic implication of different tillage practices on soil penetration resistance and crop growth. *International Journal of Agricultural Biology*, 1, 6-23.
- Khurshid, K.M., Iqbal, Arif, M.S., & Nawaz A. (2006). Effect of tillage and mulch on soil physical properties and growth of maize. *International Journal of Agricultural Biology*, 8, 593-596.
- Kumar, A., Hunjan, M.S., Singh, P.P., & Kaur, H. (2015a). Cross infectivity of *Erwinia chrysanthemi* pv. *zeae* isolates on different hosts. *Plant Diseases Research*, 30, 103-105.
- Kumar, A., Hunjan, M.S., Singh, P.P., & Kaur, H. (2015b). Status of bacterial stalk rot of maize in Punjab. *Plant Diseases Research*, 30, 97-99.
- Kumar, A., Gali, S.K., & Hebsur, S. (2007). Effect of different levels of NPK on growth and yield parameters of sweet corn. *Karnataka Journal of Agricultural Sciences*, 20 (1), 41-43.

- Majumdar, K., Satyanarayana, T., Pampolino, M., Dutta, S., Jat, M.L., Sulewski, G., & Johnston, A.M. (2013). Nutrient Expert ® for Hybrid Maize (version 1.1). A decision support tool for providing field specific fertilizer recommendations for tropical hybrid maize. International Plant Nutrition Institute and International Maize and Wheat Improvement Center, India.: Pp. 52.
- Martinez-Cisneros, B.A., Juarez-Lopez, G., Valencia-Torres, N., Duran-Peralta, E., & Mezzalama, M. (2014). First report of bacterial stalk rot of maize caused by *Dickeya zea* in Mexico. *Plant Disease*, 98, 1267-1267.
- Pauer, G.D. (1964). *Erwinia carotovora* sp. *zea*, the bacterium causing stalk rot of maize in the republic of South Africa. *South African Journal of Agricultural Science*, 7, 581–82.
- Prasad, H.H. (1930). A bacterial stalk rot of maize. *Indian Journal of Agricultural Science*, 25, 72.
- Sabet, K.A. (1954). Etiological aspects of the bacterial root and stalk disease of maize. *Bull. Fac. Agric. Cairo Univ.* 48, 17
- Sharar, M.S., Ayub, M., Nadeem, M.A., & Ahmad, N. (2003). Effect of different rates of nitrogen and phosphorus on growth and grain yield of maize. *Asian Journal of Plant Science*, 2(3), 347-349
- Sharma, B.C., & Singh, R.P. (2019). Effect of Planting Methods and Management Practices on Banded Leaf and Sheath Blight and Bacterial Stalk Rot of Maize, *Ind. J. Pure App. Biosci.* 7(6), 307-316
- Sheoran, O.P., Tonk, D.S., Kaushik, L.S., Hasija, R.C., & Pannu, R.S. (1998). Statistical Software Package for Agricultural Research Workers. Recent Advances in information theory, Statistics & Computer Applications by D.S. Hooda & R.C. Hasija Department of Mathematics Statistics, CCS HAU, Hisar, India. pp: 139-143.
- Sivamurugan, A.P., Ravikesavan, R., & Yuvaraja, A. (2017) Effect of Planting Density and Nutrient Management Practices on the Performance of Maize Hybrids in Kharif Season. *Chemical Science Review and Letters*, ISSN 2278-6783.
- Thind, B.S., & Payak, M.M. (1978). Evaluation of maize germplasm and estimation of losses to *Erwinia* stalk rot. *Plant Disease Report*, 62, 319-23.
- Umesh, M.R. (2008). Investigation on balanced fertilization for maize–pigeonpea cropping sequence in Alfisols of Karnataka. *Ph.D. Thesis*. Univ. Agric. Sci., Bangalore,
- Volcani, Z. (1961). A maize stalk disease caused by a strain of *Erwinia caratovora* in Israel. *Journal of Agriculture Research*, 11, 179-183.
- Zachos, D.G., Panagopoulos, G.G., & Makris, S.A. (1963). A disease of maize in Greece caused by *Erwinia caratovora* (Jones) Holland. *Ann. Inst. Phytopath Benaki*. 5, 288-293.