MANAGEMENT OF STEMPHYLIUM BLIGHT OF LENTIL BY THE APPLICATION OF DIFFERENT DOSE OF CHEMICAL AND BIOLOGICAL FUNGICIDES

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ABSTRACT

Field experiment was conducted at Plant Pathology block of Grain Legumes Research Program, Khajura, Banke during 2018 to evaluate the different doses of chemical and biological fungicides against *Stemphylium* blight disease of Lentil. The experimental design was laid in Randomized Complete Block design in field condition with three replications. Altogether 3 fungicides, 2 chemical {Saff (Carbendazim 12%+ Mancozeb 63%); Farm guard (Chlorothalonil 75% WP} at the dose of 1.5 gm, 2 gm and 2.5 gm per liter water and one biological {Commericial Phytoderma (*Trichoderma harzianum*) at the dose of 2.5 gm, 3 gm and 3.5 gm per liter water along with no fungicide application (control) was evaluated. Lowest mean disease severity (28.89) was obtained when Farm guard (Chlorothalonil @ 2.5 gm/ water) was applied followed by Saff (30) at the same dose. Highest mean disease severity (43.33) was obtained when no fungicide was applied. Similarly lowest Area Under Disease Progress Curve (AUDPC) (204.2) was obtained when Saff @ 2.5 gm/lit water was applied followed by Chlorothalonil (210) at the same dose. Highest AUDPC (291.7) was obtained in control plot. In case of grain yield Chlorothalonil @2gm per liter water obtained highest yield (836 kg/ha) with highest yield increase percent (34.6%). Lowest grain yield was obtained from control plot (546 kg/ha) followed by Trichoderma (624 kg/ha) when sprayed at 2.5 gm per liter water. Thus, from the study it is concluded that Chlorothalonil @ 2 gm when applied timely for three times can manage the Stemphylium blight disease.

Keywords*: *biological fungicide, chemical fungicide, management, stemphylium blight, yield

INTRODUCTION

Lentil (*Lens culinaris* Medik.), one of the classic founder crops is an annual, herbaceous selfpollinating grain legume grown in winter-season belonging to family Fabaceae/Leguminosae (Schaefer *et al.,* 2012). The total cultivated area of lentil in world is estimated about 6.10 million hectares with annual production and productivity of 6.33 million tons and 1.04 mt/ha, respectively.The top 10 lentil producing countries are Canada, India, USA, Turkey, Australia, Kazakhstan, Nepal, Russian Federation Bangladesh, and China respectively (FAOSTAT, 2020). In 2021/22, area, production of productivity of lentil in Nepal was 202416 ha, 246092 kg and 1.21 ton/ha respectively and lentil share 60.3% of the total cultivated area of grain legumes (MoAD, 2077/78). Nepalese lentil was regarded as exportable commodity because of its highly digestable protein, high palatability, medium sized grain and red cotyledon. But in recent years the export scenario has dropped down due to low productivity caused by different biotic and abiotic. Lentil production is challenged by different fungal disease. Among the diseases, Stemphylium blight caused by *Stemphylium*

botryosum Wallr., is destructive one that cause huge economic loss in short period of time if effective management strategy is not adopted in proper time. Stemphylium blight in lentil was previously regarded as minor disease but it is increasing rapidly as a serious threat in recent years (Mwakutuya and Banniza, 2010).

Over 33 species of Stemphylium are known among which *S. botryosum*, *S. solani*, and *S. vesicarium* are very prevalent to cause important crops and fruit trees diseases (Wang *et al.,* 2010). *S. botryosum* has wide host range and cause disease. Stemphylium blight is a foliar fungal disease which causes heavy defoliation of leaves in severe condition. The first appearance of this disease was recognized in Bangladesh in 1986 (Bakr 1992). Latter the disease has been reported in India, Nepal, the USA and Canada (Morral *et al.,* 2005). Initially disease symptoms appear brown pin dot like structure and latter whole leaves, branches are blighted along with defoliation. Sometime the symptoms can be often confused with aschochyta and alternaria blight during flowering and pod filling stage and sometimes mixed symptoms are also noticed. The disease causes brightening of the leaves reducing photosynthetic activity at flowering and pod filling stage affecting the quantity and quality of grain as well as seed production (Hay *et al.,* 2019). Disease cause heavy losses up to 80-92.35% but disease development can be influenced by many environmental factors (Huq and Khan, 2008). In Nepal Stemphylium blight (SB) disease is prevalent In lentil fields of Banke, Bardia, Rupandehi, Chitwan, Nepalgunj, Makwanpur, Bara, Parsa and Rautahat districts of Nepal (Joshi, 2006).

Thus, due to the importance of Stemphylium blight disease attention needs to be paid to combat this disease. Among the plant disease management options, use of disease-resistant cultivars is considered as the most economical and best option. But cultivars are no longer durable against SB disease therefore it is necessary to develop alternate and more effective control measures with available fungicides in the market. This experiment was done to find out effective dose of fungicide(s) against Stemphyliun blight to minimize the disease severity and obtain good yield.

MATERIALS AND METHODS

Experiment detail

The experiment was conducted at the research field of Plant Pathology, Grain Legume Research Program, Khajura, Banke during November to April 2017/18. Geographically, it lies between at 81^0 37" East longitudes and 28^0 06" North lattitude and an altitude of 181 meters above mean sea level.The experiment was conducted in Randomized Complete Block (RCB) with 3 replications. Each replication received 10 treatments. Individual plot size was 4 m^2 (2m x 2m). A susceptible variety Shital was used in this experiment. Altogether 3 fungicides, 2 chemical {Saff (Carbendazim 12%+ Mancozeb 63%); Farm guard (Chlorothalonil 75% WP} at the dose of 1.5 gm, 2 gm and 2.5 gm per liter water and one biological {Commericial Phytoderma (*Trichoderma harzianum*) at the dose of 2.5 gm, 3 gm and 3.5 gm per liter water along with no fungicide application (control) was evaluated against stemphylium blight of lentil.

Application of the fungicide

The experimental field was monitored regularly to observe the on-set of Stemphylium blight disease symptom. Spraying of fungicides was started when the disease appeared on

the field. Altogether three sprays of each dose of fungicides were applied at 10 days interval beginning from the symptom appearance.

Agronomic practices

Chemical fertilizer at rate of 20:40:20 kg/ha NPK was applied through Urea, DAP and Potash. Weeding was done two times during the growing period of the crop to maintain normal hygienic condition of crop growth. One weeding was done at 20 days and another at 35 days after sowing. Light irrigation was provided after each weeding.

Data recording of Stemphylium Blight severity

The severity of stemphylium blight disease was recorded at 60, 70 and 80 days after sowing. The severity of stemphylium blight of lentil was rated based on (0-5) scoring scale described by Bakr et al., 2000.

0-5 scoring scale:
0 = No infection (HR),
1 = Few scattered leaf but no twig blighted (R),
2 = 5-10% leaflets infected and/or few scattered twig blighted (MR),
3 = 11-20% leaflets infected and/or 1-5% twig blighted (MS),
4 = 21-50% leaflet infected and/or 6-10% twig blighted (S) and
5 = above 51% leaflet infected and/or more than 10% twig blighted (HS)

Analysis of data

The collected data were analyzed statistically. The experimental data were analyzed by MSTAT-C software. Mean comparisons for treatment parameters were compared using Duncan's Multiple Range Test (DMRT) at 5% level of significance.

RESULTS AND DISCUSSION

Fungicidal effect on mean disease severity and mean AUDPC

Analysis of variance revealed that mean disease severity, mean AUDPC were highly among the different treatments. Lowest mean disease severity (28.89) was obtained when Farm guard (Chlorothalonil @ 2.5 gm/ water) was applied followed by Saff (30) at the same dose. Highest mean disease severity (43.33) was obtained when no fungicide was applied. Similarly lowest AUDPC (204.2) was obtained when Saff @ 2.5 gm/lit water was applied followed by Chlorothalonil (210) at the same dose. Highest AUDPC (291.7) was obtained in control plot (Table 2). In the previous research conducted by Subedi et al (2015), the disease control was found effective when Saff was used at 2 gm per liter water against stemphylium blight of lentil in field condition. Our result was also found similar with (Subedi et al 2015). Subedi et al (2015) when used different isolates of Trichoderma against Stemphylium blight of lentil, Commercial Trichoderma obtained highest disease severity. In our study also commercial product Phytoderma (*Trichoderma harzianum)* obtained higher disease severity in all doses and was found least effective in controlling disease compared to chemical fungicides.

Table 2. Effect of fungicides on disease severity and mean AUDPC

Treatments	Mean DS	Mean AUDPC
Saff (Carbendazim 12%+ Mancozeb 63%) 1.5 gm/lit water	36.67 ^{abc}	250.8 ^{abcd}
Saff (Carbendazim 12%+ Mancozeb 63%) 2 gm/lit water	31.11^{cd}	215.8^{cd}
Saff (Carbendazim 12%+ Mancozeb 63%) 2.5 gm/lit water	30.00^{cd}	204.2^{d}
Farm guard (Chlorothalonil) 1.5 gm/lit water	33.33^{bcd}	233.3^{bcd}
Farm guard (Chlorothalonil) 2 gm/lit water	31.11^{cd}	215.8^{cd}
Farm guard (Chlorothalonil) 2.5 gm/lit water	28.89 ^{d}	210.0 ^{cd}
Phytoderma (Trichoderma 2.5 gm/lit water)	42.22 ^{a}	285.8 ^{ab}
Phytoderma (Trichoderma 3 gm/lit water)	38.89 ^{ab}	268.3 ^{abc}
Phytoderma (Trichoderma 3.5 gm/lit water)	37.78 ^{ab}	256.7 ^{abcd}
Control	43.33 ^{a}	291.7 ^{a}
CV%	10.09	12.48
LSD	6.11 **	52.09**

*Mean DS: Mean Disease severity; Mean AUDPC: Mean Area Under Disease Progress Curve. **:P<0.01, same letters signify that there is no significant difference among treatments*

Fungicidal effect on hundred seed weight, grain yield and percent yield increase

All the tested dose of fungicides reduced the disease and significantly increased crop yield of lentil compared to control. However the dose of fungicides was not significant for hundred seed weight parameter (Table 3). Remarkable effect of different dose of fungicides was noticed on the grain yield of lentil and yield was increased considerably compared to control (Figure 1). Among the nine dose of fungicides Chlorothalonil at the rate of 2 gm per liter water sprayed plot obtained highest yield (836 kg/ha) followed by Chlorothalonil at the rate of 1.5 gm per liter water. Lowest grain yield was obtained from control plot (546 kg/ha) followed by Trichoderma (624 kg/ha) when sprayed at 2.5 gm per liter water (Table 3). Highest percent yield increase (34.6%) was obtained when Chlorothalonil was sprayed at the rate of 2 gm per liter water followed by Chlorothalonil when sprayed at the rate of 1.5 gm per liter water. Lowest percent yield increase (12.5%) was obtained when Trichoderma was sprayed at the rate of 2.5 gm per liter water (Figure 1). Chlorothalonil is deemed low risk for fungicide resistance and is registered for use on several crops including wheat, peas, lentil and potatoes for protection against a broad spectrum of diseases including fusarium head blight, mycosphaerella blight, anthracnose and late blight (Government of Saskatchewan, 2018). In Ontario, chlorothalonil suppressed SLB in field trials conducted in 2011 and 2012 and increased yield (Stricker *et al.*, 2021b).

Table 3. Effect of different dose of fungicides on hsw, grain yield and percentage yield increase

Treatments	Mean AUDPC	HSW	GY (kg/ha)	% yield increase
Saff (Carbendazim 12%+ Mancozeb 63%) 1.5 gm/lit water	250.8 ^{abcd}	1.26	622^{e}	12.2
Saff (Carbendazim 12%+ Mancozeb 63%) 2 gm/lit water	215.8^{cd}	1.36	631^{e}	13.4
Saff (Carbendazim 12%+ Mancozeb 63%) 2.5 gm/lit water	204.2^{d}	1.23	712^{cd}	23.3
Farm guard (Chlorothalonil) 1.5 gm/lit water	233.3^{bcd}	1.3	809 ^{ab}	32.5
Farm guard (Chlorothalonil) 2 gm/ lit water	215.8^{cd}	1.1	836 ^{a}	34.6
Farm guard (Chlorothalonil) 2.5 gm/lit water	210.0^{cd}	1.2	761 ^{bc}	28.25
Phytoderma (Trichoderma 2.5 gm/ lit water)	285.8^{ab}	1.3	624 e	12.5
Phytoderma (Trichoderma 3 gm/ lit water)	268.3^{abc}	1.06	638 e	14.4
Phytoderma (Trichoderma 3.5 gm/ lit water)	256.7^{abcd}	1.1	675 de	19.11
Control	291.7^{a}	1.1	546 f	
CV%	12.48	12.20	4.88	
LSD	52.09**	ns	57.46**	

*Mean AUDPC: Mean Area Under Disease Progress Curve; HSW: Hundred seed weight; GY: Grain yield; %: percent ; ns: non-significant; **denotes highly significant value at 5% level of significance*

AUDPC of Stemphylium blight of lentil in relation to grain yield

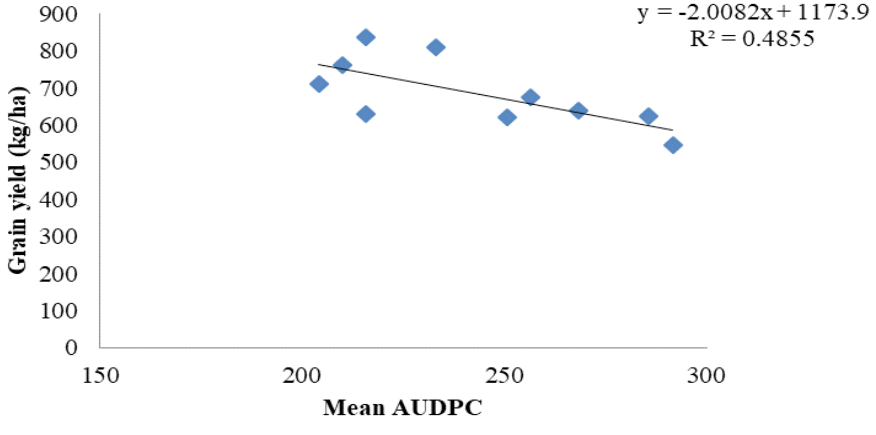

Figure 1. The relationship between grain yield (y) and mean AUDPC (x) of Stemphylium blight of lentil

The predicted linear regression line displayed downward slope i.e. y = -2.008x+1173, where 'y' denoted predicted grain yield of lentil and 'x' stood for mean AUDPC of stemphylium blight of the crop (Figure 1). Coefficient of determination (R^2) indicated that 48.5% of yield loss is governed by stemphylium disease and remaining by other factors. The regression equation indicated the necessity of controlling stemphylium blight of lentil.

CONCLUSION

Stemphylium blight (SB) of lentil caused by *Stemphylium botryosum* is considered as one of the most important constrains of lentil production. For the management SB disease different doses of chemical and biological fungicides were evaluated in field condition. The finding of study revealed that Chlorothalonil at the rate of 2 gm per liter water application was able to manage the disease with highest yield increase compared to other doses of fungicides. Thus, Chlorothalonil @ 2 gm when applied timely for three times can manage the stemphylium blight disease.

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REFERENCES

Bakr, M. A., & Ahmed, F. (1992). Development of stemphylium blight of lentil and its chemical control. *Bangladesh Journal of Plant Pathology*, *8*(1), 39-40.

FAO. (2020). Available from http://www.fao.org/ faostat/en/#home (Accessed May 29 2020).

FAOSTAT Database. (2020). Food and agriculture organization of the United Nations. Rome, Italy.

Government of Saskatchewan. (2018). *Guide to Crop Protection*. [Online]. Available: http://publications.gov.sk.ca/documents/20/87089-

Hay, F. S., Sharma, S., Hoepting, C., Strickland, D., Luong, K., & Pethybridge, S. J. (2019). Emergence of Stemphylium leaf blight of onion in New York associated with fungicide resistance. *Plant disease*, *103*(12), 3083-3092.

Huq, M. I., & Khan, A. N. A. (2008). Epidemiology of Stemphylium blight of lentil. *Bangladesh Journal of Scientific and Industrial Research*, *43*(4), 513-520.

Joshi, S. (2006). Review of important grain legume diseases and their management. In Proceedings of a national workshop on Integrated Pest Management (IPM) (pp. 100-116).

MoAD.(2077/78). *Statistical Information on Nepalese Agriculture*. Singha Durbar, Kathmandu, Nepal.

Morrall, R.A.A., Carriere B., Pearse C., Schmeling D & Thomson L. (2006). Seedborne pathogen of lentil in Saskatchewan in 2005. *Can.Plant.Dis.Surv,* 8, 104-106

Mwakutuya, E., & Banniza, S. (2010). Influence of temperature and wetness periods on the development of Stemphylium blight on lentil. *Plant Disease*, 94(10), 1219-1224.

Stricker, S. M., Tayviah, C. S., Gossen, B. D., & Mcdonald, M. R. (2021). Fungicide efficacy and timing for the management of Stemphylium vesicarium on onion. *Canadian Journal of Plant Pathology*, 43(2), 275-287.

Subedi, S. U. B. A. S. H., Shrestha, S. M., Bahadur, K. G., Thapa, R. B., Ghimire, S. K., Neupane, S. A. R. A. S. W. A. T. I., & Nessa, B. A. D. R. U. N. (2015). Botanical, chemical and biological management of Stemphylium botryosum blight disease of lentil in Nepal. *Indian Phytopath*, *68*(4), 415-423.

Wang, Y., Geng, Y., Pei, Y. F., & Zhang, X. G. (2010). Molecular and morphological description of two new species of Stemphylium from China and France. *Mycologia*, 102(3), 708-717.