Progressive Agriculture 28 (3): 167-173, 2017 ISSN: 1017 - 8139

Progressive Agriculture
Journal homepage:http://www.banglajol.info/index.php/PA

Evaluation of garlic, BAU-biofungicide, bion and chemical fungicides in controlling leaf spot of Taro

MAS Sohag, MT Hossen, MS Monjil*

Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh 2202, Bangladesh

Abstract

The field experiment was conducted to evaluate the efficacy of Garlic extract @ 10%, BAU-Biofungicide @ 2%, Bion@ 0.2%, Bavistin DF (Carbendazim) @ 0.1% and Proud 250EC (Propiconazole) @ 0.1% for controlling leaf spot disease of taro (*Colocasia esculenta*). Performance of these treatments was assessed by applying as cormel treatment and foliar spray. Cormel treatment under field experiment was found effective for BAU-Biofungicide and Proud 250EC. Bavistin DF and Proud 250EC was more effective than other treatments in increasing plant height and healthy leaves, and in decreasing spotted and dead leaves. Before foliar spraying, BAU-Biofungicide as cormel treatment reduced the disease incidence (46.19%) and severity (25.28%) of taro leaf spot at 180 days after sowing. As foliar spray all the treatments has significant effect on taro leaf spot. Among the treatments BAU-Biofungicide was found superior to control leaf spot of taro. BAU-Biofungicide resulted maximum reduction of disease incidence and severity and increase in number of healthy leaf followed by Bion and Proud 250EC. BAU-Biofungicide showed enhanced results in terms of disease incidence and severity of leaf spot of Taro before and after foliar spraying.

Key words: Taro, leaf spot, garlic, biofungicide, bion, fungicide

 ***Corresponding Author:** smonjil@yahoo.com

Introduction

Taro [*Colocasia esculenta* (L.) Schott], a traditional tuber crop of the tropics is grown for its edible cormels and leaves, and is a member of the Araceae family. It is believed to be one of the earliest cultivated tuber crops in the world. Many tropical nations rely on taro as a main export. According to Food and Agriculture Organization (FAO), taro production has doubled over the past decades and taro is now the fifth most consumed tuberous vegetable worldwide (FAOSTAT, 2015).. In Bangladesh taro is a very popular vegetable and extensively grown in kharif season and contributes a considerable part in the total supply of bulky summer vegetables in the market (Siddique *et al.,* 1988). The corms and cormels are consumed as staple or subsistence food in some developing countries in the Asia, Africa and the Pacific. The area and gross annual production of aroids in Bangladesh is increasing year after year, but its yield per unit area in 2012 was 5.58 mt ha^{-1} (BBS, 2012), which is very low as compared with Egypt (37.11 mt ha^{-1}), China (19.15 mt ha^{-1}) and Japan (12.87 mt ha^{-1}) (FAOSTAT, 2015).

Taro is affected by a number of infectious diseases caused by fungi, bacteria, nematodes and viruses, and non infectious or abiotic problems by poor soil nutrients. Although, taro is susceptible to at least 23 pathogens, only a few cause serious reduction in growth and production (Ooka *et al*., 1990). Among all disease classes, fungal diseases are the most important (Ooka, 1994). Leaf spot disease caused by

Cladosporium colocasiae Sawada has been reported in Ghana (Awuah, 1995). Pathogens that plaque taro include *Pythium* species, *Phytophthora colocasiae* (Racc.), *Cladosporium colocasiae* (Sawada), *Curvularia* species, *Fusarium solani* (Mart.) which cause leaf spot and leaf blight diseases (Ooka, 1994).

In Bangladesh, crop growth and appearance of disease are coincides with onset of monsoon making the conditions most favorable for the development of the disease. The disease assumes severe since in areas having high temperature (22-33ºC) and maximum relative humidity (85-100%) with frequent rainfall causes 25-50% losses in crop yield (Jackson, 1999). Leaf blight has become a limiting factor for taro production in all taro growing countries including India causing yield loss of 25-30% (Misra and Chowdhury, 1997). Losses of 25-35% of corm yield have been recorded in the Philippines while in some extreme cases, losses of 95% have been recorded in various cultivars across Hawaii. It is revealed that a mean yield loss of 25-60% occurs due to taro leaf blight every year (Gadre and Joshi, 2003; Misra *et al*., 2007).

Several approaches have been suggested to control leaf blight. Growing of resistant variety is the most practicable and economical method to reduce the disease, if such variety is available (Dey *et al*., 1993). Available literatures from abroad indicate that the disease can be minimized by applying Ridomil MZ, Indofil M-45, Blitox 50 and Hill copper (Maheshwari *et al.* 1999). Biological control of the taro diseases remains a favorable alternative to pesticide control since biological control promises reduced risk to agricultural workers, consumers and the environment.

In Bangladesh, no extensive research work has been carried out on different aspect of taro diseases to assess the losses due to diseases. Few information are available on taro diseases in Bangladesh, only for notifying the diseases and identifying the causes (Dey *et al*., 1991 and Goswami *et al*., 1993). As the taro production is greatly decreased due to leaf spot infection, appropriate attempt should be taken to develop effective control measures through different approaches against the disease and to maximize yield. Therefore, indepth research work is needed for assessing taro diseases incidence and severity. Thus, the present research work was undertaken to observe the effect of *Trichoderma* based formulation BAU-Biofungicide, Garlic extract, Bion (resistance inducer) and chemical fungicides (Bavistin DF and Proud 250 EC) and against leaf spot of taro.

Materials and Methods

The experiment was conducted in Field Laboratory, Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh. The land of the experimental plot was thoroughly prepared by ploughing and cross ploughing followed by laddering to obtain a good tilth.

***Collection and treatment of cormels*:** The seed cormels were collected from Boyra Village, Sadar Upazilla, Mymensingh. The variety of taro was Panikachu. The experiment was conducted using six treatments viz. T_1=Garlic clove extract (10%), T_2= BAU-Biofungicide (*Trichoderma harzianum)* at the rate of 2%, T_3=Bion (Acibenzolar- S- methyl) at the rate of 0.2%, T_4= Bavistin DF (Carbendazim) at the rate of 0.1%, T_5= Proud 250 EC (Propiconazole) at the rate of 0.1% and T_6= Control (Non-treated).

The collected garlic cloves were weighed before cleaning in running tap water and removed excess water. The extract was prepared by crushing the garlic cloves in a blender with distilled water (100g/L) following the method of Hossain *et al.* (1997). All the chemicals were weighed as per need and solutions were prepared.

Treatment application and Data collection: Seed cormels were treated by soaking in each treatment for 30 mins. Treated seed cormels of Taro were planted. In each plot, 12 seed cormels were planted maintaining a row to row distance of 60 cm and plant to plant distance of 45 cm (Ahammed, 1988). The seed cormels were planted at a depth of 6-7 cm. All the treatments

including garlic extract and fungicidal solutions were sprayed using hand sprayer. The spray was done 60 days after transplanting.

Collection of data were initiated from first onset of disease. Data were considered for recording treatment effect on plants are height (cm), No. of healthy leaves, No. of spotted leaves, No. of dead leaves, percent of disease incidence and percent of leaf area diseased (disease severity). The disease incidence and severity were evaluated following the formula of Rai and Mamatha (2005), and Johnston (2010) respectively.

The data collected from the experiments were analyzed for test of significance and compared the treatment means by using Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984) at 5% level of probability following the MSTAT-C program.

Results and Discussion

The effect of garlic extract, BAU-Biofungicide, Bion, Bavistin DF and Proud 250 EC on plant height of taro at 90 and 180 days after sowing was recorded and presented in Table 1. Significant variation of plant height was observed under different treatments. All the treatments increase the plant height of taro over control except garlic extract. At 90 days after sowing, the highest (90.22 cm) plant height was observed in Proud 250 EC, which was increased 18.71% over control followed by Bavistin DF (10.38%), BAU-Biofungicide (6.29%) and Bion (6.29%). At 180 days after sowing, the highest (95.17 cm) plant height was observed in Bavistin, which was 17.97% over control followed by Proud 250EC (11.15%) and Bion (9.36%). On the other hand, the lowest plant height was recorded in both times from garlic clove extract. Present research is supported by Shakywar *et al.* (2008), who evaluated the effect of neem leaf extract garlic bulb extract @ 10% and other plant extracts as foliar application. Among them neem leaf extract significantly increase the cormel yield over control. Sahayaraj (2014) reported that treatment with biological fungicides resulted in significantly higher plant growth parameters like plant height, root length, plant fresh weight and dry weight. Bion increases induced resistance against pathogen by increasing β-1,3-glucanase and chitinase activity and keeps normal growth of the plants (Parkinson et al. 2015). Debergh et al. (1993) reported that fungicide Carbendazim (Bavistin) as an alternative plant growth regulator and may increase plant growth.

Table 1. Effect of garlic extract, BAU-Biofungicide, Bion, Bavistin DF and Proud 250EC as cormel seedling treatment on plant height of taro at 90 and 180 days after sowin

Treatment	Mean plant height (cm)		Plant height increase over control (%)	
	90 DAS	180 DAS	90 DAS	180 DAS
T1	74.45e	73.89e	-2.04	-8.40
T2	80.78c	85.50c	6.29	5.99
T3	80.78c	88.22b	6.29	9.36
T4	83.89b	95.17a	10.38	17.97
T5	90.22a	89.67b	18.71	11.15
T6	76.00d	80.67d	-	-
Level of significance	**	**		

** indicates significance at 1% level of probability, Here, DS= days after sowing, T_1= garlic extract, T_2= BAU-biofungicide, T_3= bion, T_4= bavistin DF, T_5= proud 250EC and T_6= control

The effect of garlic extract, BAU-Biofungicide, Bion, Bavistin DF and Proud 250 EC onleaf spot disease of taro at 90 and 180 days after sowing differed significantly among treatments and presented in Table 2. At 90 DAS, highest number of healthy leaves was recorded by BAU-Biofungicide and lowest number was recorded by garlic extract. At 180 DAS highest number of healthy leaves was recorded by BAU-Biofungicide followed by Bavistin DF and lowest number was recorded by control. In case of spotted leaves, highest number of spotted leaves was observed in control and lowest number of spotted leaves was

recorded in BAU-biofungicide followed by garlic extract at both 90 and 180 DAS. Lowest dead leaves at 90 and 180 DAS was recorded by BAU-biofungicide. At 90 DAS, highest decreased spotted leaves by BAU-biofungicide over control was 20.83% followed by garlic extract (19.60%). At 180 DAS, BAU-biofungicide followed by Bion and spotted leaves decreased over control was 29.07% and 16.54%, respectively. It is reported that foliar application of BAU-biofungicide on peanut is effective to reduce infected and defoliated leaves per plant and number of lesions per leaf (Hossain and Hossain, 2014). Palomar (2001) found that significant reduction in the numbers of infected leaves was observed in taro plants sprayed with the fungus *Trichoderma.*

Table 2. Effect of garlic extract, BAU-biofungicide, bion, bavistin DF and proud 250EC as cormel seedling treatment on healthy leaves, spotted leaves and dead leaves of Taro

	Treatment	Healthy leaves	Increase over control (%)	Spotted leaves	Decrease over control (%)	Dead leaves	Decrease over control (%)
90 Days after sowing	T_1	2.51f	-15.13	1.44d	19.10	0.45d	19.60
	T_2	3.89a	34.49	1.11e	37.45	0.44d	20.83
	T_3	2.78d	-3.92	1.77a	0.19	0.57c	-1.78
	T_4	2.56e	-11.53	1.71b	3.93	0.61b	-8.90
	T_5	3.11b	7.73	1.55c	12.73	0.66a	-17.85
	T_6	2.89c	-	1.78a	-	0.56c	-
	Level of signi.	**		**		**	
180 Days after sowing	T_1	2.51f	-15.13	1.44d	19.10	0.45d	19.60
	T_2	3.89a	34.49	1.11e	37.45	0.44d	20.83
	T_3	2.78d	-3.92	1.77a	0.19	0.57c	-1.78
	T_4	2.56e	-11.53	1.71b	3.93	0.61b	-8.90
	T_5	3.11b	7.73	1.55c	12.73	0.66a	-17.85
	T_6	2.89c	-	1.78a	-	0.56c	-
	Level of signi.	**		**		**	

** indicates significance at 1% level of probability, Here, DS= days after sowing, T_1= garlic extract, T_2= BAU-biofungicide, T_3= bion, T_4= bavistin DF, T_5= proud 250EC and T_6= control

The effect of garlic extract, BAU-Biofungicide, Bion, Bavistin DF, Proud 250 EC on disease incidence and severity of taro leaf spot was determined and presented in Table 3 and 4. Significant variation of percent disease incidence was observed under different management practices. At 90 DAS, only BAU-Biofungicide reduced the percent disease incidence of taro leaf spot over control. The lowest disease incidence (28.71%) was observed in BAU-Biofungicide, which resulted 35.63% reduction over control. The highest disease incidence (56.63%) was obtained from Garlic extract. At 180 DAS, the lowest disease incidence (46.19%) was observed in BAU-Biofungicide, which resulted 27.70% reduction over control followed by Bavistin DF (22.56%) and Bion (20.47%). The highest disease incidence (63.89%) was obtained from control. Significant variation of disease severity was observed under different management practices. At 90 DAS, the lowest mean disease severity (14.15%) was observed in BAU-Biofungicide and highest disease severity (29.38%) was recorded in Bavistin closely followed by Garlic clove extract (29.09%). In case of percent reduction of disease severity (32.13%) over control was observed in BAU-

Biofungicide. But at 180 DAS, all the treatments significantly reduced the disease severity of taro leaf spot after spraying. The lowest mean disease severity (25.28%) was observed in BAU-Biofungicide and the highest disease severity (34.75%) was recorded in Control closely followed by Proud 250 EC (34.66%) and Garlic clove extract (34.04%).

Table 3. Effect of garlic extract, BAU-biofungicide, bion, bavistin DF and proud 250 EC on leaf spot of Taro

Treatment	Total leaves/plant		No. of infected leaves/plant		Disease incidence (%)		Dieses incidence decrease over control (%)	
	90 DAS	180 DAS	90 DAS	180 DAS	90 DAS	180 DAS	90 DAS	180 DAS
T1	4.89c	5.55d	2.77	3.22	56.63a	59.03b	-26.98	7.60
T2	5.44b	6.22c	1.56	2.89	28.71e	46.19e	35.63	27.70
T3	5.22b	6.22c	2.44	3.11	46.36c	50.81c	-3.95	20.47
T4	5.33b	6.50a	2.78	3.22	52.42b	49.47d	-17.54	22.56
T5	5.67a	6.17c	2.55	3.56	45.14d	58.75b	-1.22	8.05
T6	5.22b	6.34b	2.33	4.00	44.60d	63.89a	-	-
Level of signi.	**	**			**	**		

** indicates significance at 1% level of probability; Here, DS= days after sowing, T_1= garlic extract, T_2= BAU-biofungicide, T_3= bion, T_4= bavistin DF, T_5= proud 250EC and T_6= control

Table 4. Effect of garlic extract, BAU-Biofungicide, Bion, Bavistin DF and Proud 250 EC on as cormel seedling treatment on severity of leaf spot of taro

Treatment	Disease severity (%)		Disease severity decrease over control (%)	
	90 DAS	180 DAS	90 DAS	180 DAS
T1	29.09a	34.04a	-39.54	2.05
T2	14.15e	25.28c	32.13	27.25
T3	25.09c	30.56b	-20.35	12.06
T4	29.38a	31.47b	-40.93	9.44
T5	26.04b	34.66a	-24.88	0.27
T6	20.85d	34.75a	-	-
Level of signi.	**	**		

** indicates significance at 1% level of probability; Here, DS= days after sowing, T_1= garlic extract, T_2= BAU-biofungicide, T_3= bion, T_4= bavistin DF, T_5= proud 250EC and T_6= control

In case of percent reduction of disease severity, maximum reduction (27.25%) over control was observed in BAU-Biofungicide and minimum reduction (0.27%) was observed in Proud preceded by Garlic clove extract (2.05%). Foliar application of biological control agents has some potential to protect taro crops from infection. For example, significant reductions in the numbers of infected leaves and disease severity were observed in taro plants sprayed with the fungus *Trichoderma* (Palomar et al. 2001). Bion (Acibenzolar-S-methyl) has the unique ability to protect plants from fungal, bacterial and viral infection (Ruess et al., 1996). Bion does not have direct anti-microbial activity (Whan et al. 2009) but it is shown to reduce incidence and severity of leaf spot of taro. Mridha et al., (2007) observed that Bavistin is more effective than mancozeb, Cupravit and other fungicides in controlling leaf spot and reducing fungal mycelial growth. The results of Bavistin treatment in the experiment has also been supported by Hassan et al. (2013), who reported that Bavistin significantly

reduce the disease incidence and severity of Cercospora leaf spot of chilli. Thus, BAU-biofungicide can effectively be used against leaf spot of taro.

References

Ahammed AD, Siddique MA, Rabbani MG (1988) Effect of date of planting and mulching on growth and yield of mukhikachu. Bangladesh Journal of Agricultural Research, 13: 52-56.

Awuah RT (1995) Leafspot of taro (Colocasia esculenta (L.) Schott) in Ghana and suppression of symptom development with thiophanate methyl. A/i'. Crop Science Journal, 3: 457-462.

BBS (2012) Yearbook of Agricultural Statistics- 2012. Bangladesh Bureau of Statistics, Statistics and Informatics Division (SID), Ministry of Planning, Government of the People's Republic of Bangladesh 136.

Chan E (1997) A summary of trials carried out in the taro leaf blight control programme 1994-1997. Western Samoa Farming Project, Ministry of Agriculture, Forestry, Fisheries and Meteorology, Samoa. 33 pp.

Debergh PC, De Coster G, Steurbaut W (1993) Carbendazim as an alternative plant growth regulator in tissue culture systems. In VitrL, Cell. Dev. Biol. 29::89-91

Dey TK, Ali MS, Bhuyan MKR, Siddique AM (1993) Screening of *Colocasia esculenta* (L.) Schott. Lines to leaf blight. Journal of Root crops, 19: 62-65.

Dey TK, Ali MS, Chowdhury N, Siddique MA (1991) Vegetative growth and sporangial production in *Phytophthora colocasiae* Racib. Journal of Root Crops, 17: 142-146.

FAOSTAT (2015) http://faostat.fao.org/site/567/ Desktop Default. aspx? PageID = 567#Ancor.

Fullerton R, Tyson J (2004) The biology of *Phytophthora colocasiae* and implication for its management and control. In Proceedings of the Third Taro Symposium, Nadi, Fiji Islands, 21-23 May 2003; Secretariat of the Pacific Community: Noumea, New Caledonia, pp. 107–111.

Gadre UA, Joshi MS (2003) Influence of weather factors on the incidence of leaf blight of Colocasia. Annual Plant Protection Science, 11: 168-170.

Gomez KA, Gomez AA (1984) Statistical Procedures for Agricultural Research. 2nd ed., International Rice Research Institute, John Willy and Sons, New York, Chichester, Brisbane, Toronto, Singapore. pp. 187-240.

Goswami BK, Zahid MI, Haq MO (1993) Screening of *Colocasia esculenta* germplasm to Phytophthora leaf blight. Bangladesh Journal of Plant Pathology, 9: 21-24.

Hassan MR, Hossain I, Islam MR, Khokon MAR (2013) Comparative efficacy of compost, compost tea, poultry litter and Bavistin in controlling diseases of chili. Progress. Agric. 24(1 & 2): 39-44.

Hossain MH, Hossain I (2014) Evaluation of Three Botanicals, Bavistin and BAU-Biofungicide for Controlling Leaf Spot of Groundnut Caused by *Cercospora arachidicola* and *Cercosporidium personatum*, The Agriculturists, 12(1): 41-49.

Jackson, GVH (1993). Brief summary of situation in the region and comments on available assistance for long-term regional projects on taro leaf blight control. Proceedings of Taro Leaf Blight Seminar, Alafua Campus, USP, Samoa, 22-26 November 1993. Pp71-74.

Johnston PR (2010) The importance of phylogeny in understanding of host relationships within Colletotrichum. In: Prusky D, Dickman MB Freeman S, eds. Colletotrichum host specificity, pathogenicity and host-pathogen interactions. St. Paul, Minnesota: APS. pp. 21-28.

Maheshwari SK, Sahu AK, Misra RS (1999) Efficacy of fungicides against *Phytophthora colocasiae* under laboratory conditions. Annuals of Plant Protection Sciences, 7: 228-229.

Misra RS, Maheshwari SK, Sriram S, Sharma K, Sahu AK (2007) Integrated Management of Phytophthora Leaf Blight Disease of Taro (*Colocasia esculenta* (L.) Schott). Journal of Root Crops, 33: 144-146.

Misra RS, Chowdhury SR (1997) *Phytophthora* Leaf Blight Disease of Taro, CTCRI Technical Bulletin Series 21, Central Tuber Crops Research Institute, Trivandrum, 32 pp.

Mridha MAU, Jabbar F, Bhuiyan MK, Rahman M, Akter F, Dewan S (2007) The severity and cause of leaf spot disease of *Pongamia pinnata* L. and fungicidal control of the pathogen. Journal of Forestry Research, 18(3): 236–240.

Ooka JJ (1994) Taro diseases: A guide for field identification. College of Tropical Agriculture and Human Resources, University of Hawai'i, Honolulu, Hawai'i. Web link;http://hbs.bishopmuseum.org/botany/taro/key/HawaiianKalo/Media/Html/refs/ooka1994.html.

Ooka JJ, Hollyer JR, Sato DM (1990) Taro diseases: Proceedings of Taking Taro into the 1990s: A Taro Conference. Taking Taro into the 1990s: A Taro Conference; 1989 Aug 17; Hilo, Hawaii. Honolulu (HI): University of Hawaii. p. 51-59.

Palomar MK, Mangaoang YC, Palermo VG, Escuadra GE, Posas MB (2001) Biocontrol of root crop diseases through microbial antagonism. In Proceedings of the 4th Asia-Pacific Biotechnology Congress and 30th Annual Convention of the PSM, Laguna, Philippines, 16–18 May 2001; pp. 56–62.

Parkinson LE, Crew KS, Thomas JE, Dann EK (2015) Efficacy of acibenzolar-S-methyl (Bion®) treatment of Australian commercial passionfruit, Passiflora edulis f. sp. flavicarpa, on resistance to Passionfruit woodiness virus (PWV) and activities of chitinase & β-1,3-glucanase. Australasian Plant Pathology, 44: 311–318 DOI 10.1007/s13313-015-0349-4

Rai VR, Mamatha T (2005) Seedling diseases of some important forest tree species and their management. *International Working papers of the Finnish Forest Research Institue* pp. 11.

Ruess W, Mueller K, Kanuf-Beiter G, Kunz W, Staub T (1996). Plant activator CGA 245704: An innovative approach for disease control in cereals and tobacco. Proc. Brighton Crop Prot. Conf. Pest Dis. p 53- 60.

Sahayaraj K (2014) Basic and applied aspect of beiopesticides, Microbial elicitors to induce immunity for plant disease control in chilli and tomato. Spinger New Delhi, India. 99-128 p. ISBN 978-81-322-1877-7 (e-Book).

Shakywar RC, Pathak SP, Sah D (2012) Management of Leaf Blight of Taro through Integrated Approaches. Technofame, 1(1): 43-49.

Siddique MA, Dhar M, Rabbani MG (1988) Effect of seed cormel size and plant spacing on the yield of mukhikachu. Bangladesh Journal of Agriculture Research 13: 31-36.

Singh D, Jackson G, Hunter D, Fullerton R, Lebot V, Taylor M, Iosefa T, Okpul T, Tyson J (2012) Taro Leaf Blight—A Threat to Food Security, Agriculture, 2: 182-203.

Whan JA, Dann EK, Smith LJ, Aitken EAB (2009) Acibenzolar-S-methyl-induced alteration of defence gene expression and enzyme activity in cotton infected with *Fusarium oxysporum* f. sp. *vasinfectum*. Physiol Mol Plant Pathol, 73:175–182.