Bangladesh J. Bot. **52**(2): 291-295, 2023 (June) DOI: https://doi.org/10.3329/bjb.v52i2.67026

INTEGRATED MANAGEMENT OF PURPLE BLOTCH DISEASE OF GARLIC (*ALLIUM SATIVUM* L.)

KN VIJAYKUMAR, SHRIPAD KULKARNI*, TR SHASHIDHAR[1], SM HIREMATH[2], PV PATIL[3] AND DN KAMBREKAR[4]

Department of Plant Pathology, University of Agricultural Sciences, Dharwad 580005, Karnataka, India

Keywords: Management, Purple blotch, Per cent disease index, Bulb yield, Benefit cost ratio

Abstract

Purple blotch (*Alternaria porri*) is one of the major diseases of garlic causing huge loss to the growers. An investigation was undertaken to formulate suitable management practices against purple blotch of garlic var. DWG1. Among the various treatments, seed treatment with *Trichoderma harzianum* @ 10 g/kg of cloves and two foliar applications of fluopyram 17.7% + tebuconazole 17.7% @ 0.1% on 50 and 65 days after sowing recorded the minimum disease severity (13.34 PDI) and higher bulb yield (5.77 t/ha), 10 bulbs weight (83.00 g), number of cloves (15.67) and 100 cloves weight (65.33 g) with C:B ratio of 1: 3.51. The combined application of cow urine, nimbecidine and *Trichoderma harzianum* also showed significant impact on disease reduction as well as on yield of garlic. However, fluopyram 17.7% + tebuconazole 17.7% showed a higher benefit with minimum production cost and this approach is proposed to garlic growing farmers to mitigate the purple blotch disease.

Introduction

The garlic (*Allium sativum* L.) crop is cultivated in several countries and susceptible to number of diseases at various stages of plant growth (Bisht and Agarwal 1993). Purple blotch (*Alternaria porri*) is one of the major diseases of garlic hindering the production and productivity (Prahlad *et al.* 2021).

Chemical management plays a predominant role among all the different components responsible in managing the disease effectively. It is quicker in action and intensity of disease control is much higher when compared to different methods (Roopadevi and Patil 2017).

Continuous use of chemical fungicides in the management of diseases also brought new problems with them and also there has been development of harmful environment for human beings (Kareem *et al.* 2018). Contrary to the problems associated with the use of synthetic chemicals, cow urine, botanicals and bioagents are environmentally pollution free, renewable, indigenously available, easily accessible, largely non-phytotoxic and relatively cost effective and hence constitute as a suitable plant protection in the strategy of integrated disease management (Abhay *et al.* 2016). Integrated management strategies applied at right time could reduce the use of fungicides and it enforces eco-friendly low cost and effective management of purple blotch of garlic. So, the present study was taken up to formulate suitable management practices against purple blotch of garlic by using chemicals along with cow urine, botanicals and bioagents under field conditions to know the individual and their combinations spray effect.

*Author for correspondence: <kulkarnish@uasd.in>. [1]Department of Horticulture, University of Agricultural Sciences, Dharwad 580005, Karnataka, India. [2]Department of Horticulture, University of Agricultural Sciences, Dharwad 580005, Karnataka, India. [3]Department of Plant Pathology, University of Agricultural Sciences, Dharwad 580005, Karnataka, India. [4]Department of Agricultural Entomology, University of Agricultural Sciences, Dharwad 580005, Karnataka, India.

Material and Methods

The present investigation was carried out in the field during *Kharif*, 2019 at AINRPOG (All India Network Research Project on Onion and Garlic, Main Agricultural Research Station (MARS), Dharwad.

The recommended package of practices *viz*., Farm yard manure at the rate of 25 t/ha and fertilizers urea, SSP (Single super phosphate), MOP (Muriate of potash) at the rate of 272, 390 and 104 kg/ha, respectively were used. The whole amount of SSP and MOP; half amount of urea were applied as basal dose before sowing of seeds. The rest amount of urea was applied at 30 days after sowing (DAS). The experiment was laid out in a randomized complete block design (RCBD). The cloves of garlic cv. DWG1 were sown on the deep black soil field by following spacing of 15 × 10 cm and with plot size of 2.5 × 1.2 m. Light irrigation was given immediately after sowing. The cloves were treated with *Trichoderma harzianum* @ 10g/kg cloves by following dry seed treatment. Then the cloves were dried under shade and used for the study.

Based on the studies of Vijaykumar *et al*. (2021, 2022) 17 different combinations of treatments were developed based on their effectiveness under *in vitro* condition. In addition to their superiority in bio-efficacy, cost of different fungicides, cow urine, botanical and bioagent were considered while including them in the schedule. Effective and economically viable non-systemic fungicide: mancozeb (Indofil M-45 75% WP), systemic fungicide: propiconazole (Tilt 25% EC), combiproduct fungicide: fluopyram 17.7% + tebuconazole 17.7% (Luna Experience 400 SC), cow urine: cow urine, botanical: nimbecidine (Azadirachtin 0.03%) and bioagent: *Trichoderma harzianum* (MH027645.1) were selected for the field evaluation. In treatments T_1 to T_{16}, the cloves were treated with *T. harzianum* @ 10 g/kg cloves, while T_{17} was absolute control (without seed treatment and foliar spray).

Two sprays were given as per the combination and schedule along with unsprayed control. The 1st spray was done immediately after the onset of disease (50 DAS) followed by 2nd spray (65 DAS). The disease severity was recorded at 15 days after second spray on ten randomly selected plants per plot. In each plant, 3 leaves were graded by using 0-5 scale (Sharma 1986) and expressed as per cent disease index (PDI). Per cent disease index was calculated by using formula of Wheeler (1969).

Bulb yield per plot was also recorded and converted into tonnes per hectare and 10 bulbs weight, number of cloves per bulb and 100 cloves weight from each treatment were recorded after the harvest of the crop. Finally, the cost of production was analyzed in order to find out the most economic treatment of different management practices. Cost and return analysis were done according to the procedure of Shivayogi *et al*. (2015).

The experimental data were analysed statistically for its significance of difference by the normal statistical procedure adopted for randomized complete block design (RCBD) and interpretation of data was carried out in accordance with Walter (1967). Fischer's method of analysis of variance was used for analysis and interpretation of the data as outlined by Gomez and Gomez (1984). The level of significance used in 'F' tests was p = 0.05 for the study.

Results and Discussion

Results presented in the Table 1 indicated that significant difference among the spray schedules was evident in respect of per cent disease index and all the schedules significantly reduced the purple blotch severity as compared to control. The treatment T_3 recorded least per cent disease index of 13.34, which was on per with T_2 (14.66) followed by T_1 (16.11 %). The control recorded significantly highest per cent disease index of 34.00 %. The treatments T_{14}, T_{11} and T_8

Table 1. Screening of fungicides, botanicals, cow urine and bioagent for the management of purple blotch of garlic.

Treat-ments	First spray	Second spray	% disease index	10 Bulbs wt. (g)	No. of cloves/bulb	100-cloves wt. (g)	Yield (t/ha)	Benefit cost ratio
T_1	Mancozeb @ 0.2 %	Mancozeb @ 0.2 %	16.11 (23.66)*	75.67	13.67	61.67	4.55	3.66
T_2	Propiconazole @ 0.1 %	Propiconazole @ 0.1 %	14.66 (22.52)	81.67	14.33	62.00	4.61	3.67
T_3	Fluopyram 17.7 % + Tebuconazole 17.7 % @ 0.1 %	Fluopyram 17.7 % + Tebuconazole 17.7 % @ 0.1 %	13.34 (21.42)	83.00	15.67	65.33	4.81	3.51
T_4	Cow urine @ 10 %	Cow urine @ 10 %	25.44 (30.29)	59.67	9.67	43.03	3.61	2.95
T_5	Nimbecidine @ 1 %	Nimbecidine @ 1 %	22.67 (28.43)	60.00	8.67	41.67	3.68	2.79
T_6	*Trichoderma harzianum* @ 1 %	*Trichoderma harzianum* @ 1 %	25.22 (30.15)	58.33	9.67	40.83	3.49	2.79
T_7	Mancozeb @ 0.2 %	Cow urine @ 10 %	21.78 (27.82)	66.33	10.00	56.67	4.00	3.24
T_8	Mancozeb @ 0.2 %	Nimbecidine @ 1 %	18.00 (25.10)	71.33	11.00	56.00	4.21	3.29
T_9	Mancozeb @ 0.2 %	*Trichoderma harzianum* @ 1 %	20.00 (26.57)	64.33	9.00	50.33	3.79	3.04
T_{10}	Propiconazole @ 0.1 %	Cow urine @ 10 %	21.33 (27.51)	69.00	10.67	55.00	4.09	3.30
T_{11}	Propiconazole @ 0.1 %	Nimbecidine @ 1 %	18.11 (25.19)	72.00	11.33	58.21	4.28	3.32
T_{12}	Propiconazole @ 0.1 %	*Trichoderma harzianum* @ 1 %	23.89 (29.26)	64.67	9.00	46.11	3.73	2.97
T_{13}	Fluopyram 17.7 % + Tebuconazole 17.7 % @ 0.1 %	Cow urine @ 10 %	20.78 (27.12)	69.00	10.67	57.78	4.09	3.15
T_{14}	Fluopyram 17.7 % + Tebuconazole 17.7 % @ 0.1 %	Nimbecidine @ 1 %	17.40 (24.66)	73.33	11.67	58.00	4.40	3.27
T_{15}	Fluopyram 17.7 % + Tebuconazole 17.7 % @ 0.1 %	*Trichoderma harzianum* @ 1 %	24.33 (29.55)	68.67	10.00	46.94	3.84	2.93
T_{16}	Clove treatment with *Trichoderma harzianum* @ 10 g/kg cloves		31.67 (34.25)	54.67	9.33	40.00	3.16	2.62
T_{17}	Absolute control		34.00 (35.67)	49.33	8.33	39.67	2.93	2.53
S.Em. ±			0.967	3.16	0.51	2.48	0.187	
C.D. at 5 %			2.787	9.09	1.48	7.16	0.538	

*Angular transformed values. In treatments T_1 to T_{16}, cloves were treated with *Trichoderma harzianum* @ 10g/kg.

recorded 17.40, 18.11, 18.00 % disease index, respectively and these treatments found as on per with each other.

The results of bulb yield were significant and the treatment T_3 recorded the highest bulb yield of 4.81 t/ha and superior over other spray schedules evaluated. The next best spray schedule was T_2 which had recorded the bulb yield of 4.61 t/ha and found on per with T_3 treatment. Bulb yield performance in different treatments *viz*., treatment T_{14}, T_{11} and T_8 were found superior over the control (2.93 t/ha).

In case of 10 bulbs weight, number of cloves per bulb and 100 cloves weight, the treatment effects were similar to that of per cent disease index and bulb yield. The treatment T_3 recorded the highest 10 bulbs weight (83.00 g), number of cloves per bulb (15.67) and 100 cloves weight (65.33 g) followed by T_2 and it has recorded 81.67g of 10 bulbs weight, 14.33 number of cloves per bulb and 62.00 g of 100 cloves weight. The least weight of 10 bulbs (49.33 g), number of cloves per bulb (8.33) and 100 cloves weight (39.67 g) were observed in control T_{17} treatment.

The estimation of cost : benefit ratio is an important aspect in the economic management of plant disease. Table 2 revealed that the maximum cost: benefit ratio of 1 : 3.67 was obtained in the treatment T_2 followed by T_1 and T_3 with cost: benefit ratio of 1 : 3.66 and 1 : 3.51, respectively whereas, the least cost : benefit ratio of 2:53 was recorded in the control (T_{17}) treatment. The chemical fungicides, fluopyram 17.7% + tebuconazole 17.7% and propiconazole were proved to be the best chemicals in managing the disease under field condition.

Table 2. Economic analysis of different purple blotch management practices in garlic production.

Treatments	Yield (kg/ha)	Gross returns (Rs./ha)	Cost of cultivation (Rs./ha)	Net returns (Rs.)	Benefit cost ratio
T_1	4,550	3,64,000	99,343.60	2,64,656.4	3.66
T_2	4,610	3,68,800	1,00,608.00	2,68,192.0	3.67
T_3	4,810	3,84,800	1,09,488.00	2,75,312.0	3.51
T_4	3,610	2,88,800	97,967.60	1,90,832.4	2.95
T_5	3,680	2,94,400	1,05,647.60	1,88,752.4	2.79
T_6	3,490	2,79,200	1,00,047.60	1,79,152.4	2.79
T_7	4,000	3,20,000	98,655.60	2,21,344.4	3.24
T_8	4,210	3,36,800	1,02,495.60	2,34,304.4	3.29
T_9	3,790	3,03,200	99,695.60	2,03,504.4	3.04
T_{10}	4,090	3,27,200	99,287.60	2,27,912.4	3.30
T_{11}	4,280	3,42,400	1,03,127.60	2,39,272.4	3.32
T_{12}	3,730	2,98,400	1,00,327.60	1,98,072.4	2.97
T_{13}	4,090	3,27,200	1,03,727.60	2,23,472.4	3.15
T_{14}	4,400	3,52,000	1,07,567.60	2,44,432.4	3.27
T_{15}	3,840	3,07,200	1,04,767.60	2,02,432.4	2.93
T_{16}	3,160	2,52,800	96,314.00	1,56,486.0	2.62
T_{17}	2,930	2,34,400	92,814.00	1,41,586.0	2.53

Price of garlic: Rs. 80/kg

The present studies were in fine tune with the findings of Ahmed *et al.* (2017) who found that luna experience as an effective fungicide when applied at different intervals with regard to reducing purple blotch of onions as well as enhancing yield and growth of onion crops. Ravikumar *et al*. (2020) also found that luna sensation 500 SC at 600 ml/ha proved to be superior in reducing onion purple blotch severity (22.03%) over rest of the treatments with enhanced bulb yield of 24.77 t/ha.

The chemicals *viz*., fluopyram 17.7% + tebuconazole 17.7% SC and propiconazole EC @ 0.1 per cent proved to be best chemicals in managing the disease under field condition. So, farmer can follow the management schedule involving clove treatment with *Trichoderma harzianum* @ 10g/kg followed by two sprays of fluopyram 17.7% + tebuconazole 17.7% or propiconazole @ 0.1 per cent at 50 and 65 DAS to manage the disease and to get higher bulb yield.

Acknowledgements

The authors are grateful to the members of AINRPOG and AICRP on Potato, Department of Plant Pathology, University of Agricultural Sciences, Dharwad for providing the necessary facilities and timely assistance to conduct the experiment.

References

Abhay KP, Satish KS and Pooja SA 2016. Perspective on integrated disease management in agriculture. Bio Bulletin. **2**(2): 13-29.

Ahmed M, Amin M and El-Fiki I 2017. Efficacy of bioagents against *Alternaria porri* incitant of purple blotch of onion in Egypt. Egyptian J. Phytopathol. **45**(1): 17-29.

Bisht IS and Agarwal RC 1993. Susceptibility to purple blotch (*Alternaria porri*) in garlic. Ann. App. Biol. **122**: 31-38.

Gomez KA and Gomez AA 1984. Statistical Procedures for Agricultural Research (2nd Edition). A Willey Interscience Publication, New York.

Kareem MA, Bhat AS, Kurubetta KD, Mesta RK, Allolli TB, Ajjappalavar PS, Shweta K, Masuthi D and Waseem MA 2018. Evaluation of silicon and bio-formulations for the management of purple blotch disease of onion. Res. J. Chem. Environ. Sci. **6**(1): 46-50.

Prahlad, Anupriya, Godara SL, Kumhar DR and Chawla N 2021 Prevalence and management of major diseases of garlic is it global level: A review. Agric. Rev. **42**(1): 1-8.

Roopadevi and Patil PV 2017 *In vitro* bioassay of fungicides, bioagents, botanicals and itk's against *Pyricularia grisea* (Cooke) Sacc. incitant of pearl millet blast. Int. J. Pure App. Biosci. **5**(5): 1457-1463.

Ravikumar MR, Harish DK, Kumara BH and Kumar A 2020. Evaluation of pre-mix fungicide, fluopyram and trifloxystrobin 250 SC against purple blotch disease of onion in Karnataka. Curr. J. App. Sci. Technol. **39**(8): 44-50.

Sharma SR 1986. Effect of fungicidal sprays on purple blotch and bulb yield of onion. Indian Phytopath. **39**: 78-82.

Shivayogi DN, Mamle Desai NR and Hosamani SB 2015. Economic analysis of garlic production in North Karnataka. J. Farm Sci. **28**(1): 116-117.

Vijaykumar KN, Shripad K, Patil PV, Kambrekar DN and Shashidhar TR 2021. *In vitro* evaluation of new molecules of fungicides against purple blotch *Alternaria porri* (Ellis) Ciferri of garlic (*Allium sativum* L.). Pharma Innov. J. **10**(12): 1048-1054.

Vijaykumar KN, Shripad K, Patil PV, Kambrekar DN and Shashidhar TR 2022. Eco-friendly management of purple blotch of garlic caused by *Alternaria porri* (Ellis) Ciferri. Biol. Forum. Int. J. **14**(2): 1-7.

Walter TF 1967. Experimental Design: Theory and Application. 2nd Edition, Oxford and IBH Publishing Company, New York.

Wheeler BEJ 1969. An Introduction to Plant Diseases. John Wiley and Sons Ltd., London, 301 p.

(Manuscript received on 10 July, 2022; revised on 30 April, 2023)