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Cite This: J. of. Adv. Agri. & Horti. Res. 2021, 1-2, 33-37

Sciforce

Journal of Advanced Agriculture & Horticulture Research

Journal homepage: www.sciforce.org

Benefit: Cost Ratio (BCR) analysis of Botanical extracts against Brown spot disease of rice caused by *Helminthosporium oryzae* (Breda de Haan)

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ARTICLE INFO

Article history:
Received: 20211013
Received in revised form: 20211023
Accepted: 20211023
Available online: 20211116

Keywords:
Agricultural enterprises ;
Online applications;
Multinomial logistic regression.

ABSTRACT

Many investigations has been done on the efficacy of botanicals against various pest and diseases of crops but there is paucity of information on benefit cost ratio of their application. In the present study five indigenous botanicals extracts of Solanum incanum, Allium hookerii, Mariandra benghalensis and Flogacanthus thyrsiflorus, the indigenous plants of Manipur have been used against the brown spot disease of rice caused by Helminthosporium oryzae. The analysis of benefit cost ratio (BCR) recorded maximum value of BCR in Millettia pachycarpa (1.45:1) followed by Solanum incanum (1.36:1), Allium hookerii (1.33:1), Mariandra benghalensis (1.30:1) and Flogacanthus thyrsiflorus (1.26:1) and in Control (1.13:1). It was found that in treatment M. Pachycarpa an investment of Re.1.00 will generate a gross income of Rs.1.45 or net return (Rs.0.45) and net return for following treatment S. incanum (Rs. 0.36), A. hookerii (Rs.0.33), M. Benghalensis (Rs. 0.30) and F. thyrsiflorus (0.26) as compared to low net return in Control (Rs.0.13).

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Introduction

Rice is the staple food for more than half of the world population. More than 90% of world rice is produced and consumed in the Asian countries. The world demand for rice is increasing day by day which is expected to reach 852 million tonnes by 2035 from present status of 676 million tonnes and in order to produce 176 million tonnes of more rice to fill this deficit. It is necessary to increase the productivity level from 10 tons/ha to 12.5 tons/ha (Khus, 2011). One important constraint of potential rice productivity is attack of various pathogenic fungi, bacteria, viruses, MLO, nematodes etc. Among these pathogenic disease of Rice, Brown spot disease caused by fungal pathogen Helminthosporium oryzae (Breda de Haan). This is one of the major disease which occurs in all rice growing areas of the country (R.S. Singh, 2005; Khalili et al. 2012). It adversely affects yield and milling quality of grain (Datnoff et al. 1994). In India the disease is widespread and known to cause upto 29% losses in grain yield (Bedi and Gill, 1960). The pathogen has been found to caused leaf spot, stalk rot and grain discoloration in non-scented high yielding rice varieties (Sunder et al. 2005). Various plant protection measures mainly synthetic pesticides has been taken up as mandatory for managing crop diseases. At present due to people consciousness of the ill effect of chemical pesticides, the use of plant base pesticides and bio-pesticides has been on the rise in integrated management approaches. However, it is necessary to assess how far these plant protection measures has been effective against the diseases and application has increased the yield thereby getting profitable economic return, need to be worked out figuratively to sustain the farm economy. In the present investigation an attempt has been made to ascertain the actual benefit cost ratio of fungi toxic botanicals extracts against brown spot disease of rice, indicates that over 2 million youths Kenya have access to online platforms at the palm of their hand on a daily base.

This study conceptualized agri-enterprise development at two stages in the agricultural value chain; marketing/broker and value addition/processing. Marketing in this study was conceptualized as the process in which the individuals link the producers with the final consumers of agricultural products. In other words, these stakeholders are deemed to create a career from buying the raw produces from the farmers and selling the same product to the final consumer in the value chain. Processing was conceptualized

as any action that increases the value and the shelf life of raw agricultural products

Materials and Methods

The field trials was conducted in RBD with three replication at the Research field of the Department of Plant Pathology, SHUATS, Prayagraj, Uttar Pradesh during Kharif seasons from 2014 to 2016. The trials was conducted on a susceptible Manipur local rice cultivar viz. Daramphou. 25 days old seedlings was transplanted at (15x25) cm plant to plant and row to row spacing in (2x3) sq. m plots with 2-3 plants/hill. Five indigenous botanicals of Manipur state was evaluated for their efficacy against brown spot disease of Rice. The aqueous extract of botanicals was prepared following Pundir and Jain (2010) methods where 25 g powdered plant material was dissolved in enough sterilized distilled water to make 100 ml of aqueous extract (25% w/v) or (25:100 w/v). The mixture was kept undisturbed at room temperature for 24 hours in a sterile flask covered with aluminium foil to avoid evaporation and subjected to filtration through sterilized Whatman No.1 filter paper. After filtration, the extracts was evaporated in water bath until 25 ml extracts was left in the container. The botanical extracts obtained in this form are taken as standard full concentration. Three spray was given at 10 days interval at the time of disease appearance and observation on disease severity was done one day ahead of every schedule of spray and at 10 days after third or the last final spray.

Benefit Cost ratio:

Benefit Cost ratio is the ratio of Gross return divided by Total cost of cultivation which can also be expressed as return per rupee invested. This index provides an estimate of the benefit a farmer derives from the expenditure he incurs in

adopting a particular cropping system. Benefit: cost ratio (BCR) is an indicator of the relative economic performance of the treatments and a ratio of more than one indicates the economic viability of the treatment compared with the control treatment (Aziz *et al.,* 2012). The benefit cost ratio (BCR) was calculated using the following formula by Reddy *et al.,* (2004).

$$BCR = \frac{\text{Gross Return (Rs/ha)}}{\text{Total cost of cultivation (Rs/ha)}}$$

Gross returns:

The total monetary value of economic produce and by-products obtained from the crop raised in the cropping system was calculated based on the local market prices.

Cost of cultivation:

Cost of cultivation is the total expenditure incurred for raising crops in cropping systems. The cost included for this purpose consists of own or hired human labour, value of seed, manure, fertilizers, pesticides, herbicides and irrigation charges.

Net returns:

Net returns is obtained by subtracting Cost of cultivation from Gross return. It is a good indicator of suitability of a cropping system since this represents the actual income to the farmers.

Results and Discussion:

Data presented in the above Table 1 is the per cent disease severity index of botanical extracts against brown spot disease of rice and per cent disease reduction over untreated Control. It was found that all treatments were statistically significant over the control. However, among the treatments minimum per cent disease incidence was recorded in *Solanum incanum* (14.21) with 39.68% disease control followed by *Allium hookerii* (16.17) with 31.36% disease conrol, *Millettia pachycarpa* (17.55) with 25.50% disease control, *Mariandra benghalensis* (19.34) with 19.05% disease control and minimum significant reduction was recorded on *Flogacanthus thyrsiflorus* (20.65) with 12.35% disease control over Control (23.56). The data on yield parameter revealed that among the treatments highest yield was recorded in *S. incanum* (3.37 t/ha.) with 29.95% increase over the control followed by *A. hookerii* (3.27 t/ha.) with 25.96% increase, *M. pachycarpa* (3.19) with 22.76% increase, *M. Benghalensis* (3.12) with 19.33% increase over the untreated control (2.62 t/ha.). It was reported that secondary metabolite compounds like phenols, quinine, flavones, flavanoids, tannins, caumarin etc. causes toxic effect on pathogens {Chavan *et al.* (2011)}. Gaichui (2008) reported that *Flogacanthus thyrsiflorus* indigenous plant from Manipur extracts at 5% concentration applied at root zone can reduce per cent wilt incidence of Chilli plant upto 46.66%. Devi and Chhetry (2013) who reported that during field trial application of aqueous extract of botanicals *Acorus calamus* at 20% concentration shows maximum 45.29% brown spot disease reduction over untreated Control.

Sl. No	Treatment	PDI	% disease reduction	Yield t/ha	% yield increase
1.	T_0 Control	23.56	-	2.62	-
2.	T_1 *M. benghalensis*	19.34	19.05	3.12	19.33
3.	T_2 *M. pachycarpa*	17.55	25.50	3.19	22.76
4.	T_3 *Allium hookerii*	16.17	31.36	3.27	25.96
5.	T_4 *F. thyrsiflorus*	20.65	12.35	3.02	15.97
6.	T_5 *S. incanum*	14.21	39.68	3.37	29.95
7.	T_6 *Propiconazole*	6.06	74.27	4.58	74.80
	S.Ed (±)	0.36	2.71	0.51	5
	CD	0.71	9.82	1.3	15

Table.1 Efficacy of botanicals on per cent disease severity index and grain yield.

The pool mean cost of cultivation data presented in the above Table 2 is inclusive of botanical treatments during two consecutive crop seasons (2014-15) and (2015-16) keeping other inputs remain constant. The results found highest cost of production in *Solanum incanum* (Rs.32003.00) followed by *Allium hookerii* (Rs.31930.50), *Millettia pachycarpa* (Rs.31855.00), *Flogacanthus thyrsiflorus* (Rs.3152.00) and *Mariandra benghalensis* (Rs.31409.00). However, maximum cost of production was recorded in chemical Propiconazole (Rs.33796.0) since most chemicals are expensive in relation to cost of application. It is also revealed that among the botanical treatments, pool mean of benefit :cost ratio (PCR) i.e. ratio of gross return to cost of cultivation expressed as return per rupee invested on application of five botanicals pesticides in managing the brown spot disease of rice was found highest in *M. pachycarpa* (1.45:1) followed by *S. incanum* (1.36:1), *A. hookerii* (1.33:1), *M. benghalensis* (1.30:1), *F. thyrsiflorus* (1.26:1) and Control (1.13:1) only. The inferences of above result show that in treatment with *M. pachycarpa* investment of a sum of Rs.1.00 will generate a net returned of Rs.0.45 followed by *A. hookerii* (Rs.0.33), *M. benghalensis* (Rs.0.30), *F. Thyrsiflorus* (Rs.0.26) and in Control (Rs.0.13) only. A benefit: cost ratio of more than one indicates the economic viability of the treatment compared with the control treatment (Blankson *et al*., 2014) while Shabozoi *et al.* (2011) obtained a cost: benefit ratio of 1:4.1 and were biologically effective resulting in significant return on investment in plant from application of a neem-based botanical whereas Avirudainambi *et al.* (2010) reported much less favourable ratio of benefit cost:ratio of 1:1.33. This could be because analysis was based on the cost of plant protection and calculated the cost: benefit ratio based on the income of the control treatment. From the above analysis it was evident that application of botanicals fungicides increases the overall grain yield and consequently increases the net return of the farm income. Therefore, plant protection measure is inevitable in modern agriculture for quantitative and qualitative production and will continue to play an important role in food security and at present an important constraint factor of limited arable land resources and increasing human population globally. Our present work is justified by Oerke *et al.* (1994) who claimed that during crop production if you do not use control precautions against diseases, pests and weeds there will be about 65% production losses.

Treatment	Total cost of cultivation (Rs./ha)			Gross return (Rs./ha)			Net profit (Rs./ha)			Benefit cost ratio		
	2014-15	2015-16	Pool mean	2014-15	2015-16	Pool mean	2014-15	2015-16	Pool mean	2014-15	2015-16	Pool mean
T_0 Control	30470	30686	30478.5	34823	34832	34827.5	4558.0	4146.0	4352.0	1.14:1	1.13:1	1.13:1
T_1 *Mariandra benghalensis*	31300	32618	31409.0	41724.8	41730.3	41727.55	10424.8	9112.3	9768.55	1.33:1	1.27:1	1.30:1
T_2 *Millettia pachycarpa*	31835	31875	31855.0	46360	46370	46365	14525.0	14495.0	14510.0	1.45:1	1.45:1	1.45:1
T_3 *Allium hookeri*	31801	32060	31930.5	42649	42657	42653	10848.0	10597.0	10722.5	1.34:1	1.33:1	1.33:1
T_4 *Flogacanthus thyrsiflorus*	31462	31578	31520.0	39912	39923	39917.5	8450.0	8345.0	8397.5	1.26:1	1.26:1	1.26:1
T_5 *Solanum incanum*	31944	32062	32003.0	43647	43656	43651.5	11703.0	11594.0	11648.5	1.36:1	1.36:1	1.36:1
T_6 Propiconazole	33624	33968	33796.0	56192	56110	56151	22568.0	22142.0	22355.0	1.67:1	1.65:1	1.66:1

2. Effect of botanicals extract application on marginal benefit cost ratio (BCR) in management of brown spot disease of rice.

Conclusion:

The present investigation has shown that indigenous botanicals extracts of in-situ or readily available plants offer cost-effective plant protection alternatives to synthetic insecticides. This was evident in the favourable benefit: cost ratios of the botanical treatments. Small holding farmers who have free access to such plant materials have the labour available to gain immensely. More over the synthetic insecticides has been linked with causing hazards to humans, animals and environment. The study also demonstrated that the use of locally available plant materials as crop protectants could be less expensive and give financial benefit as compared with the non-treatment. This model of botanicals disease management will work on efficacy in a wider range of pest or disease crop system.

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