JOURNAL OF PURE AND APPLIED MICROBIOLOGY, FEBRUARY 2014. Vol. **8**(1), p. 149- 158

Integrated Management of Alternaria Blight of Broccoli

M.H. Kabir[1], M.M. Rashid[2], M.R. Bhuiyan[2], M.S. Mian[2], M. Ashrafuzzaman[4], M.Y. Rafii[5,6] and M.A. Latif[2,5]*

[1]DAE, Kalmakanda, Netrokona, [2]Plant Pathology Division, Bangladesh Rice Research Institute, Gazipur, [4]Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh. [5]Department of Crop Science, Faculty of Agriculture, University Putra Malaysia, Malaysia. [6]Institute of Tropical Agriculture, University Putra Malaysia, Malaysia.

(Received: 10 May 2013; accepted: 23 August 2013)

An experiment was conducted to find out the effect of some organic foliar treatments to manage the alternaria leaf blight disease in broccoli (cv. Green Sprouting) was studied under natural field condition in the field Laboratory of Plant Pathology Department, Bangladesh Agricultural University, Mymensingh during the period from November 2005 to March 2006. The integrated management options were placed in Completely Randomized Block Design with three replications. The treatments were control (no spray), field sanitation, Neem extract, Mahogany extract, Koromcha (*Carissa carandas)* extract, Garlic extract (*Allium sativum*), Neem+Mahogany+Koromcha (*Carissa carandas)* extract, Garlic+Neem+Koromcha (*Carissa carandas)* extract, Rovral 50 WP @ 0.2% which was used as a positive control. Besides field sanitation, aqueous extracts of Neem, Mahogany (*Swietania mahagoni*), Koromcha (*Carissa carandas)* and garlic clove (*Allium sativum*) administered as foliar spray, singly or in combination were studied for efficacy and profitability compared to control treatment and spray with Rovral 50 WP. All the treatments controlled the alternaria blight disease of broccoli significantly giving higher yield compared to control. Though spraying with Rovral gave the best result both in terms of disease control and yield of broccoli, the combined application of Garlic (*Allium sativum*), Neem and Koromcha (*Carissa carandas)* extracts performed as good as Rovral. Rather this organic combination gave a higher BCR (4.74) due to reduced production cost indicating that judicious combination of organic management practice promises a healthy broccoli production which is environment friendly, healthy and profitable.

Key words: Integrated, Alternaria blight, Broccoli, Spray, Management.

Broccoli (*Brassica oleracea* var, *italica*) is one of the exotic winter vegetables of Bangladesh introduced several years ago. Although it originated from temperate region, has been distributed in both the sub-tropical and tropical areas (Mitra *et al.*, 1990). Broccoli is well adapted to the environment in these areas and its adaptation has been better than Cauliflower (Rashid, 1976).

* To whom all correspondence should be addressed. E-mail: alatif1965@yahoo.com

Broccoli is nutritious similar to cauliflower (Walt, 1963). It is easily digested after consumption and digestibility is higher than cauliflower (Rashid, 1976). Broccoli is an attractive tasty green vegetable (Gordon and John, 1976). Broccoli can be harvested for a longer period of time as successive growth of flower heads occurs for a prolonged period depending on environment and availability of required nutrients. *Brocoli* contains phytochemicals called iso-thiocyanates including sulphorophanes, which may induce enzymes that reduce inflammation and detoxify carcinogens. So far, research shows this combination of nutrients and phytonutrients means cruciferous vegetables may prevent cancer and help soothe airway inflammation. It is fairly rich in vitamin-A, ascorbic

acid and contains appreciable amounts of calcium, phosphorus, riboflavin, thiamin, niacin and iron (Blomhoff R , 2005 and Thompson and Kelly, 1985).

The yield of broccoli is low in Bangladesh. The low yield may be due to use of poor seeds, low soil fertility, inefficient management system, disease infection and inadequate irrigation along with adverse climatic conditions etc. (Mitra *et al*., 1990). Among the diseases alternaria blight is the most serious one (Talukder, 1974). Fungicide is used to control this disease until now. But as this is a green vegetable and the exposed flower is eaten with or without Cooking. These toxic chemicals directly enter into human tissue, get deposited and at critical concentration cause serious health disorder. This realization emphasizes the importance of finding materials and products which are safe. Therefore, an integrated management practice and use of plant and natural products leading to organic production of broccoli may guarantee for safe and healthy production (Neeraj and Shilpi Verma, 2010). Besides, fungicides are responsible for air, soil and water pollution. These are sold at such a high price which increases cost of production. Removal of disease foliage can be conditioned for their effective use for eco friendly disease management in the field either alone or as a component of integrated disease management. But Integrated Disease Management is economic and environment friendly (Kashyap and Dhiman, 2010).

People are now very conscious about environmental deterioration due to excessive use of spray chemicals. So, to save the nature and getting balanced environment a judicial method of controlling plant disease is to be established. For this reason, it is necessary to find out a suitable integrated disease management by using botanical extracts, resistant variety and economic use of fungicide along with possible cultural and other practices. Use of plant extracts as a component of integrated management against plant disease control is however a recent approach to plant disease management and it has drawn the special attention of the plant pathologists all over the world.

In view of the above facts, the present research was undertaken to determine the efficacy of the treatments individually or in combination against Alternaria blight disease of broccoli and to identify the best option in case of benefit-cost ratio of the treatments.

MATERIALS AND METHODS

The experiment was conducted at the Plant Pathology Field Laboratory of Bangladesh Agricultural University, Mymensingh during November 2005 to March 2006. The variety Green Sprouting Broccoli was used in this experiment. The seedlings of this variety were collected from the Horticulture Centre, Kewatkhali, Mymensingh. Cowdung @ 20t/ha and fertilizers Urea, TSP, MOP and Gypsum @ 260, 200, 180, 150 kg/ha were applied.

Twenty one days old seedlings were transplanted in the experimental field on November 16, 2005 maintaining 60 cm X 45 cm spacing. The experiment was laid out in a Completely Randomized Block Design with four replications. The treatments were control (no spray), field sanitation, Neem extract (*Azadirachta indica*), Mahogany (*Swietania mahagoni*) extract, Koromcha (*Carissa carandas)* extract, Garlic extract (*Allium sativum*), Neem (*Azadirachta indica*)+Mahogany (*Swietania mahagoni*) + Koromcha (*Carissa carandas)* extract, Garlic (*Allium sativum*)+Neem (*Azadirachta indica*)+Koromcha (*Carissa carandas)* extract, Rovral 50 WP @ 0.2% which was used as a positive control.

Plant parts were blended in a blender machine and these extracts were sieved through a thin cloth. The plant extracts were diluted in tap water at 1:10 dilution. The prepared fungicide and plant extracts were sprayed at 15 days interval from 30 days after transplanting. The symptom bearing diseased leaves/infected plants serve as a source of inoculum which were collected, removed and destroyed maintaining zero tolerance, therefore field sanitation was used as a treatment.

Data collection

Percent plant infection

Total number of plants and number of diseased plants were recorded in each plot to determine the percent infection. Percent of blighted symptom expressing plants was calculated by using the following formula:

$$\% \text{ Plant infection} = \frac{\text{Number of infected plants}}{\text{Total number of plants}} \times 100$$

Number of infected leaf per plant

Total number of leaves and number of

infected leaves from the selected plants were counted to determine the percent leaf infection per plant. Percent of blighted symptom expressing plants was calculated by using the following formula:

$$\%\ \text{Leaf infection} = \frac{\text{Number of infected leaves}}{\text{Total number of leaves}} \times 100$$

Percent leaf area diseased (LAD %)

Twenty infected leaves were selected at random in each plot. Percent damaged area was recorded by using the following formula:

$$\%\ \text{Leaf area diseased} = \frac{\text{Area of plant tissue affected by diseased}}{\text{Total area}} \times 100$$

The compact mature curds were only harvested and also yield related data recorded on the following parameters:

Weight of curd and shoot

The average weight (gm) of curd and shoot per plant were recorded by a balance.

Curd Shoot ratio

Curd and shoot ratio were determined by calculation according the following formula:

$$\text{Curd: Shoot} = \frac{\text{Weight of curd}}{\text{Weight of shoot}}$$

Yield

The yield per unit plot was calculated in kg by adding the yields of all (eight) plants of each unit plot and then yield was converted to ton per hectare.

The sale proceed was also calculated after selling those in the local market. The expenditures for transporting the broccoli flowers to the local market was excluded from the sale proceed and added to the production cost of the product.

The cost of production was analyzed in order to find out the most economic treatment of different compounds of integrated management practices. All input costs, including the cost for lease land and interest on running capital were considered for computing the cost of production. The interests were calculated @ 13% per year for 6 months. Cost and return analysis were done in details according to the procedure of Alam *et al.* (1989). The benefit cost ratio (BCR) was calculated as follows:

$$\text{Benefit Cost Ratio (BCR)} = \frac{\text{Gross return per hectare Tk}}{\text{Total cost of production per hectare Tk}}$$

The collected data were analyzed for analysis of variance (ANOVA) following Randomized Completely Block Design (RCBD) to verify the level of significance. Duncan's Multiple Range Test (DMRT) was needed to compare the effect of the treatment (Gomez and Gomez, 1984).

RESULTS

Percent plant infection

All the treatments reduced the incidence of alternaria blight disease significantly compared to the control treatment through the observation

Table 1. Percent infection per plant due to alternaria blight of broccoli at different days after transplanting as influenced by integrated management practices

Treatment	% Plant infection at different days after transplanting (DAT)		
	40 DAT	60 DAT	80 DAT
T_0 (Control)	75.83 a	79.28 a	89.5 a
T_1 (Sanitation)	66.67 b	70.83 b	75.00 b
T_2 (Neem)	41.64 c	45.43 c	54.16 c
T_3 (Mahogany)	45.43 c	50.00 c	58.33 c
T_4 (Koromcha)	42.66 d	48.57 c	56.19 c
T_5 (Garlic)	30.17 d	36.74 d	45.83 d
T_6 (N+M+K)	26.66 e	33.33 d	36.45 e
T_7 (G+N+K)	20.83 f	29.16 d	33.62 e
T_8 (Rovral 50wp@0.2%)	12.5	18.83 e	25.00 f
LSD (0.05)	4.694	7.512	7.274
CV (%)	6.74	9.48	7.91

N = Neem, M = Mahogany, K = Koromcha, G = Garlic

Means followed by the same letter(s) in a column did not differ at 5% level by DMRT

period 40, 60 and 80 days after transplanting (DAT). The first expression of typical alternaria blight infection as necrotic spots with concentric rings circled by a wide yellow halo was detected on a plant in control plot from 22 DAT.

At all the observations 40, 60 and 80 days after transplanting, the highest plant infection 75.83 %, 79.28 % and 89.5 % respectively were recorded in control treatment whereas, the lowest 12.5 %, 18.83 %, 25.0 % and second lowest 20.83 %, 29.16 % and 33.62 % plant infection were observed in Rovral 50 WP and integrated application of Garlic (*Allium sativum*), Neem (*Azadirachta indica*) and Koromcha (*Carissa carandas)* respectively which were significantly different from control as well as other treatments (Table 1). At 80 DAT maximum (72.06%) leaf area disease reduction in plants compared to control was recorded in Rovral 50 WP spraying followed by 62.43 % in the integrated application of Garlic (*Allium sativum*), Neem (*Azadirachta indica*) and Koromcha (*Carissa carandas)* (Fig. 1).

Table 2. Percent leaf infection per plant due to alternaria blight of broccoli at different days after transplanting as influenced by integrated management practices

Treatment	% leaf infection at different days after transplanting (DAT)		
	40 DAT	60 DAT	80 DAT
T0 (Control)	25.88 a	30.66 a	34.33 a
T1 (Sanitation)	21.25 b	25.00 b	29.66 b
T2 (Neem)	17.09 cd	19.14 cd	21.00 d
T3 (Mahogany)	18.03 c	20.47 c	22.15 cd
T4 (Koromcha)	18.99 bc	21.13 c	23.33 c
T5 (Garlic)	15.00 de	17.12 de	19.01 e
T6 (N+M+K)	14.30 e	15.22 e	16.70 f
T7 (G+N+K)	8.00 f	10.00 f	12.20 g
T8 (Rovral 50wp @0.2%)	4.66 g	5.67 g	8.31 h
LSD (0.05)	8.98	2.612	1.499
CV (%)	2.472	8.26	4.18

N = Neem, M = Mahogany, K = Koromcha, G = Garlic
Means followed by the same letter(s) in a column did not differ at 5% level by DMRT

Table 3. Percent leaf area diseased (%LAD) due to Alternaria blight of broccoli at different days after transplanting as influenced by integrated management practices

Treatment	% Leaf Area Disease at different days after transplanting (DAT)		
	40 DAT	60 DAT	80 DAT
T0 (Control)	35.06 a	41.52 a	48.59 a
T1 (Sanitation)	30.65 b	32.65 b	39.73 b
T2 (Neem)	24.07 c	26.04 c	30.12 c
T3 (Mahogany)	26.43 c	28.17 c	33.48 c
T4 (Koromcha)	25.07 c	27.38 c	32.14 c
T5 (Garlic)	18.68 d	21.49 d	25.13 d
T6 (N+M+K)	15.30 e	17.83 e	21.28 e
T7 (G+N+K)	8.21 f	10.14 f	12.27 f
T8 Rovral 50wp @0.2%)	7.23 f	9.14 f	10.72 f
LSD (0.05)	2.998	3.401	3.70
CV (%)	8.17	8.25	7.59

N = Neem, M = Mahogany, K = Koromcha, G = Garlic
Means followed by the same letter(s) in a column did not differ at 5% level by DMRT

Percent leaf infection

All the treatments reduced percent plant infection more or less significantly compared to the control (Table 2). At all the observations 40, 60 and 80 days after transplanting, the highest percent leaf infection 25.88, 30.66 and 34.33 respectively were observed in control whereas, the percent leaf infection were observed lowest 4.66, 5.67 and 8.31 in Rovral 50 WP and second lowest 8.0, 10.0 and 12.2 in and integrated application of Garlic (*Allium sativum*), Neem (*Azadirachta indica*) and koromcha (*Carissa carandas)* which were significantly different from control as well as other treatments (Table 2). At 80 DAT maximum (75.69%) in percent infected leaf reduction compared to control was recorded in the treatment Rovral 50 WP followed by 64.46% in the integrated application of Garlic, Neem (*Azadirachta indica*) and koromcha (*Carissa carandas)* (Fig. 2).

Percent leaf area diseased

All the treatments reduced percent plant infection more or less significantly compared to the control. At all the observations 40, 60 and 80 days after transplanting, the highest percent leaf infection 35.06, 41.52 and 48.59 respectively were observed in control whereas, the lowest 7.23, 9.14 and 10.72 in Rovral 50 WP and second lowest 8.21, 10.14 and 12.27 were observed in integrated application of Garlic (*Allium sativum*), Neem (*Azadirachta indica*) and koromcha (*Carissa carandas)* which were significantly different from control as well as other treatments (Table 3). At 80 DAT, highest (77.94%) leaf area diseased reduction was observed in Rovral 50 WP spraying followed

Table 4. Performance of integrated management practices on different yield parameters of broccoli as affected by alternaria blight infection

Treatment	Curd Wt. (g)/plant	Shoot Wt. (g)/plant	Curd: Shoot Ratio	Yield per plot (kg)	Yieldt /ha
T_0 (Control)	145.40 g	165.47 e	1.15 b	1.15d	5.75e
T_1 (Sanitation)	167.50 f	198.75 e	1.20b	1.34d	6.70d
T_2 (Neem)	305.00 d	381.25 d	1.25b	2.44b	12.20b
T_3 (Mahogany)	268.10 e	447.43 c	1.66a	2.14c	10.70c
T_4 (Koromcha)	270.00 e	450.15 c	1.67a	2.16c	10.80c
T_5 (Garlic)	340.14 b	625.74 ab	1.83a	2.72a	13.60a
T_6 (N+M+K)	334.17 c	589.13 b	1.74a	2.67ab	13.35a
T_7 (G+N+K)	350.16 a	635.48 ab	1.81a	2.80a	14a
T_8 Rovral 50WP (0.2%)	352.31 a	656.45 a	1.86a	2.82a	14.10a
LSD (0.05)	5.405	45.20	0.2844	0.2448	0.8550
CV (%)	5.02	5.66	10.43	6.32	4.39

N = Neem, M = Mahogany, K = Koromcha, G = Garlic

Means followed by the same letter(s) in a column did not differ at 5% level by DMRT

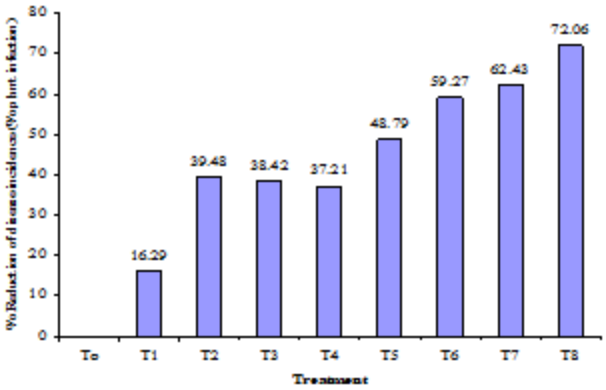
Table 5. Cost and return of broccoli due to different integrated management practices

Treatment	Yield (t/ha)	Gross return (Tk/ha)	Total cost of Production (Tk/ha)	Net return (Tk/ha)	Benefit cost ratio (BCR)
T_0 (Control)	5.75	86250	41615	44635	2.07
T_1 (Sanitation)	6.70	100500	42953	57547	2.33
T_2 (Neem)	12.20	183000	43176	139824	4.23
T_3 (Mahogany)	10.70	160500	43176	117324	3.71
T_4 (Koromcha)	10.80	162000	43733	118267	3.7
T_5 (Garlic)	13.60	204000	43400	160600	4.7
T_6 (N+M+K)	13.35	200250	43733	156517	4.57
T_7 (G+N+K)	14.00	210000	44292	165708	4.74
T_8 Rovral 50WP (0.2%)	14.10	211500	46522	164978	4.54

by 74.75% in the integrated application of Garlic (*Allium sativum*), Neem (*Azadirachta indica*) and Koromcha (*Carissa carandas)* (Fig. 3).

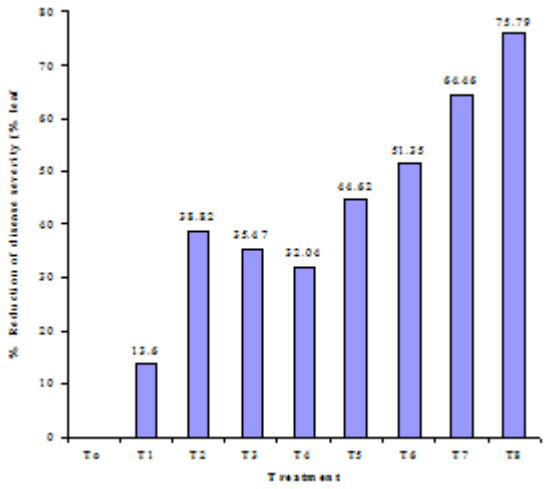
Weight of curd, shoot and their ratio

The treatments influenced the weight of curd significantly. Maximum weight 352.31g & 350.16g curd and 656.45g & 635.48g shoot was obtained from Rovral 50 WP and integrated combination of Garlic (*Allium sativum*), Neem (*Azadirachta indica*) and Koromcha (*Carissa carandas)* which has significant difference from control and other treatments but there was no significant difference in between them. The effect of different treatment on broccoli plant was found statistically significant (Table 4). There were significant variations in curd: shoot ratio per plant. The highest curd: shoot ratio of per plant (1.86) was recorded in Rovral 50 WP followed by 1.81 in



T_0 = Control T_1= Sanitation T_2 = Neem extract T_3 = Mahogany extract
T_4 = Koromcha extract T_5 = Garlic extract T_6= Neem + Mahogony + Koroncha extract
T_7 = Garlic + Neem + Koromcha extract T_8= Rovral 50 WP @ 0.2%

Fig. 1. Percent reduction of disease incidence of Alternaria blight of broccoli at 80 DAT due to the effect of different management practices



T_0 = Control T_1= Sanitation T_2 = Neem extract $_3$ = Mahogany extract
T_4 = Koromcha extract T_5 = Garlic extract T_6= Neem + Mahogony + Koroncha extract
T_7 = Garlic + Neem + Koromcha extract T_8= Rovral 50 WP @ 0.2%

Fig. 2. Percent reduction of disease severity (% leaf infection/plant) of Alternaria blight of Broccoli at 80 DAT due to the application of integrated management practices

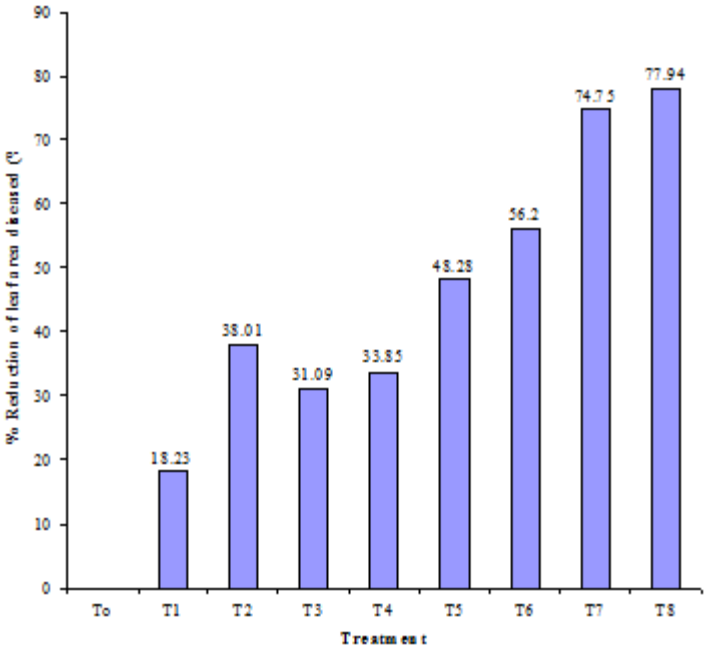
Garlic+Neem (*Azadirachta indica*)+Koromcha (*Carissa carandas)* treatment. The minimum curd, shoot ratio per plant (1.15) was recorded in control treatment (Table 4).

Yield of curd (t/ha)

The yield of broccoli (curd) under different treatments differed significantly from the control. It ranged from 5.75 to 14.1 t/ha. The highest curd yield 14.1 and 14.0 t/ha under the treatment Rovral 50 wp and the integrated combination of Garlic, Neem (*Azadirachta indica*) and Koromcha (*Carissa carandas)* which was significantly different from control as well as other treatments (Table 4).

Benefit –cost –ratio (BCR)

Benefit cost ratio for all the treatments was shown in Table 5. The results from the cost-benefit analysis revealed that the maximum gross return was obtained from the integrated combination of Garlic, Neem (*Azadirachta indica*) and Koromcha (*Carissa carandas)* (Tk. 210000). But the cost of production (Tk.44292) was also relatively higher in this treatment. So, the benefit cost ratio (BCR) was 4.74. The second highest BCR



T_0 = Control T_1= Sanitation T_2 = Neem extract T_3 = Mahogany extract
T_4 = Koromcha extract T_5 = Garlic extract T_6= Neem + Mahogony + Koroncha extract
T_7 = Garlic + Neem + Koromcha extract T_8= Rovral 50 WP @ 0.2%

Fig. 3. Percent reduction of disease severity (% LAD) of Alternaria blight of broccoli observed at 80 DAT due to the application of integrated management practices

(4.57) was obtained from the integrated combination of Neem (*Azadirachta indica*), Mahogony (*Swietania mahagoni*) and Koromcha (*Carissa carandas)*. On the other hand, the lowest BCR (2.07) was obtained from the control treatment.

DISCUSSION

Alternaria blight an endemic disease caused by *Alternaria brassicae* and *Alternaria brassicicola* is the most devastating disease of broccoli in Bangladesh. This disease occurs in all parts of the world where broccoli is grown. The best measure to control this disease could be developing high yielding resistant cultivars. But so far, goal to incorporate sustainable resistance with minimum cost of yield reduction could not be achieved. Moreover an apparently resistant cultivar developed at one centre or country appears to fail in retaining the acquired resistance, when grown in another Agro-ecological zone (AEZ).

Considering that chemical fungicides are

hazardous to human health and nature, attempt is being made, all over the world, to use plant extracts against plant diseases. Fortunately some plant extracts have been identified or detected as having reasonable antifungal qualities. Especially some plant extracts have been used effectively to control Alternaria blight disease.

The plants extracts can be used in controlling disease have been experienced by man since the dawn of human civilization. Materia medico of oriental Unani and Ayurvedi medicine and American Maya and Inka medicine were based on the medicinal use of different plants. Since plant pathological science developed rather recently, use of chemical dominated in combating plant disease. In later years, antibiotics dominated the world of medicine. Thus as usual, protection strategy of plant against microbial disease depended on life threaten, environment polluting chemicals and organochemicals substances.

By this time some plants have already been found very effective, in some cases, more than that of chemical pesticides. Out of the many promising plants, reported Garlic, Neem (*Azadirachta indica*), Mahogany (*Swietania mahagoni*) and Koromcha (*Carissa carandas)* have been selected to asses their ability against Alternaria blight of broccoli.

An experiment was conducted to find out the efficacy of integrated management practices with different plant extracts on the incidence and severity of Alternaria blight disease of broccoli. The benefit cost ratio analysis of the treatments was also aimed. It was felt necessary to evaluate the difference in performance of treatments with an aim for developing an appropriate control package for profitable broccoli production in the open field, under natural inoculum pressure.

In the present study, the administered nine treatments either alone or in integration resulted effect on the reduction of Alternaria blight disease in broccoli compared to control. From the results, it had been observed that different treatments over broccoli variety Green sprouting showed positive and significant effects on different parameters observed in broccoli. Number of plant expressing blight symptom was observed maximum under the control plot and the lowest were obtained under the integrated application of Garlic, Neem (*Azadirachta indica*) & Koromcha (*Carissa carandas)* and Rovral 50WP at 40, 60 and 80 days after transplanting. In general, integrated effects of different practices were much more effective in case of expression of blight symptoms than the individual effects of treatments. This finding was consistently in corroboration to the suggestions given by many researchers (Kishori *et al*. 1982; Naidu, 1988; Ashrafuzzaman and Hossain, 1992 and Suratuzzaman *et al*. 1994). This disease, caused by *Alternaria brassicae* had become a serious problem for broccoli cultivation as seed crop in India. Application of integrated management practices gave effective control and reduced the number of alternaria diseased plant.

Sanitation practice significantly reduces in terms of all the parameters, compared to the control. This was probably because the experiment was laid down in the open field and exposed to aerial as well as vector and other transmission of inoculums (*Alternaria brassicae* and *Alternaria brassicicola*).

Another observation was there also add, the individual treatment (Component like foliar spray of Neem, Mahogany (*Swietania mahagoni*), Garlic and Koromcha (*Carissa carandas)* extracts minimize the infection significantly compared to control and sanitation. Blight disease reduces the number of active green leaf area per plant. Thus affecting the efficiency of photosynthesis and quick release of energy through increased respiration. Maximum infection of leaves was observed under the control treatment and minimum % leaf infection was observed under the Rovral 50 WP treatment followed by the combined treatment Garlic+Neem (*Azadirachta indica*)+Koromcha (*Carissa carandas)*. Remaining aware from published information that Rovral acts highly against (*Alternaria*).

The percentage of diseased leaf area per plant was also found highest in control plots in this experiment and lowest in plots where combined treatments were applied. The results obtained by Miah *et al.* (1990) with Gada (*Tageles erecta*) against *Monographella aboscens*, *Pyricularia oryzae* and *Rhizoctonia solani* are also in consonance with the present findings.

Percent amount of reduction of plant infection, leaf infection, and leaf area diseased were highest in combined Garlic+Neem (*Azadirachta*

indica)+Koromcha (*Carissa carandas)* and Rovral 50WP. Sharma *et al*. (2007) reported that the neem leaf extract showed high efficacy to inhibit the radial growth of Alternaria of 43.3% and 26.7% respectively at 0.1% and 0.01%. Dharam and Sharma (1985) used 10% of Neem oil preparation against the growth of Alternaria and found it 100% effective against the germination in inhibiting growth in culture media. Lakshmann, *et al*. (1990) found Neem (*Azadirachta indica*) extract to inhibit completely Sclerotial germination of *I. cucumeris* a serious pathogen causing wilt of cucumber. The work of Singh and Dwivedi (1987), Achimu and Schlosser (1992) and other confirmed that Neem leaf and Neem seed extracts have high antifungal properties. Percent reduction in plant infection, leaf infection and leaf area diseased were low in control followed by sanitation.

All the treatments employed in the experiment produced significant positive results compared to the control of different yield parameters El-Shami *et al*. (1986), found garlic clove extract to be more effective against certain fungi than control. In 1987 Assadi and Behroozin tested garlic bulb extract against *Fusarium* and *Sclerotium* that found was highly effective. Singh and Dwivedi (1987) tested the efficacy of bulb and leaf extract of garlic against a number of fungi in vitro and found both the extract significantly inhibiting the growth of fungi. Further work of Tariq and Magee (1990), and Lakshmann *et al*. (1990) supported the earlier findings and recommended the use of garlic as an antifungal agent.

The obtained results of curd weight, shoot weight, curd: shoot ratio were significantly influenced by the treatments. Average curd weight was the highest in plots where Rovral 50 WP 0.2% was used and average curd weight was low in control plots. The results of the present study is in partial agreement with Hossain *et al*. (1997) who reported that application combined botanical extracts significantly increased curd yield.

The combined treatment provided the plant growth in the assigned plots with adequate nutrition, a clean healthy environment, conserved soil moisture besides inhibiting pathogenic micro flora, helped the built in genetic resistance to activate. Thus the plants under the combined treatment were not only less prone to alternaria blight but also producing bigger and heavier fruits (curds).

The maximum average curd weight (352.31 g) from Rovral 50WP but combined Garlic+Neem (*Azadirachta indica*)+Koromcha (*Carissa carandas)* reach the nearest maximum average weight (350.16 g), which was statistically in the same level of significance. The single treatment field sanitation though produced significantly heavier fruits compared to the control; there was significant difference in terms of shoot weight and curd: shoot ratio and the gross yield per plot. This happened because the plots were exposed to aerial inocula of the causal pathogen. The results obtained by Lakshmann *et al*. (1990) with garlic and Achimu and Schlosser (1992) with Neem (*Azadirachta indica*) leaf and Neem seed extracts corroborate with the present findings. Kumar *et al*. (2004) showed quite effective results with neem against *Alternaria brassicae* which substantiates the present findings. Findings of the study revealed that Rovral (0.2%) spray might be fruitful in reducing Alternaria blight intensity (Neeraj and Shilpi Verma, 2010 and Kumar *et al*. 2006). On the other hand plant extracts controlled the disease as well as increased yield significantly.

The result from the benefit cost ratio analysis revealed that maximum financial benefit was obtained from the combined treatment Garlic+Neem (*Azadirachta indica*)+Koromcha (*Carissa carandas)* where the BCR (4.74) was the highest (Table 5). The second highest return was from Garlic (4.7) while the lowest BCR (2.07) was observed in control plot. It was evident from the obtained results that higher cost of treatments and comparatively low yield was responsible for the lower gross return and BCR against each treatment.

CONCLUSION

It can be concluded that the incidence and severity of Alternaria blight disease can significantly be reduced by the combined use of Garlic+Neem (*Azadirachta indica*)+Koromcha (*Carissa carandas)* in order to have a higher profitable yield as well eventual higher economic return with minimum environmental pollution.

REFERENCES

1. Achimu, P. and Schlosser, E. Effect of neem seed extracts (*Azadirachta indica*) against downy

mildew (*Plasmopara viticola*) of grave vine. Int, Sym. Sytofarmacie (Belgium) Geze.V.44 (O Pt.2) 1992: pp. 421-423.

2. Ashrafuzzaman, H. and Hossain, I. Antifungal activity of crude extracts of plants against *Rhizoctonia solani* and *Bipolaris sorokinina*. *Proc. BAU. Res. Prog*.1992: **6**:188-192.
3. Assadi, P. and Behroozin, M. The effect of bulb extracts of onion and garlic on the mycelial growth of *Fusarium spp, Sclerotium cepivorum*. *Iranian J. Plant Path.* 1987: **23** (1-4):1-32.
4. Blomhoff R. Dietary antioxidants and cardiovascular disease. *Curr Opin Lipidol*. 2005; **16**(1):47-54.
5. Dharam and Sharma, R.K. Efficacy of fungicides on the fungicidal properties on Neem oil. *Indian J. Plant path*.1985: **3**(2):241-242.
6. El-Shami, M.A.F. FADL, A., Tawfic, K.A., Sirry, A.R. and El Zayat, M.M. Antifungal property of garlic clove juice compared with fungicidal treatments against Fusarium wilt of water melon. *Egyptian J. Phytopath*.1986; **17**(1):55-62.
7. Gomez, K. A. and Gomez, A. A. "Statistical Procedures for Agricultural Research" (second Edn). John Wiley and Sons, New York,1984; pp. 680.
8. Gordon, H.R and John, A.B. Horticulture First Edition, Mcgraw-Hill. Book Co. New York, 1976: pp. 545-546.
9. Hossain, I., Ashrafuzzaman, H.and Khan, M. H. H. Biocontrol of *Rhizoctonia solani*. *BAU Res. Prog*.1997; **7**: 264-269.
10. Kishori, N., Dubey, N.K., Tripathi, R.D. and Singh, S.K. Fungitoxic activity of leaves of higher plant. *National Acad. Sci. Letters*.1982; **5**: 9-10.
11. Kumar, P; Prajapati, C.R. & Singh, D. V. Efficacy of some fungitoxicants against *Alternaria brassicae* causing Alternaria blight of radish. *Ind. J. Pl. Pathol*.,2006: **24**(1-2): 29-31.
12. Kumar, S; Mehta, N; Sangwan. M. S. & Kumar, R. Relative sensitivity of various isolates of *Alternaria brassicae* (Berk.) Sacc. to fungicides. *J. Mycol. Pl. Pathol.*, 2004: **34**(1): 28-32.
13. Lakshmann, P., Mohan, S. and Jeyarajan, R. Antifungal properties of some plants extracts against *Thanatephorus cucumeris*, the casual agent of collar rot disease of *Phaseolus aureum Maradas Agric.J*. 1990: **77**(1):1-4.
14. Miah. A.T., Ahmed, M.U., Sharma, N.R., Ali, A. and Miah, S.A. Antifungal activity of some plant extracts. *Bangladesh J. Botany*.1990 **:19** (1):5-20.
15. Mitra, S.K., Sadhu, M.K., and Bose, T.K. Nutrition of vegetables crops. Naya Prokash, Calcutta 700006, India,1990: pp. 157-160.
16. Naidu, G.P. Antifungal activity of *Codiaeum variegafun* leaf extracts. *Current Science*.1988; **57**: 502-504.
17. Neeraj and Shilpi Verma. Alternaria diseases of vegetable crops and new approaches for its control. *Asian J. Exp. Biol. Sci*. 2010; **1**(3): 681-692.
18. Kashyap, P. L. and Jagtar S. Dhiman, J. S. Eco-friendly strategies to suppress the development of Alternaria Blight and Black Rot of Cauliflower. *Academic Journal of Plant Sciences*, 2010: **3**(4): 140-146.
19. Rashid, M.M. Vegetable of Bangladesh (in Bengali).First Edition. Bangla Academy, Dhaka,1976 p. 283.
20. Sharma, A; Dass, A. & Pau, M. S. Antifungal effect of neem extract on some common phytopathogenic fungi. *Adv. Pl. Sci.*, 2007: **20**(2): 357-358.
21. Suratuzzaman, M., Hossain, I. and Fakir, G. A. Control of seed borne fungi of two rice varieties with some plant extracts. *Progress. Agric.* 1994: **59**(1):11-15.
22. Singh, R. K. and Dwivedi, R. S. Fungitoxicity of different plants against *Sclerotium rolfsii* Sacc. *Nat Aca. Sci. Lett*. 1987: **10**(3):89-91.
23. Talukder, M.J. Plant diseases in Bangladesh. Bangladesh *J. Agric. Res.* 1974: **1**:61-86.
24. Tariq, V.N. and Magee, A.C. Effect of volatiles from garlic bulb extracts on *Fusarium oxysporum f. sp. Lycopersici Mycological Res*.1990: **94**(5): 617-620.
25. Thomson, H.C. and Kelly, W.C. Vegetable Crops (5th Edition. McGraw-Hill Book Co., 1985: pp. 280-370.
26. Walt, B.K. Nutritive value of Fruits and Vegetables USAID. Handbook No. 8. [Cited from vegetable Production, Nonceke T.L., An Avi Book Published by Van Nostrand Reinbold, 1963: New York. 369-414 (1989)].