International Journal of Bio-resource and Stress Management https://ojs.pphouse.org/index.php/IJBSM

Crossref

IJBSM May 2023, 14(5):756-761 Print ISSN 0976-3988 Online ISSN 0976-4038 **Article** AR3360

Research Article *Stress Management*

DOI: HTTPS://DOI.ORG/10.23910/1.2023.3360

Management of Mango Powdery Mildew through Potential Organic Products

Shripad Kulkarni[1], Tippesh Chavan[2] and Vijaykumar K. N.[3]

[1]Dept. of Plant Pathology, [2]Institute of Organic Farming, University of Agricultural Sciences, Dharwad, Karnataka (580 005), India

[3]ICAR-IARI, Regional Research Centre, Dharwad, Karnataka (580 005), India

Open Access

Corresponding kulkarnish@uasd.in

0000-0002-0090-4021

ABSTRACT

The present study was conducted at farmer's field in Kyarakoppa village of Dharwad taluka, Karnataka, India during 2014–15 and 2015–16. Mango (*Mangifera indica* L.) is considered as one of the most important fruit crop for millions of people in the world, particularly in India where it is deemed to be the choicest of all indigenous fruits. Mango powdery mildew caused by *Oidium mangiferae* Berthet is a severe disease that infects all parts of mango trees except the fruits. Organic production has recently increased the demand for environmental friendly control programs to eliminate the risk of fungicide and pesticide resistance so, it is important to study the alternatives from natural extractions. Hence, the present investigation was carried to evaluate the use of some eco-friendly compounds as alternatives to control the powdery mildew of mango. The results revealed that out of ten different treatments evaluated, the treatment T_4 involving panchagavya @ 1:10 dilution has resulted in least mean disease severity of 30.27% and maximum net returns (₹ 1,12,900) as against 61.00% disease severity and minimum net returns (₹ 50,000) in the control. The treatment T_4 was statistically on par with recommended fungicide sulphur @ 3 g l^{-1} which has resulted in 28.96% Disease Index over the years. However, the taste and smell were found to be superior with panchagavya sprayed trees which has produced yield 6.75 t ha^{-1} with cost benefit ratio of 5.11 as compared to C:B ratio of triadimefon (6.86) and sulphur (6.37).

KEYWORDS: C:B ratio, mango, *Oidium mangiferae*, panchagavya, per cent disease index

***Citation* (VANCOUVER):** Kulkarni et al., Management of Mango Powdery Mildew through Potential Organic Products. *International Journal of Bio-resource and Stress Management,* 2023; 14(5), 756-761. HTTPS://DOI.ORG/10.23910/1.2023.3360.

Data Availability Statement: Legal restrictions are imposed on the public sharing of raw data. However, authors have full right to transfer or share the data in raw form upon request subject to either meeting the conditions of the original consents and the original research study. Further, access of data needs to meet whether the user complies with the ethical and legal obligations as data controllers to allow for secondary use of the data outside of the original study.

Conflict of interests: The authors have declared that no conflict of interest exists.

RECEIVED on 04th December 2022 RECEIVED in revised form on 12th April 2023 ACCEPTED in final form on 02nd May 2023 PUBLISHED on 24th May 2023

1. INTRODUCTION

Mangoes (*Mangifera indica* L.) are considered as one of the finest fruits and the most important fruit crops in tropical and subtropical areas of the world (Singh, 1960, Makhmale et al., 2016). The mango tree is not only adored as a sacred item but also is treasured due to its great economic potential since all its components are deemed useful and are utilized for different reasons (Reddy, 2001, Parmar et al., 2012). India is renowned around the world for its diverse collection of mango types, each with its own distinct flavour, texture and aroma (Anila and Radha, 2006, Dalvi et al., 2010). Though mango cultivation is recorded from more than 120 nations, simply more than 60% of global mango output comes from India, China, Thailand, Indonesia and Mexico (Sai Krishna et al., 2022). The consumption of mangoes, as well as the area under mango production, is steadily expanding since the fruit is recognized as a super fruit (Nath et al., 2007, Sharma et al., 2021). However, the King of Fruits is also confronted with a number of obstacles as a result of the perpetually changing climate and the emergence of biotic pressures in a variety of agro-ecological environments (Verma and Deepraj, 1998, Rajan, 2021). Powdery mildew is one of the important fungal diseases of mango flowers and young fruits which are primary cause of the widespread problem of poor mango fruit set and yield (Palti et al., 1974).

Powdery mildew, caused by the fungus, *Oidium mangiferae* Berthet (Telomorphic stage: *Eyrsiphe polygoni*) is a widespread, devastating disease causing yield loss up to 90% due to its effect on fruit set and development (Boesewinkel, 1980, Misra et al., 2016). Its severity mainly depends on weather conditions and susceptible crop stage and available inoculum load. Minimum temperatures of 10–13°C and maximum temperatures of 27–31°C, combined with high humidity, were found to be the most conducive to disease development (Butt, 1978, Verma and Kaur, 1999, Sinha et al., 2001, Naqvi et al., 2014). The characteristic symptom is the white superficial, powdery appearance of fungal growth on inflorescences, stalks of the inflorescences, leaves, and young fruits (Reuveni et al., 2017, Anita et al., 2021). The mildew attack on mango flowers results in the dropping of infected flowers (Nofal and Haggag, 2006, Dalvi et al., 2021). Infected young fruits either drop or if they grow, their epidermis in the infected area cracks and a corky tissue is formed (Singh, 2000). The pathogen survives on infected plants for a period of time as conidia on fallen mango plant debris. Pathogen populations can build up rapidly during seasonal flushes of new mango leaves and flowers (Ray, 2003, Nasir et al., 2014).

One of the potential methods of reducing the severity of powdery mildew in an environmentally safe manner is the use of natural compounds. Natural compounds are those products which are not produced by synthesis but which occur in nature in mineral salts, plants and biological agents (Komal et al., 2022). Farmers around Dharwad have begun growing organic mangoes, as this improves the tree's immunity against pests without using fertilizers or pesticides. Organically grown mangoes will have easier access to new markets and higher keeping quality (shelf life). Organic farming assures farmers good returns with lower production costs and higher demand in the market for their products. Farmers need not to search for markets, as customers book in advance and buy produce directly from them. Thus, the present investigation was undertaken to study and evaluate the effectiveness of potential organics to manage mango powdery mildew in order to minimize the hazardous effects of the fungicides.

2. MATERIALS AND METHODS

Organic products have been applied in field experiments to control powdery mildew disease of mango under natural infection. The trial was applied in two growing seasons on the mango trees of 5 years old in fields of Alphanso cultivar that was cultivated in spacing 5×5 m^2 between trees in Kyarakoppa village of Dharwad taluka, Karnataka, India during 2014–15 and 2015–16. The field trials were conducted in a randomized block design (RBD) with three replications along with the control.

In the present study various organic products such as cow urine, jeevamrutha, butter milk and panchagavya were used along with mineral salt (KH_2PO_4), antitranspirant (kaolin) and antioxidant (ascorbic acid) were evaluated against powdery mildew of mango and compared their efficacy in contrast to recommended fungicides such as sulphur and triadimefon.

These organic products were sprayed at 15 days interval for two times, whereas first spray was taken immediately after onset of the disease while second spray was taken 15 days after first spray to test their efficacy in the management of powdery mildew of mango in the farmer's field. Each treatment was imposed on five fully grown five year old mango trees. Natural inoculum was relied on as the disease occurs every year on mango plantations in this region. The control plots were sprayed with water only. The experimental design was randomized complete block design with three replications for each treatment.

The data on powdery mildew infection was recorded for every 10 days after the last spray by visual observations, on the basis of area of inflorescence affected by powdery mildew disease using self-designed 0–5 grade disease rating scale, where 0 indicates free from the infection, 1:less than 1% of the inflorescence area affected, 2:1–5% of the inflorescence

area affected, 3:6–25% of the inflorescence area affected, 4:26–50% of the inflorescence area affected and 5:51–100% of the inflorescence area affected.

Mean Percent Disease Index (PDI) was calculated and statistically analysed to know the effect of individual treatments. Observations on yield were also recorded and expressed in terms of tonnes per ha. Economic analysis for these treatments was done with and without premium price for organic mangoes in the market and cost benefit ratio was also worked out.

2.1. Panchagavya preparation

Panchagavya consists of nine products viz., cow dung, cow urine, milk, curd, jaggery, ghee, banana, tender coconut and water. Proper mixing of these products and usage of panchagavya shows miraculous effects. Panchagavya preparation as follows, initially cow dung (7 kg) and Cow ghee (1 kg) are mixed thoroughly both in morning and evening hours and kept for 3 days. After 3 days 10 l of cow urine and 10 l of water were mixed and kept it for 15 days with regular stirring both in morning and evening hours. After 15 days cow milk (3 l), cow curd (2 l), tender coconut water (3 l), Jaggery (3 kg) and well ripened banana (12 numbers) were mixed and kept it for fermentation and panchagavya was ready after 30 days. Solutions of other organic products and fungicides were prepared as per the proposed concentrations and used for the spray.

3. RESULTS AND DISCUSSION

The results of the pooled data revealed that organic products and fungicidal treatments were found effective in reducing the severity of powdery mildew of mango and increasing the net returns over the control (Table 1 and 2). Among the treatments tested, T_4 treatment significantly reduced the disease severity to 30.28% and recorded 6.75 t ha^{-1} of yield with C:B ratio of 5.11 as against control recorded 61.00%, 3.65 t ha^{-1} and 2.65, respectively. The T_4 treatment was statistically on par

Table 1: Efficacy of different organic products for the management of mango powdery mildew during the period, 2014–15 and 2015–16

Treatment No.	Treatments	Concentration	Per cent disease index (PDI)				Yield (t ha^{-1})			
			I season	II season	Mean	PROC	I season	II season	Mean	PIOC
T_1	Cow urine	1:10 Dilution	44.44 (41.80)*	36.61 (37.23)*	40.53 (39.54)*	33.56	4.76	5.51	5.14	40.82
T_2	Jeevamrutha	1:10 Dilution	44.44 (41.80)	36.61 (37.23)	40.53 (39.54)	33.56	4.56	5.13	4.85	32.88
T_3	Butter milk	1:10 Dilution	40.74 (39.66)	36.61 (37.23)	38.68 (38.46)	36.59	6.16	6.47	6.31	72.88
T_4	Panchagavya	1:10 Dilution	33.33 (35.26)	27.22 (31.44)	30.28 (33.39)	50.36	6.68	6.81	6.75	84.93
T_5	Mineral salt phosphate solution (KH_2PO_4)	1 g l^{-1}	40.74 (39.66)	40.24 (39.37)	40.49 (39.52)	33.62	5.86	5.99	5.93	62.47
T_6	Antitranspirant (Kaolin)	1 g l^{-1}	40.74 (39.66)	35.40 (36.51)	38.07 (38.10)	37.59	6.33	6.04	6.19	69.59
T_7	Antioxidant (Ascorbic acid)	1 ml l^{-1}	40.74 (39.66)	35.83 (36.77)	38.29 (38.23)	37.23	4.46	5.60	5.03	37.81
T_8	Sulphur	3 g l^{-1}	25.92 (30.60)	32.00 (34.45)	28.96 (32.56)	52.52	7.86	7.21	7.53	106.30
T_9	Triadimefon	1 g l^{-1}	14.81 (22.63)	22.86 (38.48)	18.84 (25.72)	69.11	8.58	8.48	8.53	133.70
T_{10}	Control	-	66.66 (54.72)	55.33 (48.06)	61.00 (51.35)	-	2.65	4.65	3.65	-
	SEm±	4.03	2.32	2.02		0.45	0.41	0.27		
	CD (p=0.05)	11.99	6.88	6.00		1.32	1.21	0.79		

* Arc sine transformed values PROC: Per cent reduction over control; PIOC: Per cent increase over control

Table 2: Economic analysis of the effect of usage of organic products in managing mango powdery mildew

Treatment No.	Treatments	Concentration	Income (₹ ha^{-1})	Quantity of organic product (OP) (2 sprays) (kg l^{-1} ha^{-1})	Cost of OP (2 sprays) (₹ ha^{-1})	Cost of OP+Wages (₹ ha^{-1})	Total cost of cultivation (₹ ha^{-1})	Net income (₹ ha^{-1})	B:C ratio
T_1	Cow urine	1:10 Dilution	1,02,800	100	250	750	20,750	82,050	3.95
T_2	Jeevamrutha	1:10 Dilution	97,000	100	200	700	20,700	76,300	3.68
T_3	Butter milk	1:10 Dilution	1,26,200	100	850	1350	21,350	1,04,850	4.91
T_4	Panchagavya	1:10 Dilution	1,35,000	100	1600	2100	22,100	1,12,900	5.11
T_5	Mineral salt phosphate solution (KH_2PO_4)	1 g l^{-1}	1,18,600	1	1000	1500	21,500	97,100	4.51
T_6	Antitranspirant (Kaolin)	1 g l^{-1}	1,23,800	1	800	1300	21,300	1,02,800	4.83
T_7	Antioxidant (Ascorbic acid)	1 ml l^{-1}	1,00,600	1	500	1000	21,000	79,600	3.79
T_8	Sulphur	3 g l^{-1}	1,57,800	3	900	1450	21,450	1,36,650	6.37
T_9	Triadimefon	1 g l^{-1}	1,70,600	1	1200	1700	21,700	1,48,900	6.86
T_{10}	Control	-	73,000	-	-	-	20,000	53,000	2.65

1US$= ₹ 66 (average value during the harvesting month of mango)

with T_8 treatment (sulphur @ 3 g l^{-1}) which has resulted in mean disease severity of 28.96%, yield of 7.53 t ha^{-1} and C: B ratio of 6.37 over the years. However, the taste and smell were found to be superior with panchagavya sprayed trees compared to all other treatments tested. The T_9 treatment (triadimefon @ 1 g l^{-1}) has significantly reduced the disease severity to 18.84% and recorded 8.53 t ha^{-1} of yield with C: B ratio of 6.86 compared to all other treatments tested.

It is evident from the present study that the beneficial microorganisms of panchagavya which influenced the plant growth and crop yield, it might be due to the presence of growth accelerating enzymes in panchagavya which favoured rapid plant cell division and multiplication (Pagar et al., 2015). With the application of Panchagavya, the plants show an increased growth of side shoots, profuse root growth and fruit size. Apart from this, panchagavya also increases the shelf-life of fruits and vegetables thus the quality of yield increases considerably (Prasad and Kothari, 2022).

The efficiency of individual treatments varied but panchagavya was found to be best in better utilization of leaf nitrogen, efficient photosynthetic activity and improving yield. Foliar spray of panchagavya not only provides the nutrients, IAA and GA but also protection to the plants from insect pests and diseases which is present in the panchagavya (Senthilkumar et al., 2023). Panchagavya possess the properties of fertilizers and biopesticides and have been resulted in positive effect on growth and yield of crops (Alias and Ram, 2017, Ramkumar et al., 2022). Mixed cultures of naturally occurring beneficial microbes like lactic acid bacteria (*Lactobacillus* spp.), yeast (*Saccharomyces* spp.), actinomycetes (*Streptomyces* spp.), photosynthetic bacteria (*Rhodopseudomonas* spp.) and certain fungi (*Aspergillus* spp., *Penicillium* spp. etc.,) are present in panchagavya. It also includes chemolithotrops and autotrophic nitrifies (Ammonifers and nitrifiers) which helps in colonization on the leaves and increase the ammonia uptake and enhance the total N supply. The pH of panchagavya was lowered to 4.5 at 30 days after fermentation due to *Lactobacillus* bacteria, which produced more organic acid during fermentation (Mathivanan et al., 2006, Verma et al., 2023).

Earlier reports of Sarkar et al. (2014) have found that increased polyphenol oxidase activity in the plant system in panchagavya sprayed plots which in turn enhanced the systemic resistance against powdery mildew. Srimathi et al. (2013) revealed that mixture of panchagavya spray has increased the linear growth of shoot and root system in tomato, chilli and cowpea seedlings. They have observed induced defence mechanism acquired by the tomato, chilli

and cowpea which was quantified in terms of polyphenol oxidase activity in panchagavya sprayed seedlings.

Antifungal potential of panchagavya against many pathogens of various crops has been reported by several workers that were similar to the results obtained in the present study (Sugha, 2005, Naik and Sreenivasa, 2009, Sangeetha and Thevanathan, 2010, Ramya, 2014, Rathore and Patil, 2019, Sreethu and Singh, 2020).

4. CONCLUSION

Panchagavya sprayed plots were found to have the least mean disease severity of 30.27% as against 61.00% in the control. As compared with the cost benefit ratios of triadimefon (6.86) and sulphur (6.37), the panchagavya sprayed plots yielded the greatest net returns of ₹ 1,12,900 with a C:B ratio of 5.11. Based on these results, eco-friendly tested compounds and fungicides could be recommended to reduce the severity of mango diseases and to increase fruit yields.

5. REFERENCES

Alias, A., Ram, M., 2017. Panchagavya is a bio-fertilizer in organic farming. International Journal of Advanced Science and Research 2(5), 54–57.

Anila, R., Radha, T., 2006. Studies on fruit drop in mango varieties. Journal of Tropical Agriculture 41, 30–32.

Anita, A., Harpreet, S., Yesmin, K., Mandeep, S., Sumanjit, K., 2021. Management of powdery mildew (*Oidium mangiferae*) of mango with fungicides. Plant Disease Research 36(1), 58–61.

Boesewinkel, H.J., 1980. The identity of mango mildew, *Oidium mangiferae*. Journal of Phytopathology 99, 126–130.

Butt, D.J., 1978. Epidemiology of powdery mildews. In: Spencer, D.M. (Ed.), The Powdery Mildews. Academic Press, London, 51–81.

Dalvi, M.B., Patil, P.D., Pawar, H.D., Raut, R.A., Bhure, S.S., Desai, V.S., 2021. Efficacy of different bio-organics for the management of important diseases of mango (*Mangifera indica* L.). Crop Research 56(6), 308–312.

Dalvi, N.V., Salvi, B.R., Chavan, S.A., Kandalkar, M.P., 2010. High density planting in mango cv. Alphonso. Journal of Horticultural Sciences 5(2), 117–119.

Komal, K., Bajaj, K.K., Chavhan, V., Raut, N.A., Gurav, S., 2022, Panchgavya: A precious gift to humankind. Journal of Ayurveda and Integrative Medicine 13(2), 100525. DOI: 10.1016/j.jaim.2021.09.003.

Kumar, S., Hariprabha, S., Kamalakannan, S., Sudhagar, R., Sanjeevkumar, K., 2020. Effect of panchagavya on germination and seedling growh of balsam (*Impatiens balsamina*). Plant Archives 20, 3735–3737.

Makhmale, S., Bhutada, P., Yadav, L., Yadav, B.K., 2016. Impact of climate change on phenology of mango-The case study. Ecology Environment and Conservation Paper 22, 119–124.

Mathivanan, R., Edwin, S.C., Viswanathan, K., Chandrasekaran, D., 2006. Chemical, microbial composition and antibacterial activity of modified panchagavya. International Journal of Cow Science 2(2), 8–10.

Misra, A.K., Dalvi, M.B., Agarwal, R., Salvi, B.R., 2016. Forewarning powdery mildew of mango (*Mangifera indica* L.) caused by *Oidium mangiferae* Berthet. Journal of Eco-friendly Agriculture 12(1), 1–9.

Naik, N., Sreenivasa, M.N., 2009. Influence of bacteria isolated from panchagavya on seed germination and seed vigour in wheat. Journal of Farm Sciences 22(1), 231–232.

Naqvi, S.A.H., Perveen, R., Manzoor, S.A., Umar, H.M.I., Iqbal, M.T., Liaquat, F., Majid, T., Irshad, A., 2014. Evaluation of various mango varieties against the infection dynamics of powdery mildew (*Oidium mangiferae* Bert.). American Journal of Plant Sciences 5, 2372–2377.

Nasir, M., Mughal, S.M., Mukhtar, T., Awan, M.Z., 2014. Powdery mildew of mango: A review of ecology, biology, epidemiology and management. Crop Protection 64, 19–26.

Nath, V., Das, B., Rai, M., 2007. Standardization of high density planting in mango (*Mangifera indica*) under sub humid alfisols of eastern India. Indian Journal of Agricultural Sciences 77, 3–7.

Nofal, M.A., Haggag, W.M., 2006. Integrated management of powdery mildew of mango in Egypt. Crop Protection 25, 480–486.

Pagar, R.D., Patel, M.M., Munde, S.D., 2015. Influence of panchagavya on growth and yield of wheat (*Triticum aestivum* L.). Agriculture for Sustainable Development 3(1), 57–59.

Palti, J., Pinkas, Y., Chorin, M., 1974. Powdery mildew of mango. Plant Disease Report 58, 45–49.

Parmar, V.R., Shrivastava, P.K., Patel, B.N., 2012. Study on weather parameters affecting the mango flowering in south Gujrat. Journal of Agrometeorology 14, 351–353.

Prasad, A., Kothari, N., 2022. Cow products: boon to human health and food security. Tropical Animal Health and Production 54, 12.

Rajan, S., 2021. Mango-The king of fruits. Indian Horticulture 66(4), 3.

Ramkumar, R., Arjunan, S., Adhithya, S, Gomez, L.A., 2022. Effect of panchagavya on *Sesamum indicum*.

International Journal for Research in Applied Science and Engineering Technology 10(10), 43–48.

Rathore, M.S., Patil, A.D., 2019. Panchagavya, An organic amendment for inhibiting damping-off causing *Fusarium solani* and *Sclerotium rolfsii* under *in-vitro* conditions. Indian Journal of Pure and Applied Biosciences 7(4), 203–206.

Ray, S.K., 2003. Efficacy of different fungicides for management of powdery mildew of mango in West Bengal. Journal of Mycopathological Research 41, 153–155.

Reddy, Y.T.N., Kurian, R.M., Sujatha, N.T., Srinivas, M., 2001. Leaf and soil nutrient status of mango (*Mangifera indica* L.) grown in peninsular India and their relationship with yield. Journal of Applied Horticulture 3(2), 78–81.

Reuveni, M., Gur, L., Farber, A., 2017. Development of improved disease management for powdery mildew on mango trees in Israel. Crop Protection 110, 221–228.

Sai Krishna, K., Chaudhary, R.K., Kumar, M., 2022. Stability analysis for assessment of yield performance and adaptability of selected mango (*Mangifera indica* L.) genotypes under multi location trials in India. International Journal of Bio-resource and Stress Management 13(5), 454–462.

Sangeetha, V., Thevanathan, R., 2010. Effect of Panchagavya on nitrate assimilation by experimental plants. Journal of American Science 6(2), 76–82.

Sarkar, S., Kundu, S.S., Ghorai, D., 2014. Validation of ancient liquid organics-panchagavya and kunapajala as plant growth promoters. Indian Journal of Traditional Knowledge 13, 398–403.

Senthilkumar, S., Kondi, R.K.R., Praveen Kumar, K., Manoj Kumar, S., Raja Reddy, P., Sravani, S., 2023. A study of certain organic inputs on phenological, yield and quality related traits of strawberry (cv. Camarosa) in pot culture. Emergent Life Sciences Research 9(1), 77–82.

Sharma, V.K., Kumar, K., Sharma, S.D., Kuchay, M.A., 2021. Long term effects of weather parameters on crop yield in mango and citrus under Una district of Himachal Pradesh. Biological Forum-An International Journal 13(1), 756–761.

Singh, L.B., 1960. The mango botany, cultivation and utilization. Inter-Science Publication Inc., New York.

Singh, R.S., 2000. Powdery mildew of mango. In: Singh, R.S. (Ed.), Diseases of fruit crops. Oxford and IBH Publishing, New Delhi, 157–159.

Sinha, P., Chakrabarti, U., Varma, A., 2001. Critical factors for mango powdery mildew development. Annals of Plant Protection Sciences 9(2), 264–267.

Sreethu, S., Singh S., 2020. Effect of nitrogen and panchagavya on growth and yield of baby corn yield of baby corn (*Zea mays* L.). The Bioscan 15, 243–246.

Srimathi, P., Mariappan, N., Sundaramoorthy, L., Paramathma, M., 2013. Efficacy of panchagavya on seed invigoration of biofuel crops. Academic Journals 8(41), 2031–2037.

Sugha, S.K., 2010. Antifungal potential of panchagavya. Plant Disease Research Ludhiana 20(2), 156–158.

Verma, K.S., Deepraj, K., 1998. Management of powdery mildew of mango. Plant Disease Research 13, 190–192.

Verma, K.S., Kaur, D., 1999. Growth and development of *Oidium mangiferae* on mango in relation to temperature and relative humidity. Plant Disease Research 14, 213–215.

Verma, P.K., Singh, G., Kumar, R., Srivastava, V., 2023. Panchagavya: A potential growth promoting and immunity stimulating plant system. Vigyan Varta 4(2), 110–112.