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SHORT COMMUNICATION

Evaluation of plant extracts for the management of Cowpea anthracnose disease caused by *Colletotrichum lindemuthianum*

M. R. Satpathy[1*] and S. K. Beura[2]

[1*]P.G. Department of Botany, Dhenkanal Autonomous College, Dhenkanal, Odisha, India
[2]Department of Plant Pathology, College of Agriculture, OUAT, Bhubaneswar-751003

Edited by:

Dr. Kailash Behari Mohapatra,
College of Agriculture, OUAT, Bhubaneswar,
Odisha, India.

Reviewed by:
Dr. P. Nallathambi, ICAR-Regional Station,
Wellington, Tamil Nadu, India

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ABSTRACT

The fungus *Colletotrichum lindemuthianum* is both seed and soil borne which is the causative of cowpea anthracnose. This causes a significant loss of the crop and becoming a major hindrance in its bumper productivity in all countries where such crop is grown. In order to find out an environment friendly, sustainable control protocol, experiments were conducted by taking eight different plant extracts against the pathogen. The extracts were applied to the plant samples after the 25th day of germination in the field. Application of neem followed by ginger, onion, garlic and tulsi extracts effectively reduce the percent disease incidence by 90%, 85%, 82%, 79% and 76%, respectively. Similarly, the percent green pod yield increased by 134,127, 114, 93 and 84, respectively over control as well as the cost-benefit ratio which can be recommended to the farming community.

Keywords: Anthracnose; *Colletotrichum lindemuthianum*; Cowpea; Plant extracts; Management.

*Corresponding author e-mail address:
manasnitusatpathy@gmail.com (M.R. Satpathy)

INTRODUCTION

Since protein, calories, minerals and vitamins are profusely available in legumes, it plays a very vital role in human diet (Deshpande, 1992). Cowpea being a legume, is a rich source of proteins. In semi-arid and arid tropics of Asia, Africa and America, this has been utilised as a food (Enyiukwu et. al., 2014). Especially for the lower-income group population, the cowpea is a better alternative source of protein, minerals, ash, etc., as compared to other legumes. Dry cowpea seed is rich in protein (23-33%), carbohydrates (56-68%) and folic acid. In humid forest of South-western Nigeria, the cakes made from crushed and fried cowpea seeds are very popular and sold as convenience street food in roadsides (Ogu & Owoeye, 2013).

Major pestilential organisms those can cause cowpea diseases include: bacteria, viruses, fungi and nematodes. Anthracnose in cowpea is a major fungal disease caused by *C. lindemuthianum* perfect stage Glomerella *lindemuthianum* Shear. Being seed and soil borne, the pathogen remains distributed in tropical region mostly in the situations where the humidity remains high during the growing period. The fungus infects all the aerial parts of the plant mostly through development of lesions. Such lesions create tan to brown irregular sunken spots which expand quickly and merge to stems, petioles and the entire plant. As the environment remains wet and humid in the growing period in tropical parts of Africa, Latin America and Asia, the fungus causes maximum financial loss of the growers in these areas (Latunde-Dada, 1990). Studies revealed that in South-west Nigeria, 100% of the crop plants gets infected reducing the grain quality and yield to half (Ajibade and Amusa, 2001). Countries like Western Nigeria and Northern Nigeria reportedly suffer a yield loss of more than 46% due to the anthracnose. The bumper productivity of this crop is hampered due to 90% of loss in Sudan, 40-80% in Tanzania, 92% in Malawi, 95% in Columbia (Enyikwu et al.,2014) and almost 50% in India (Satpathy et al., 2021). However, the loss can reach cent per cent if susceptible variety gets exposed to the pathogen in a suitable disease surrounding.

Agronomic methods (clean seeds/hygienic fields and practices), host plant resistance (HPR), and botanicals (biopesticides) are used to manage the anthracnose disease of cowpea (Ganiyu et al., 2018). The employment of antagonistic microorganisms (Akinbode and Ikotun, 2008) and plant extracts (Akinbode and Ikotun, 2008) are two key courses of action in the control of plant illnesses (Popoola et al., 2016). Due to rising environmental concerns, plant extracts are now being used to manage plant diseases instead of conventional fungicides (Tripathi and Shukla, 2010). Natural fungicides from botanicals decompose quickly, lowering environmental risk (Fokialakis et al. 2006). Plants may manufacture secondary metabolites of phenols, flavonoids, and coumarins, which are known to be natural fungicides. Carvacrol, eugenol, and thymol are powerful anti-causative botanicals (Choudhary et al., 2017). These chemicals have an antibacterial activity and act as a defensive mechanism against harmful microbes (antibiosis). Researchers in South Africa (Falade et al., 2017; Ganiyu et al., 2018), India (Satpathy and Beura, 2020) and Bangladesh (Mondal et al., 2010) have employed such chemicals as biopesticides to control anthracnose.

MATERIALS AND METHODS

In order to study the efficacy of plant extracts on the control of anthracnose disease in cowpea, field trials were conducted for three consecutive kharif seasons by taking the variety Utkal Manika at the farmer's field, Ghatikia, Bhubaneswar as per the details given below:

Number of treatments = 9

T_1 = Spraying with Ginger (*Zingiber officinale*) 20%
T_2 = Spraying with Onion (*Allium cepa*) 20%
T_3= Spraying with Garlic (*Allium sativum*) 20%
T_4= Spraying with Bel (*Aegel marmelos*)20%
T_5 = Spraying with *Eucalyptus* sps. 20%
T_6 = Spraying with Neem (*Azadirachta indica*) 20%
T_7 = Spraying with Karanj (*Pongamia pinnata*) 20%
T_8 = Spraying with Tulsi (*Ocimum sanctum*) 20%
T_9 = Control (No spraying)

The first foliar spray was done on the 25th day of germination, and subsequent spray was applied at an interval of 10 days. The experiment performed with four replications. Plot size and spacing were 2.5 m X 2.4 m and 45 cm x 25 cm, respectively. Fertilizer was applied as 30:60:30 Kg N: P_2O_5: K_2O ha^{-1}. Agronomical practices as generally recommended were taken up.

The plants were artificially inoculated on the 18th day of the sowing by spraying spore suspension (5 x 10^5 spores' ml^{-1}) of *C. lindemuthianum* to build up high inoculum density in the field. Observations in terms of per cent disease incidence (PDI) were recorded just one day prior to each spraying and seven days after the last spraying on the 0-5 scale (Singh et al., 1990). To obtain the extracts, the plant parts (leaf, bulb or rhizome) were cut into small pieces and weighed up to 100gm and ground in 100ml of sterile water in a homogenizer. The extract was filtered using a muslin cloth and kept as stock. Five plant samples were selected randomly in each treatment of the replication and tagged for recording the disease incidence. The cowpea pods were harvested at appropriate maturity, and cumulative green pod yield was worked out. Economics of plant extract application was worked out on the basis of the prevailing market price of the green pod of cowpea @ Rs. 2200/- per quintal, labour wage @ Rs. 200/- per day per person and cost of botanicals, taking into account. The data obtained from the experiments were analysed statistically by RBD (randomised block design) to find out the SEM and CD values.

RESULTS

Field trials were conducted on foliar spraying of plant extracts basing on the evidences in laboratory tests and observed that all the plant extracts included under investigation were found significantly superior over the control in eliminating the disease occurrence. Among the plant extracts tested, lowest disease incidence was recorded from the plots sprayed with leaf extracts of neem (PDI-3.4%) which correspond to the maximum green pod yield of 66.1q ha^{-1}. Spraying with the rhizome extract of ginger was found to be the next best followed by spraying with bulb extracts of onion and garlic, which were at par. Spraying with bel, eucalyptus and karanj was found to be comparatively less effective among the different plant extracts tested. Application of neem extracts attributed to 90.1% disease control corresponding to 134.3% increase in green pod yield over control. Analysis on cost-benefit ratio showed that the maximum benefit was obtained from this treatment accounting for 1:8.31 followed by 1:5.16 (spraying with rhizome extracts of ginger).

Table 1. Effect of foliar application of plant extracts on disease incidence, green pod yield and economics.

Treatments	PDI		Green Pod Yield		Excess produce over control	Expenditure over control (Rs ha^{-1})	Economics (Return over control in Rs ha^{-1})		Cost Benefit Ratio
	Mean	Disease control (%)	Mean	Yield over control (%)			Gross	Net	
T_1- Spraying with Ginger	5.1 (13.05)	85.2	64.2	127.6	36.0	6425	39600	33175	5.16
T_2- Spraying with Onion	6.2 (14.42)	82.02	60.4	114.1	32.2	6020	35420	29400	4.88
T_3- Spraying with Garlic	7.2 (15.56)	79.1	54.6	93.6	26.4	6850	29040	22190	3.23
T_4- Spraying with Bel	16.7 (24.12)	51.8	43.0	52.4	14.8	4475	16280	11805	2.63
T_5- Spraying with Eucalyptus	20.3 (26.78)	41.1	41.8	48.2	13.6	4475	14960	10485	2.34
T_6- Spraying with Neem	3.4 (10.63)	90.1	66.1	134.3	37.9	4475	41690	37215	8.31
T_7- Spraying with Karanj	13.6 (21.64)	60.8	45.3	60.6	17.1	4475	18810	14335	3.20
T_8- Spraying with Tulsi	8.1 (16.54)	76.5	52.0	84.3	23.8	4475	26180	21705	4.85
T_9- Control	34.5 (35.97)	-	28.2	-	-	-	-	-	-
SEm±	1.589		4.47						
C.D. (0.05)	4.765		13.42						

* Figures in parentheses are the transformed angular values.

DISCUSSION

Table 1 shows that foliar spraying with neem leaf extract reduced disease incidence, resulting in maximum green pod yield and cost benefit ratio. This conclusion is in line with Amadioha and Obi (1998) observations when dealing with Sudha and Lakshmanan (2009) reported *C. lindemuthianum* leaf extracts on cowpea and *A. indica* (10%) and *Allium sativum* and *Allium cepa* (5%) bulb extracts significantly reduced conidial germination of *Leveillula taurica*, an incitant of chilli powdery mildew in field conditions. Obi and Barriuso Vargas (2013) used *A. indica* and its efficiency in preventing spore germination and colony formation in vitro and pathogen spread in vivo. Singh et al. (1990) reported that application of leaf extract of *Aegel marmelos* reduced the incidence of stem rot in *Cicer arietinum* caused by *Sclerotinia scleritiorum*. Also, the effectiveness of *Aegel marmelos* has been reported by Sujatha Bai et al. (1993) whose report was, two sprays of leaf extracts (10%) of *A. marmelos* combined with 0.01mg nickel sulphate at 100 and 150 days after sowing significantly reduced the fruit rot in chili caused by *Alternaria tenius*. However, in the present investigation, *A. marmelos* application has been found to be moderately effective against cowpea anthracnose. The effectiveness of *Ocimum sanctum* has been proved by Tewari and Nayak (1991) against rice pathogens. The present finding supports the findings of Amadioha (2003) who

verified the efficacy of *O. sanctum* for management of cowpea anthracnose under field conditions through antibiosis.

CONCLUSION

This study recorded the efficacy of plant extracts such as neem, ginger and onion against the anthracnose disease. When applied on the cowpea plants, these plant extracts reduced the incidence of disease significantly along with increase in the crop yield thereby the cost benefit ratio was also increased. Thus, these treatments can be practised by the farming community for the use in reducing the yield loss by way of anthracnose disease and the cost benefit can also be enhanced.

DISCLOSURE STATEMENT

The author declares no competing interests

AUTHOR CONTRIBUTIONS

Dr Manas Ranjan Satpathy carried out the piece of research under the active guidance of Professor Surjya Kanta Beura. The data were collected by the first author. The interpretation, analysis of the results and preparation of manuscript were made on a joint effort. This manuscript has got the agreement of both the authors.

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