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An Integrated Approach to Control Anthracnose of Guava (*Psidium guajava*)

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Abstract: The experiments were conducted to explore the possibility of integration of various approaches for control of guava anthracnose during fruiting seasons, 1992-93. The organic manures cowdung at 10 kg/tree, Mustard oil cake (MOC) (ghani), MOC (mill), Sesame oil cake (SOC) at 2 kg/tree and fertilizers urea, Tripple Super Phosphate (TSP), Muriate of Potash (MP), $ZnSO_4$, Gypsum at 0.3, 0.3, 0.35, 0.005 and 0.01 kg/tree respectively were applied separately and in six combinations. In another experiment tilt, rovral, Mn, B and Zn at 1000, 500 and 2000 ppm respectively were sprayed separately for three times at 15 days interval starting from early fruit stage. All the sprayed plants received a recommended basal dose of NPK before start of spraying schedule. Disease severity (% fruit infection and % fruit area diseased) was recorded at 15 days interval for continuous 4 times starting 15 days after treatment. No disease developed for the treatment of cowdung, MOC (mill), MP, $ZnSO_4$, Cowdung + MOC (mill), K + $ZnSO_4$, NPK + tilt spray and NPK + Zn spray. Very slight infections were observed for rovral spray (0.08%), Mn spray (0.08%), NPK + $ZnSO_4$ + gypsum (0.18%), PK + $ZnSO_4$ and MOC (ghani) (1.8%). TSP, cowdung + MOC (ghani) were less effective but urea, gypsum, cowdung + SOC, and SOC were ineffective. Results were very promising from the point of environmentally friendly control of guava fruit anthracnose.

Keywords: Anthracnose, guava, manure and fertilizer, fungicide, nutrient element

Introduction

Severely anthracnose infected fruits become fully unfit for consumption and lose food value and market price. Besides it is a great threat to germplasm preservation. Many commercial producers think to give up the cultivation of guava owing to a great loss by the disease. Therefore steps are required to protect this palatable and highly nutritious fruits from the menace of anthracnose. Reports of successful chemical control of the disease are available (Hossain, 1993; Hossain and Meah, 1992; Kabir and Meah, 1987; Midha and Chohan, 1972; Pathak, 1986; Raghavan and Saksena, 1978; Rahman and Hossain, 1988; Tandon and Singh, 1969). Hazardous effect of chemicals, their high price and market availability give the scope to think of alternatives. Cultural control is one of them (Chapman, 1975; Reuther and Labanauskas, 1975; Malraja, 1990; Raut, 1990; Singh *et al*., 1990). However cultural practices alone can not be an effective step. Supplementation of minor essential nutrient element sometimes help in the reduction of incidence of disease. Integration of various management practices has brought success in some crops (Raut, 1990; Singh *et al*., 1990; Adisa, 1985). But this has not been tried in case of guava anthracnose. The purpose of the present study was to explore the possibility of integration of various approaches for control of guava anthracnose.

Materials and Methods

The experiments were conducted at Bangladesh Agricultural University Campus, at Mymensingh, Bangladesh during 1992-93 in two guava seasons- main season (April-August) and the minor (off) season (October-February). Two approaches-i) soil amendment with organic manures and inorganic fertilizers and ii) foliar spray of fungicides and essential minor elements were designed. First approach was done in two adjacent homestead garden and second approach was done in AIC fruit firm.

Soil amendments: Soil amendments by organic manures and inorganic fertilizers were applied separately and in combination during early May and late October 1992. The treatments with their doses are shown in Table 1. Before fertilizations weeding was done and basin type furrows around the trees 60 cm away from the base of the tree were prepared. Well decomposed cowdung collected from the village was applied. MOC and SOC were decomposed in water for 3 days before application. Manures and fertilizers were applied in the furrows and then thoroughly mixed with soil. One set of plants were kept for control treatment receiving no manures and or fertilizers.

Table 1: Guava fruit anthracnose as affected by soil amendments with various treatment showing their rate of application, percent fruit infection and per cent fruit surface area diseased at 60 days after treatment

Treatment (Manure and fertilizer)	Rate of application (Kg/tree)	% Fruit Infected	%Fruit surface area diseased
Cowdung	10.0	0.0g	0.0g
MOC (ghani)	2.0	1.8f	3.2ef
MOC (mill)	2.0	0.0g	0.0g
SOC	2.0	7.4b	6.8b
Urea (N)	0.3	3.8d	4.8cd
TSP (P)	0.3	3.4de	4.2de
MP (KCL)	0.35	0.0g	0.0g
$ZnSO_4$	0.005	0.0g	0.0g
Gypsum	0.01	5.2c	5.8bc
Cowdung + MOC (ghani)	10.0 + 2.0	2.6ef	2.8f
Cowdung + MOC (mill)	10.0 + 2.0	0.0g	0.0g
Cowdung + SOC	10.0 + 2.0	5.8c	6.0b
NPK + $ZnSO_4$ + Gypsum	0.3 + 0.3 + 0.35 + 0.005 + 0.01	0.18g	0.24g
PK + $ZnSO_4$	0.3 + 0.35 + 0.005	0.3g	0.4g
K + $ZnSO_4$	0.35 + 0.005	0.0g	0.0g
Control	0.0	9.2a	9.2a
SE ±		0.268	0.312

Plants in the same plot receiving no treatment served as control. MOC: Mustard Oil Cake, SOC: Sesame Oil Cake, TSP: Triple Super Phosphate, MP: Muriate of Potash. Values are average of five replications with two seasons. Figures in a column with different letters differ at $p = 0.01$

Foliar spray: Two fungicides namely tilt [1-2-(2,4-Dichlorophenyl)-4-propyl-1, 3di ortho oxalen-2-Elmethyl-1 H 1,2,4-Tryozole] and rovral [1-isopropyl carbomoyl-3-(3,5-Dichlorophenyl) hydantoin] and three minor elements namely manganese ($MnSO_4$), boron (HBO_3) and zinc ($ZnSO_4$,) were sprayed as solution on to the trees. Spray solutions were prepared by mixing the definite amount of the chemicals with tap water in bucket. One single plant was

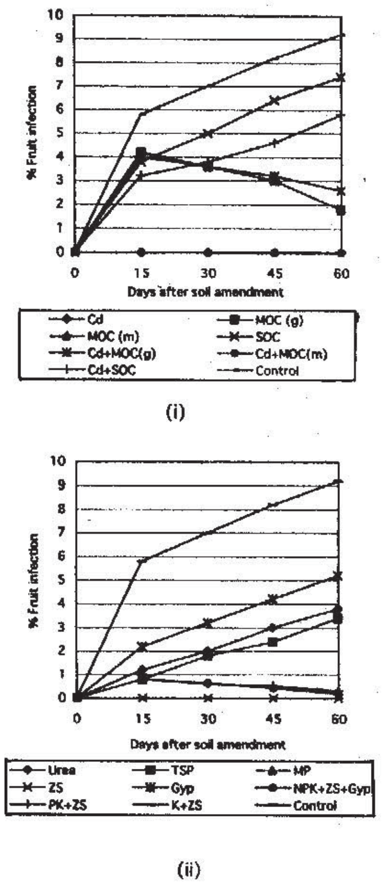

Fig. 1: Trend In Incidence of guava fruit anthracnose with time when soils were amended with manures (i) and fertilizers (ii). Symbol- cd: cowdung, m: mill, g: ghani, ZS: $ZnSO_4$, Gyp: gypsum

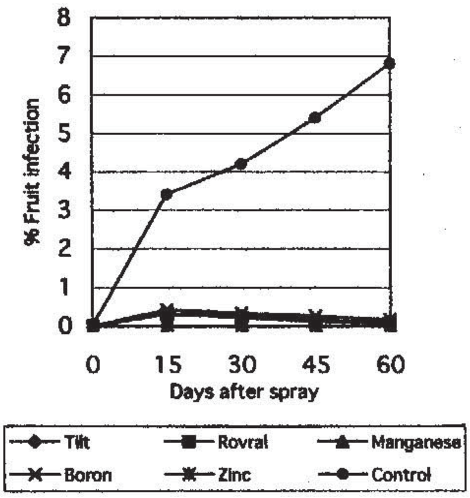

Fig. 2: Effect of fungicidal and minor element spray on severity in per cent fruit Infection

treated as one experimental unit, i.e., in a single plant no two chemicals or minor elements were applied. Five trees sprayed with compressed air sprayer containing 10L solution. The whole surface of the plant including both surface of the leaves, buds, twigs, fruits and branches were well sprayed with the suspension of fungicides and minor elements. Tilt and rovral were sprayed at the commercial rates (0.2%). Manganese, boron, and zinc were sprayed at the rate of 1000, 500 and 2000 ppm respectively. Spraying were started from early fruit stage (fruit setting) and was continued for 3 sprays at an interval of 15 days. Before start of spraying schedule, NPK fertilizers were applied mixing with the rizosphere soil of the guava plants receiving recommended dose as 0.3, 0.3, 0.35 kg/tree respectively but no spray of fungicides or minor elements served as control.

Assessment of disease strategies: Total number of diseased and healthy fruit in each test plant were counted and per cent fruit infected were calculated on the basis of totality of healthy and diseased fruits. Fruit area infections of randomly selected 5 fruits per plant were recorded. Total surface area of an individual fruit was considered as 100%. To evaluate the effectiveness of the different treatments, the severity of disease was recorded 4 times at 15 days interval with first recording at 15 days after the treatment.

Results

Soil amendments: Per cent fruit infected with anthracnose in the untreated plants were significantly higher than in the treated plants (Table 1). Among the treatments cowdung, MOC (mill), MP, $ZnSO_4$, Cowdung + MOC (mill), K + $ZnSO_4$ significantly reduced fruit infection followed by MOC(ghani), cowdung + MOC (ghani), PK + $ZnSO_4$ and NPK + $ZnSo_4$ + Gypsum. TSP, Cowdung + MOC (ghani) were less effective and urea, gypsum, cowdung + SOC and SOC were ineffective.

Cowdung, MOC (mill), MP, $ZnSO_4$, cowdung + MOC (mill) and K + $ZnSO_4$ results 100% reduction in fruit infection over control. Very slight infection occurred in those plants which were treated with NPK + $ZnSO_4$ + gypsum (0.18%), PK + $ZnSO_4$ (0.3%) and MOC-ghani (1.8%) i,e, these treatments showed 98.04, 96.7 and 80.4 % reduction respectively. On an average 9.2% fruits in untreated plants were infected (Table 1). Percent fruit surface area diseased in the untreated plants was significantly higher than in the treated plants. Minimum (0.24-0.4%) surface area diseased was observed in PK + $ZnSO_4$ and NPK + $ZnSO_4$ + Gypsum treatments. MOC (ghani) and cowdung + MOC (ghani) caused 3.2 and 2.8% respectively. Statistically the effect of TSP (4.2%) on surface area diseased was similar to that of MOC-ghani (3.2%) and urea (4.8%) but better than urea and inferior to MOC (ghani). Urea, gypsum, cowdung + SOC and SOC produced highest (4.8-6.8%) surface area infection among all other treatments with SOC supporting the highest.

Continued observation on fruit infection revealed that infections on untreated fruits increased with time, which at the time of 60 days after soil amendments resulted in 9.2% fruit infection. Similar trend was observed in SOC, cowdung + SOC and gypsum treated plants but at apparently at a slower rate. Fruit infection in urea and TSP treated plants also increased but still at slower rate. In other treatments fruit infections were reduced gradually with time comparatively more readily with PK + $ZnSO_4$ and NPK + $ZnSO_4$ + Gypsum and less slowly with cowdung + MOC (ghani) and MOC (mill) (Fig. 1).

Foliar spray: All the spray treatments significantly reduced fruit infection over control. However effect of all treatments were statistically similar. Tilt and Zinc gave 100% reduction in fruit infection followed by rovral and manganese sulphate, both of which produced 0.8% infected fruits. Boron spray gave poorer results in comparison to all other treatments. Similar observations were observed in fruit surface area infection except that rovral produced lower surface area infection (0.8%) than manganese (0.1%) treatment (Table 2). Observation after each spray indicated a slow but steady decrease in new fruit infections in treated plants. Rate of decline in fruit infections were quicker in rovral than in manganese and boron. On the other hand, untreated plants experienced higher fruit infections with time (Fig. 2).

Table 2: Guava fruit infection as affected by sprays of different fungicides and essential elements

Treatments	% fruit Infection	% fruit surface area Infection
Fungicides		
NPK + Titlt	0.00b	0.00b
NPK + Rovral	0.08b	0.08b
Minor elements		
NPK + Manganese(Mn)	0.08b	0.10b
NPK + Boron (B)	0.06b	0.24b
NPK + Zinc (Zn)	0.00b	0.00b
Control (untreated)	6.80a	7.00a
SE ±	0.156	0.399

Figure in a coulm with different letters differ at $p = 0.01$. Values are average of five replications with two seasons

Discussion

Soil amendments: Soil amendment was convincing in relation to suppression of guava fruit anthracnose. Soils when treated with cowdung, MOC (mill) and $K + ZnSO_4$, the guava plant did not develop fruit infection. There are reports that *Colletotricum gloeosporioides* thrives in media enriched with 0.8% KCl and increasing amount of potassium might be one of the factors promoting the pathogen at fruit maturity rather than earlier (Midha and Chohan 1971,1972). In another report Midha and Chohan (1970) described that *Colletotricum gloeosporioides* showed no significant response up to a concentration of 0.7% of KCl. Significant response was increased in the growth at low levels of KCl. They found young immature guava fruits were free from infection while mature fruits were infected readily and this difference might be due to concentration of potassium ion at different developmental stages have been found. And this might be one of the factors promoting pathogen growth at maturity of the fruits and not when it was young or immature (Sastry, 1965). All of the above studies had done in in vitro. These results do not support the findings of the present study that anthracnose infection was totally impaired in MP amended plants. However observation made by Raut (1990) indicate that high doses of potassium induce resistance mechanism in the plant against alternaria leaf blight of cotton. The organic manures, cowdung, MOC (mill) and their combinations improved the soil properties like texure, structure, aeration, water holding capacity etc. Manures also supply all of the essential major and minor elements. These factors might have helped in improving plant health and thereby reduced the disease incidence (Tamhani *et al.,* 1970). Very slight infection occurred in $NPK + ZnSO_4$ + Gypsum, $PK + ZnSO_4$, MOC (ghani) treated plants. This result partially coincides with the result described by Rahman and Hossain (1988) for control of guava anthracnose. They found oil cake increased the disease severity while high dose of NPK reduced it. Cowdung + MOC (ghani), TSP, Urea amended plants suffered from moderate infection of fruit anthracnose. Urea and TSP had less effect over disease development when these were used singly. Lukade and Rane (Lukade and Rane, 1994) reported that application of N in combination with phosphorus was found effective in reducing the root rot of safflower and when these inorganic amendments applied singly, they were ineffective against root rot disease. Nitrogen enhances the development of guava anthracnose. Raut (1990) postulated that high dose of nitrogen favored the development of alternaria leaf blight of cotton which agrees with our findings. High doses of nitrogen cause succulence of the plant and due to this disease incidence increase.

Statistically the effect of Cowdung + MOC (ghani) was similar to $NPK + ZnSO_4$ + Gypsum although cowdung + MOC (ghani) applied plants showed more disease. In this study cowdung produced no disease and MOC (ghani) produced slight disease infection when applied singly. But their combination produced more disease in comparison with their single effect. Probably the combination was incompatible for disease control rather it might have produced another reaction (unknown) for which disease incidence increased. SOC, cowdung + SOC, gypsum produced highest disease in order of their efficacy. This result is in agreement with Rahman and Hossain (1989) who reported that oil cake increased the disease severity. In the combination of cowdung + SOC disease severity was less than SOC. Cowdung produced no disease singly and perhaps it suppressed the effect of SOC. For this, disease occurrence was comparatively lower in combined application of cowdung + SOC. Gypsum alone had no effect on development of disease. This treatment proved ineffective. Plants take their nourishment highly from NPK sources. In the absence of NPK, plants become weak and at this condition gypsum would not be able to resist the disease singly (Ferdous, 1990).

Foliar spray: No disease observed in tilt sprayed plants. Rovral also gave significantly better result against the disease. These results corroborate with the reports of Hossain and Meah (1992) who reported that rovral flo and rovral wp when used with sticker reduced 90-96% guava fruit infection. More promising result (99% over control) was found in the present study spraying rovral wp without using sticker. Probably, the success may be attributed to low disease incidence in the experimental site during the study period. Tilt (0.2%) gave 100% reduction of fruit infection over control. Both tilt and rovral proved as effective fungicides in controlling anthracnose of unripe fruits. These two chemicals subject to their availability could be considered as potential fungicides to control guava anthracnose.

Minor elements, Zn, Mn, and B spray gave significant reduction in control of guava anthracnose. Zn sprayed plants produced no disease and Mn, B sprayed plants produced minimum disease. All of the mentioned minor elements are essentially required for plants. Deficiency of any one of the above elements makes plants vulnerable to disease. Spraying of Zn reduced the deficiency problem in plants and might have given best satisfactory effect (100% over control) in the reduction of disease. In another case B was less effective than Mn but both the elements reduced the disease significantly. Similar observations have been reported by Malraja (1990) in spraying of Zn, Cu, Mn, Mg and Fe that reduced the incidence of disease of which Cu spray recorded least incidence of fruit rot in chilli.

Based on the above discussion it is evident that soil amendments with manures and fertilizers caused marked effects on guava fruit anthracnose infestation when no disease developed. Some other soil amendments resulted in minimum disease. Similarly spray of fungicides and minor elements especially tilt, rovral and zinc had profound effects on anthracnose infestations. These results are very much promising from the view point of non-chemical control of guava fruit anthracnose. Disease severity was low during the experimental period, perhaps because of low inoculum pressure or unfavorable weather. Probably, the management approaches worked well under such above mentioned conditions. However, disease under natural condition is regulated by natural factors temperature, humidity and rainfall which vary from season to season and year to year. These factors affect the effectivity too. It is a matter to be looked into that how the management practices work under heavy disease intensity and favorable weather. Therefore, further investigation of the effectiveness of the non-chemical management practices tried in the present study for control of guava anthracnose is required.

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