International Journal of Botany

ISSN: 1811-9700

science alert

ANSInet
an open access publisher
http://ansinet.com

International Journal of Botany 4 (1): 24-32, 2008
ISSN 1811-9700

Synergistic Effect of Fungicides on the Incidence of Seed Mycoflora of Okra

Mashooda Begum and S. Lokesh
Department of Studies in Applied Botany, Seed Pathology and Biotechnology,
University of Mysore, Manasagangotri, Mysore-570 006, India

Abstract: Seeds of okra (*Abelmoschus esculentus* (L.) Moench) variety Arka anamika were treated with 5 fungicides including Anucop, Bavistin, Captan, Dithane M-45 and Vitavax with different doses (0.1, 0.2 and 0.3%) and the combination Anucop + Bavistin, Anucop + Captan, Anucop + Vitavax, Bavistin + Vitavax, Anucop + Dithane, Bavistin + Dithane, Bavistin + Captan, Captan + Vitavax, Anucop + Bavistin + Captan, Anucop + Bavistin + Dithane, Anucop + Captan + Vitavax, Bavistin + Captan + Vitavax were used to test their potency against the seed-borne fungal diseases. Among these, Anucop at a concentration of 0.3%, Bavistin @ 0.2%, Captan @ 0.3%, Dithane @ 0.3%, Vitavax @ 0.3% and their combinations, like Anucop + Bavistin, Anucop + Dithane, Bavistin + Dithane, Anucop + Captan + Vitavax, Bavistin + Captan + Vitavax were most effective in the improvement of crop both in greenhouse and field conditions. These chemicals at different doses and in combinations increased the total number of leaves, fruits, mean length, girth and biomass of fruits. Apart from these, the total number of seeds per fruit, seed density and weight and ascorbic acid content were also enhanced. These chemicals reduced the incidence of seed mycoflora, thereby enhancing the seed germination percentage and vigour index of the seedlings.

Key words: *Abelmoschus esculentus*, fungicides, synergism, okra

INTRODUCTION

Okra (*Abelmoschus esculentus* (L.) Moench) is an important summer/rainy season vegetable crop, member of the Malvaceae commonly called as lady's finger or *Bhindi*. Various mycoflora associated with the seed may prove pathogenic or weak parasites or saprophytes, may be internal or external. Heavy losses have been reported by seed-borne pathogens in vegetables (Neergaard, 1977). Control methods for fungal diseases may vary considerably depending on the host and pathogen interaction. The application of fungicides serves to controls the seed-borne diseases and also protects germinating seedlings from the seed-borne or soil-borne pathogens. Some chemicals are used as foliar spray in the field to control plant diseases. Routine or continuous application of the same chemicals often makes the pathogen to adopt themselves such compounds. Hence, it is always necessary to search for new formulations for the promising results. Although the best method to control plant disease is by introducing resistant varieties, but such varieties may not be available always in all crops and if at all available may not last long. Hence, there is a need for finding an appropriate, efficient and economically feasible method of chemical control. With this view, the present study was undertaken to evaluate the effect of some fungicides on seed mycoflora, seedling growth and other nutritional parameters of okra seed samples.

MATERIALS AND METHODS

Seed samples of okra var., Arka anamika, Arka abhy, Pusa sawani from Indian Institute of Horticulture Research and a few local varieties were collected Private Seed Companies in Bangalore. The seed samples were screened for their mycoflora. Following the procedures of ISTA (Anonymous, 1996), Seeds of var. Arka anamika were separately dusted with five chemicals like Anucop-50 (Copper oxychloride), Dithane M-45 (Mancozeb 75%), Vitavax (Carboxin 75%), Captan (Kohicap 50%), Bavistin (Carbendezim 50%) at 0.1, 0.2 and 0.3% concentrations. Their combinations (figures in parenthesis indicate concentration) such as Anucop + Bavistin (0.3, 0.2%), Anucop + Captan (0.3, 0.3%), Anucop + Captan (0.3 + 0.3%), Anucop + Vitavax (0.3 + 0.3%), Bavistin + Captan (0.2 + 0.3%), Bavistin + Vitavax (0.2 + 0.3%), Captan + Vitavax (0.3 + 0.3%), Anucop + Bavistin + Captan (0.3 + 0.2 + 0.3%), Anucop + Captan + Vitavax (0.3 + 0.3 + 0.3%), Anucop + Bavistin + Dithane (0.3 + 0.2 + 0.3%) and Bavistin + Captan + Vitavax (0.2 + 0.3 + 0.3%) were also

Corresponding Author: S. Lokesh, Department of Studies in Applied Botany, Seed Pathology and Biotechnology, University of Mysore, Manasagangotri, Mysore-570 006, India Tel: 2515126

used to treat the seeds. The seeds and the fungicides were mixed thoroughly in a polyethylene bag by shaking for about 10 to 15 min. The treated seeds were then placed at equidistantly on 3 layers of wet blotters in plastic plates and were incubated according to the standard procedures of ISTA (Anonymous, 1996). On the 8th day of incubation the seeds were tested for the presence of fungi. In an other set, seeds of similar treatment were placed in between wet blotters and incubated. On the 21st day of incubation the paper towels were unrolled, the percentage of seed germination, root-shoot length of the seedlings were measured and the vigour index was calculated based on the procedures of Abdul-Baki and Andersen (1973). The plants were maintained under proper growing conditions till fruit maturation stage under both greenhouse and field conditions. As soon as the plants were raised in greenhouse and field conditions the fungicidal suspensions were prepared in distilled water with the mentioned concentrations and combination of chemicals. The plants were sprayed separately with the fungicidal suspensions thrice first after 10 days of planting and afterwards at an equal interval of 10 days. At the fruit maturation stage growth parameters like number of leaves per plant, number of fruits per plant, number of seeds per fruit, average fruit weight, girth of the fruit and seed density were recorded.

During the growth of plants both in green-house and field conditions the disease symptoms observed were recorded. Corresponding, control plants were also grown without treatment for comparison and the data were compiled and consolidated.

Ascorbic acid estimation: Ascorbic acid estimation was done by grinding the fresh fruits into a paste using 2 mL of distilled water in a pestle and mortar. Hundred mg of the paste was used for estimation of ascorbic acid by dinitrophenyl hydrazine (DNPH) method (Behrens and Madere, 1963). Standard ascorbic acid solution was prepared for this using 5% trichloro acetic acid (TCA) and this was taken in 6 clean test tubes ranging from 0-1 mL, solution of unknown concentration was taken in another test tube. The volume of standard solution was made up to 1 mL by adding 5% TCA and 1 mL of DNPH was added to each tube. The tubes containing solutions were boiled in water bath for 15 min and cooled to room temperature; 8 mL of 65% cold H_2SO_4 was added to make up the volume to 10 mL. The test tubes were kept at room temperature for about 30 min. The optical density was read at 540 nm, using the data, standard curve was prepared and the amount of ascorbic acid was determined.

Three replicates were used for different concentrations of fungicides and the experiments were repeated twice by employing a completely randomized design. Data were analysed by ANOVA (Fisher, 1949) and variations among means were compared using DMRT (Duncan's Multiple Range Test) at 0.05 significance. Duncan's Multiple Range Test SPSS for windows (ver 100) (SPSS Inc. New York 1955) package was used.

RESULTS AND DISCUSSION

In the present study, in order to evaluate the efficacy of different fungicides against seed-borne fungi, okra seeds of variety Arka anamika were treated with fungicides. Table 1 shows the efficacy of different fungicides at different concentrations. The fungi present in the control sample were Actinomycete sp., *Alternaria alternata*, *Aspergillus flavus*, *Aspergillus columnaris*, *Aspergillus fumigatus*, *Aspergillus niger*, *Botryodiplodia theobromae*, *Chaetomium globosum*, *Colletotrichum dematium*, *Fusarium verticilloides*, *Fusarium solani*, *Macrophomina phaseolina*, *Rhizoctonia solani*, *Rhizopus stolonifer* and *Trichothecium roseum*. Seed-borne fungi like *Rhizoctonia solani*, *Fusarium verticilloides* and *Macrophomina phaseolina* were significantly reduced in all the treatments compared to the control. Anucop at 0.3% and Bavistin at 0.2%, concentration, greatly reduced the incidence of fungi. Captan and Dithane M-45 at 0.3% remained more effective than Vitavax. The varied occurrence of mycoflora due to combined effect of fungicides like Anucop + Vitavax (0.3 + 0.3%), Anucop + Captan (0.3 + 0.3%), Captan + Vitavax is shown in Table 1 and 2. Anucop (0.3%) + Bavistin (0.2%), Bavistin (0.2%) + Vitavax (0.3%), Bavistin (0.2%) + Dithane M-45 (0.3%), Bavistin (0.2%) + Captan (0.3%) were more effective in reducing the incidence of fungi. Similarly, Anucop (0.3%) + Bavistin (0.2%) + Captan (0.3%), Anucop (0.3%) + Bavistin (0.2%) + Dithane (0.3%), Bavistin (0.2%) + Captan (0.3%) + Vitavax (0.3%) were also found to be superior compared to Anucop + Captan + Vitavax in which the incidence of fungi was greatly reduced compared to the control.

The effects of different fungicides on seed germination and seedling vigour, were evaluated based on paper towel method. Bavistin at 0.2% concentration proved its superiority over any other treatment. In Vitavax (0.3%) treatment, the vigour index was greatly reduced compared to any other treatment control (Table 3 and 4).

Anucop + Bavistin treatment enhanced the vigour index to a greater extent compared to the control. Similarly, Bavistin + Dithane M-45 combination was more effective compared to Bavistin + Captan, Bavistin + Vitavax which

Table 1: Dose dependent variability of fungicides on the occurrence of fungi in Okra

		Effect of fungicides on percent incidence of fungi					
		Anucop			Bavistin		
Fungi	Control	0.1	0.2	0.3	0.1	0.2	0.3
Actinomycete	30.0±0.0^{d}	1.9±0.0^{g}	1.0±0.0^{d}	0.0±0.0^{b}	2.0±0.0^{e}	1.0±0.0^{b}	0.0±0.0^{a}
Alternaria alternata	32.0±0.0^{e}	4.0±0.0^{d}	2.0±0.0^{e}	0.0±0.0^{b}	1.0±0.0^{d}	1.0±0.0^{b}	0.0±0.0^{a}
Aspergillus flavus	5.0±0.0^{f}	3.0±0.0^{e}	2.0±0.0^{e}	0.0±0.0^{b}	1.0±0.0^{d}	1.0±0.0^{b}	0.0±0.0^{a}
Aspergillus fumigatus	4.0±0.3^{g}	2.0±0.0^{f}	1.0±0.0^{d}	0.0±0.0^{b}	1.0±0.0^{d}	1.2±0.0^{a}	0.0±0.0^{a}
Aspergillus columnaris	5.0±0.0^{f}	2.0±0.0^{f}	1.0±0.0^{d}	0.0±0.0^{b}	1.0±0.0^{d}	1.0±0.0^{b}	0.0±0.0^{a}
Aspergillus niger	5.0±0.0^{f}	2.0±0.0^{f}	1.0±0.0^{d}	0.0±0.0^{b}	1.0±0.0^{d}	1.0±0.0^{b}	0.0±0.0^{a}
Botryodiplodia theobromae	5.0±0.0^{f}	2.0±0.0^{f}	1.0±0.0^{d}	0.0±0.0^{b}	1.0±0.0^{d}	0.0±0.0^{c}	0.0±0.0^{a}
Chaetomium globosum	2.0±0.0^{h}	0.0±0.0^{a}	0.0±0.0^{e}	0.0±0.0^{b}	0.0±0.0^{e}	0.0±0.0^{c}	0.0±0.0^{a}
Colletotrichum dematium	2.0±0.0^{h}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{b}	0.0±0.0^{e}	0.0±0.0^{c}	0.0±0.0^{a}
Fusarium verticilloides	75.0±0.0^{a}	20.0±0.0^{b}	5.0±0.0^{a}	1.0±0.0^{a}	5.0±0.0^{b}	2.0±0.0^{a}	0.0±0.0^{a}
Fusarium solani	20.0±0.0	5.0±0.0^{c}	2.0±0.0^{c}	0.0±0.0^{b}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}
Macrophomina phaseolina	72.0±0.0^{b}	25.0±0.0^{a}	4.0±0.0^{b}	1.0±0.0^{a}	6.0±0.0^{a}	2.0±0.0^{a}	0.0±0.0^{a}
Rhizoctonia solani	2.0±0.0^{h}	0.0±0.0^{h}	0.0±0.0^{e}	0.0±0.0^{b}	0.0±0.0^{e}	0.0±0.0^{c}	0.0±0.0^{a}
Rhizopus stolonifer	10.0±0.0^{e}	0.0±0.0^{h}	0.0±0.0^{e}	0.0±0.0^{b}	0.0±0.0^{e}	0.0±0.0^{c}	0.0±0.0^{a}
Trichothecium roseum	1.0±0.0^{i}	0.0±0.0^{h}	0.0±0.0^{e}	0.0±0.0^{b}	0.0±0.0^{e}	0.0±0.0^{c}	0.0±0.0^{a}

		Effect of fungicides on percent incidence of fungi								
		Captan			Dithane M-45			Vitavax		
Fungi	Control	0.1	0.2	0.3	0.1	0.2	0.3	0.1	0.2	0.3
Actinomycete	30.0±0.0^{d}	4.0±0.0^{d}	2.2±0.3^{d}	1.0±0.0^{c}	2.0±0.0^{b}	1.0±0.0^{b}	0.0±0.0^{a}	5.0±0.0^{d}	4.0±0.0^{c}	2.0±0.0^{c}
Alternaria alternata	32.0±0.0^{e}	4.0±0.0^{d}	2.0±0.0^{d}	1.0±0.0^{c}	2.0±0.0^{b}	1.0±0.0^{b}	0.0±0.0^{a}	6.0±0.0^{e}	3.0±0.0^{d}	1.5±0.7^{d}
Aspergillus flavus	5.0±0.0^{f}	3.0±0.0^{e}	1.0±0.0^{e}	1.0±0.0^{c}	2.0±0.0^{b}	1.0±0.0^{b}	0.0±0.0^{a}	4.0±0.0^{e}	2.0±0.0^{e}	1.0±0.0^{e}
Aspergillus fumigatus	4.0±0.3^{g}	3.0±0.0^{e}	1.0±0.0^{e}	1.0±0.0^{c}	1.0±0.0^{c}	0.0±0.0^{c}	0.0±0.0^{a}	3.0±0.0^{f}	2.0±0.0^{e}	1.0±0.0^{e}
Aspergillus columnaris	5.0±0.0^{f}	2.0±0.0^{f}	1.0±0.0^{e}	1.0±0.0^{c}	1.0±0.0^{c}	0.0±0.0^{c}	0.0±0.0^{a}	2.0±0.0^{g}	1.0±0.0^{f}	1.0±0.0^{f}
Aspergillus niger	5.0±0.0^{f}	2.0±0.0^{f}	1.0±0.0^{e}	1.0±0.0^{c}	1.0±0.0^{c}	0.0±0.0^{c}	0.0±0.0^{a}	2.0±0.0^{g}	1.0±0.0^{f}	1.0±0.0^{e}
Botryodiplodia theobromae	5.0±0.0^{f}	2.0±0.0^{f}	1.0±0.0^{e}	1.0±0.0^{c}	1.0±0.0^{c}	0.0±0.0^{c}	0.0±0.0^{a}	2.0±0.0^{g}	1.0±0.0^{f}	1.0±0.0^{f}
Chaetomium globosum	2.0±0.0^{h}	0.0±0.0^{g}	1.0±0.0^{e}	0.0±0.0^{a}	1.0±0.0^{c}	0.0±0.0^{c}	0.0±0.0^{a}	1.0±0.0^{h}	1.0±0.0^{f}	1.0±0.0^{f}
Colletotrichum dematium	2.0±0.0^{h}	0.0±0.0^{g}	0.0±0.0^{f}	0.0±0.0^{a}	1.0±0.0^{c}	0.0±0.0^{c}	0.0±0.0^{a}	1.0±0.0^{h}	1.0±0.0^{f}	1.0±0.0^{f}
Fusarium verticilloides	75.0±0.0^{a}	25.0±0.0^{b}	10.0±0.0^{b}	5.0±0.0^{b}	4.0±0.0^{a}	2.0±0.0^{a}	0.0±0.0^{a}	30.0±0.0^{b}	20.0±0.0^{g}	10.0±0.0^{b}
Fusarium solani	20.0±0.0	6.0±0.0^{c}	3.0±0.0^{c}	1.0±0.0^{c}	1.0±0.0^{c}	0.0±0.0^{c}	0.0±0.0^{a}	5.5±0.7^{d}	2.0±0.0^{e}	1.0±0.0^{f}
Macrophomina phaseolina	72.0±0.0^{b}	3.0±0.0^{a}	6.0±0.0^{a}	7.0±0.0^{a}	4.0±0.0^{a}	2.0±0.0^{a}	0.0±0.0^{a}	32.0±0.0^{a}	22.0±0.0^{a}	12.0±0.0^{a}
Rhizoctonia solani	2.0±0.0^{h}	0.0±0.0^{g}	0.0±0.0^{g}	0.0±0.0^{d}	0.0±0.0^{d}	0.0±0.0^{c}	0.0±0.0^{a}	1.0±0.0^{h}	1.0±0.0^{f}	0.0±0.0^{f}
Rhizopus stolonifer	10.0±0.0^{e}	0.0±0.0^{g}	0.0±0.0^{g}	0.0±0.0^{d}	0.0±0.0^{d}	0.0±0.0^{c}	0.0±0.0^{a}	1.0±0.0^{h}	1.0±0.0^{f}	0.0±0.0^{f}
Trichothecium roseum	1.0±0.0^{i}	0.0±0.0^{g}	0.0±0.0^{g}	0.0±0.0^{d}	0.0±0.0^{d}	0.0±0.0^{c}	0.0±0.0^{a}	1.0±0.0^{h}	1.0±0.0^{f}	0.0±0.0^{f}

Data based on 400 seeds, According to Duncan's Multiple range test (DMRT 1955), values in each column followed by different superscript is are significantly different at $p \leq 0.05$

Table 2: Synergistic effect of fungicides on the incidence of fungi in okra seeds

		Incidence of fungi due to different fungicides in combination and concentration (%)										
Fungi	Control	A+V 0.3+0.3	A+C 0.3+0.3	A+B 0.3+0.2	B+V 0.2+0.3	B+D 0.2+0.3	B+C 0.2+0.3	C+V 0.3+0.3	A+B+C 0.3+0.2 +0.3	A+B+D 0.3+0.2 +0.3	A+C+V 0.3+0.3 +0.3	B+C+V 0.2+0.3 +0.3
Actinomycete	30.0±0.0^{d}	3.0±0.0^{c}	0.0±0.0^{d}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	2.0±0.0^{c}	0.0±0.0^{a}	0.0±0.0^{a}	2.0±0.0^{d}	0.0±0.0^{a}
Alternaria alternata	32.5±0.7^{c}	2.0±0.0^{d}	0.0±0.0^{d}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	1.5±0.0^{d}	0.0±0.0^{a}	0.0±0.0^{a}	2.5±0.7^{c}	0.0±0.0^{a}
Aspergillus flavus	5.0±0.0^{h}	1.0±0.0^{f}	0.0±0.0^{d}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	2.0±0.0^{c}	0.0±0.0^{a}	0.0±0.0^{a}	2.0±0.0^{d}	0.0±0.0^{a}
Aspergillus fumigatus	4.0±0.0^{i}	1.0±0.0^{f}	1.0±0.0^{c}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{e}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{d}	0.0±0.0^{a}
Aspergillus columnaris	5.5±0.7^{g}	0.0±0.0^{g}	0.0±0.0^{d}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{e}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{d}	0.0±0.0^{a}
Aspergillus niger	5.0±0.0^{h}	0.0±0.0^{g}	0.0±0.0^{d}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{e}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{d}	0.0±0.0^{a}
Botryodiplodia theobromae	5.0±0.0^{h}	1.0±0.0^{f}	1.0±0.0^{c}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{e}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{d}	0.0±0.0^{a}
Chaetomium globosum	2.0±0.0^{j}	1.5±0.7^{e}	1.0±0.0^{c}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{e}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{d}	0.0±0.0^{a}
Colletotrichum dematium	2.0±0.0^{k}	1.0±0.0^{f}	1.0±0.0^{c}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	4.5±0.7^{b}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{d}	0.0±0.0^{a}
Fusarium verticilloides	75.0±0.0^{a}	10.0±0.0^{b}	8.0±0.0^{b}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{e}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{d}	0.0±0.0^{a}
Fusarium solani	20.0±0.0^{e}	2.5±0.7^{d}	0.0±0.0^{d}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	6.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	4.0±0.0^{b}	0.0±0.0^{a}
Macrophomina phaseolina	72.0±0.0^{b}	14.0±0.0^{a}	9.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{e}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{d}	0.0±0.0^{a}
Rhizoctonia solani	2.0±0.0^{k}	0.0±0.0^{g}	0.0±0.0^{d}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{e}	0.0±0.0^{a}	0.0±0.0^{a}	5.0±0.0^{a}	0.0±0.0^{a}
Rhizopus stolonifer	10.0±0.0^{f}	0.0±0.0^{g}	0.0±0.0^{d}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{e}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{d}	0.0±0.0^{a}
Trichothecium roseum	1.0±0.0^{l}	0.0±0.0^{g}	0.0±0.0^{d}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{e}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{d}	0.0±0.0^{a}

Data based on 400 seeds, According to Duncan's Multiple Range Test (DMRT 1955), values in each column followed by different superscript in are significantly different at $p \leq 0.05$

Table 3: Dose dependent efficacy of fungicides on the incidence of seed mycoflora of okra

Fungicides	Concentration (%)	Seed germination (%)	MRL±SE (cm)	MSL±SE (cm)	Vigour index
Anucop	0.1	52.0±0.0^{g}	4.0±0.0^{b}	6.0±0.0^{c}	520±0.0^{g}
	0.2	56.0±0.0^{e}	4.2±0.0^{b}	6.3±0.0^{c}	588±0.0^{e}
	0.3	60.0±0.0^{c}	4.0±0.0^{b}	6.5±0.0^{c}	630±0.0^{c}
Bavistin	0.1	60.0±0.0^{c}	5.2±0.0^{a}	7.5±0.0^{b}	762±0.0^{b}
	0.2	70.0±0.0^{a}	4.9±0.0^{a}	9.5±0.0^{a}	1008±0.0^{a}
	0.3	58.0±0.0^{e}	4.2±0.0^{b}	6.2±0.0^{c}	603±0.0^{d}
Captan	0.1	53.0±0.0^{g}	2.2±0.0^{f}	4.0±0.0^{e}	329±0.0^{h}
	0.2	58.0±0.0^{e}	3.0±0.0^{d}	5.5±0.0^{d}	493±0.0^{g}
	0.3	59.0±0.3^{d}	3.5±0.0^{c}	5.9±0.1^{d}	548±2.8^{e}
Dithane	0.1	54.0±0.0^{f}	2.5±0.0^{e}	3.0±0.0^{f}	297±0.0^{d}
	0.2	59.0±0.0^{d}	3.5±0.0^{c}	6.0±0.0^{c}	560±0.0^{f}
	0.3	62.0±0.0^{b}	4.5±0.0^{a}	5.4±0.2^{c}	601±0.7^{c}
Vitavax	0.1	51.0±0.0^{h}	2.5±0.0^{e}	3.0±0.0^{f}	280±0.0^{e}
	0.2	57.0±0.0^{e}	3.5±0.0^{c}	4.3±0.0^{e}	445±0.0^{g}
	0.3	59.5±0.7^{d}	4.0±0.0^{b}	5.0±0.0^{d}	535±0.0^{f}
Control	50	50.0±0.0^{e}	2.0±0.0^{g}	5.0±0.0^{d}	350±0.0^{h}

Data based on 400 seeds, According to Duncan's Multiple range test (DMRT 1955), values in each column followed by different superscript in are significantly different at $p \leq 0.05$

Table 4: Combined effect of fungicides on seed germination and seedling growth of okra

Fungicides	Concentration (%)	Seed germination (%)	MRL±SE (cm)	MSL±SE(cm)	Vigour index
A + B	0.3 + 0.2	68.0±0.0^{c}	3.5±0.2^{c}	6.0±0.2^{d}	619±0.0^{e}
A + C	0.3 + 0.3	62.0±0.0^{e}	2.5±0.3^{f}	5.5±0.3^{f}	459±0.0^{g}
A + D	0.3 + 0.2	60.0±0.0^{e}	2.4±0.2^{e}	6.5±0.0^{c}	522±0.0^{f}
A + V	0.3 + 0.3	60.0±0.0^{e}	2.4±0.2^{e}	5.2±0.3^{f}	426±0.0^{h}
B + D	0.2 + 0.3	64.0±0.0^{d}	2.6±0.1^{d}	5.8±0.2^{e}	518±0.0^{e}
B + V	0.2 + 0.3	62.0±0.0^{e}	2.8±0.2^{d}	5.4±0.2^{f}	483±0.0^{g}
B + C	0.2 + 0.3	63.0±0.0^{d}	2.6±0.1^{d}	5.6±0.2^{e}	499±0.0^{g}
C + V	0.3 + 0.3	60.0±0.0^{e}	2.0±0.2^{e}	4.8±0.1^{g}	390±0.0^{h}
A + B + C	0.3 + 0.2 + 0.3	75.0±0.0^{b}	5.5±0.3^{b}	8.0±0.3^{b}	968±0.0^{b}
A + B + D	0.3 + 0.2 + 0.3	80.0±0.0^{a}	8.5±0.4^{a}	10.5±0.5^{a}	1448±0.0^{a}
A + C + V	0.3 + 0.3 + 0.3	70.0±0.1^{c}	5.8±0.2^{b}	7.5±0.4^{c}	889±0.0^{c}
B + C + V	0.2 + 0.3 + 0.3	72.0±0.0^{c}	5.2±0.2^{b}	7.2± 0.4^{c}	850±0.0^{d}
Control	-	50.0±0.0^{d}	2.0±0.0^{f}	5.0±0.0^{h}	350±0.0^{i}

Data based on 400 seeds, According to Duncan's Multiple range test (DMRT 1955), values in each column followed by different superscript in are significantly different at $p \leq 0.05$, A = Anucop, B = Bavistin, C = Captan, D = Dithane M-45, V = Vitavax

showed a very low vigour index and among these, Captan + Vitavax was the most inferior. Anucop + Bavistin + Dithane M-45 treatment showed its superiority with respect to the germination and vigour index. Fungicides with different doses and in combinations reduced the incidence of disease both in greenhouse and field conditions. Further, the seeds collected from plants treated with fungicides, showed reduced incidence of fungi. Among these Bavistin (0.2%), Anucop (0.3%), Captan (0.3%) and Dithane M-45 (0.3%) were more effective compared to Vitavax (Table 5 and 6). Among the combination of chemicals tested, Anucop + Captan gave very promising result in reducing the incidence of fungi as compared to Anucop + Bavistin and Anucop + Vitavax. The results with Bavistin + Captan, Bavistin + Dithane M-45, Anucop + Bavistin + Captan, Anucop + Bavistin + Dithane, Bavistin + Captan + Vitavax, Anucop + Captan + Vitavax were variable (Table 5 and 6).

Qualitative and quantitative assessment of okra in greenhouse and field conditions remained parallel to each other with respect to number of leaves, number of fruits per plant, average length of fruits, fruit biomass, number of seeds per fruit, seed density and ascorbic acid content indicated the favorable effects of Bavistin, Captan, Anucop, Dithane M-45 compared to the Vitavax and control (Table 7 and 8).

Fungicides are heterogeneous group of organic compounds, which are usually unrelated, both chemically and in their mode of action against pathogens. The fungicides may have a significant influence on the production and activity of cell wall degrading enzymes produced by plant pathogenic fungi. Mehta *et al*. (1990) reported the effect of fungicides on the production of pectolytic and cellulolytic enzymes by the fungi, there by reducing the incidence of fungal pathogen. These observations support the present findings, in which fungicides reduced the incidence of mycoflora in the seeds.

Seedling diseases such as collar rot, wilt and leaf spot, were minimized due to fungicidal treatment. Similarly, reduction in *Fusarium* wilt and collar rot were reported due to the treatment of seeds with fungicides (Ghosh and Das, 1999; Misra and Bhattacharya, 1999). The reduced incidence of seed mycoflora, due to the fungicides increased seed germination and vigour of the seedlings is also similar to the findings of Kale *et al.* (1992).

Table 5: Influence of fungicides with different concentration on the quality and yield of okra under greenhouse and field condition

		Qualitative and quantitative assessment of okra maintained under different green house and field conditions							
Fungicides	Concentration (%)	No. of leaves/plant on 30th day	No. of fruits/plant	Mean length of fruit (cm)	Girth of fruit (cm)	Fruit biomass (g)	Mean No. of seeds/fruit	Seed density* (g)	Ascorbic acid/ 100 g of fruit (mg)
Vitavax	0.1	3.0±0.0^{e}	2.0±0.0^{d}	10.0±0.0^{f}	3.0±0.0^{f}	20.0±0.0^{g}	35.0±0.0^{I}	40.0±0.0^{h}	20.0±0.0^{g}
		(3.0±0.0)^{c}	(2.0±0.0)^{d}	(10.0±0.0)^{f}	(4.0±0.0)^{e}	(20.0±0.0)^{g}	(36.2±0.0)^{I}	(40.0±0.0)^{h}	(20.0±0.0)^{g}
	0.2	3.0±0.0^{e}	2.0±0.0^{d}	12.0±0.0^{e}	4.0±0.0^{e}	21.0±0.0^{g}	37.2±0.0^{h}	45.0±0.0^{g}	21.0±0.0^{f}
		(3.0±0.0)^{c}	(2.0±0.0)^{d}	(12.0±0.0)^{e}	(4.0±0.0)^{e}	(21.0±0.0)^{g}	(38.0±0.0)^{h}	(45.0±0.0)^{g}	(21.0±0.0)^{f}
	0.3	4.0±0.0^{b}	3.0±0.0^{c}	13.0±0.0^{d}	4.0±0.0^{e}	22.0±0.0^{g}	38.0±0.0^{h}	46.0±0.0^{g}	22.0±0.0^{f}
		(4.0±0.0)^{b}	(3.0±0.0)^{c}	(14.0±0.0)^{c}	(5.0±0.0)^{d}	(23.0±0.0)^{f}	(40.2±0.0)^{g}	(46.0±0.0)^{g}	(22.0±0.0)^{f}
Bavistin	0.1	3.0±0.0^{e}	3.0±0.0^{c}	12.0±0.0	6.0±0.0^{e}	30.0±0.0^{e}	60.0±0.0^{b}	60.0±0.0^{c}	30.0±0.0^{b}
		(3.0±0.0)^{c}	(3.0±0.0)^{c}	(12.0±0.0)	(6.0±0.0)^{c}	(30.0±0.0)^{c}	(65.0±0.0)^{b}	(60.0±0.0)^{c}	(30.0±0.0)^{b}
	0.2	5.0±0.0^{a}	5.0±0.0^{a}	20.0±0.0^{a}	10.0±0.0^{a}	38.0±0.0^{a}	80.0±0.0^{a}	76.0±0.0^{a}	30.0±0.0^{b}
		(5.0±0.0)^{a}	(5.0±0.0)^{a}	(22.0±0.0)^{a}	(11.0±0.0)^{a}	(40.0±0.0)^{a}	(82.0±0.0)^{a}	(78.0±0.0)^{a}	(32.0±0.0)^{b}
	0.3	4.0±0.0^{b}	4.0±0.0^{b}	15.0±0.0^{c}	8.0±0.0^{b}	32.0±0.0^{b}	70.0±0.0^{a}	65.0±0.0^{b}	35.0±0.0^{a}
		(4.0±0.0)^{b}	(4.0±0.0)^{b}	(16.0±0.0)^{b}	(9.0±0.0)^{b}	(32.0±0.0)^{b}	(72.0±0.0)^{a}	(66.0±0.0)^{b}	(38.0±0.0)^{a}
Captan	0.1	4.0±0.0^{b}	4.0±0.0^{b}	14.0±0.0^{c}	5.0±0.0^{d}	28.0±0.0^{d}	55.0±0.0^{e}	55.0±0.0^{e}	30.0±0.0^{b}
		(4.0±0.0)^{b}	(4.0±0.0)^{b}	(14.0±0.0)^{c}	(5.0±0.0)^{d}	(28.0±0.0)^{d}	(56.0±0.0)^{d}	(56.0±0.0)^{d}	(30.0±0.0)^{b}
	0.2	5.0±0.0^{a}	4.0±0.0^{b}	15.0±0.0^{c}	6.0±0.0^{c}	30.0±0.0^{c}	58.0±0.0^{d}	58.0±0.0^{d}	30.0±0.0^{b}
		(5.0±0.0)^{a}	(5.0±0.0)^{a}	(16.0±0.0)^{b}	(7.0±0.0)^{c}	(30.0±0.0)^{c}	(57.0±0.0)^{d}	(57.0±0.0)^{d}	(30.0±0.0)^{b}
	0.3	5.0±0.0^{a}	5.0±0.0^{a}	17.0±0.0^{b}	6.0±0.0^{c}	30.0±0.0^{c}	60.0±0.0^{c}	60.0±0.0^{c}	30.0±0.0^{b}
		(5.0±0.0)^{a}	(5.0±0.0)^{a}	(18.0±0.0)^{b}	(7.0±0.0)^{c}	(30.0±0.0)^{c}	(62.0±0.0)^{c}	(62.0±0.0)^{c}	(30.0±0.0)^{b}
Dithane	0.1	4.0±0.0^{b}	4.0±0.0^{b}	14.0±0.0^{c}	4.0±0.0^{e}	23.0±0.0^{f}	40.0±0.0^{g}	45.0±0.0^{g}	21.0±0.0^{f}
		(4.0±0.0)^{b}	(4.0±0.0)^{b}	(15.0±0.0)^{c}	(5.0±0.0)^{d}	(25.0±0.0)^{e}	(40.0±0.0)^{g}	(48.0±0.0)^{g}	(21.0±0.0)^{f}
	0.2	4.0±0.0^{b}	4.0±0.0^{b}	14.0±0.0^{c}	4.0±0.0^{d}	23.0±0.0^{f}	40.0±0.0^{g}	50.0±0.0^{f}	20.0±0.0^{g}
		(4.0±0.0)^{b}	(4.0±0.0)^{b}	(14.0±0.0)^{c}	(5.0±0.0)^{d}	(24.0±0.0)^{e}	(42.0±0.0)^{f}	(50.0±0.0)^{f}	(20.0±0.0)^{g}
	0.3	5.0±0.0^{a}	4.0±0.0^{b}	15.0±0.0^{c}	5.0±0.0^{d}	24.0±0.0^{e}	42.0±0.0^{f}	50.0±0.0^{f}	25.0±0.0^{e}
		(5.0±0.0)^{a}	(4.0±0.0)^{b}	(16.0±0.0)^{b}	(6.0±0.0)^{c}	(25.0±0.0)^{e}	(45.0±0.0)^{e}	(50.0±0.0)^{f}	(25.0±0.0)^{e}
Anucop	0.1	3.0±0.0^{e}	3.0±0.0^{c}	15.0±0.0^{c}	5.0±0.0^{d}	20.0±0.0^{g}	45.0±0.0^{e}	58.0±0.0^{d}	29.0±0.0^{c}
		(3.0±0.0)^{c}	(3.0±0.0)^{c}	(16.0±0.0)^{b}	(5.0±0.0)^{d}	(24.0±0.0)^{e}	(48.0±0.0)^{e}	(58.0±0.0)^{d}	(27.0±0.0)^{d}
	0.2	3.0±0.0^{e}	3.0±0.0^{c}	15.0±0.0	6.0±0.0^{c}	23.0±0.0^{f}	50.0±0.0^{d}	60.0±0.0^{c}	28.0±0.0^{c}
		(3.0±0.0)^{c}	(3.0±0.0)^{c}	(16.0±0.0)^{b}	(6.0±0.0)^{c}	(26.0±0.0)^{d}	(50.0±0.0)^{d}	(60.0±0.0)^{c}	(28.0±0.0)^{c}
	0.3	4.0±0.0^{b}	3.0±0.0^{c}	16.0±0.0^{b}	6.0±0.0^{c}	24.0±0.0^{e}	50.0±0.0^{d}	60.0±0.0^{c}	28.0±0.0^{c}
		(4.0±0.0)^{b}	(3.0±0.0)^{c}	(17.0±0.0)^{b}	(6.0±0.0)^{c}	(27.0±0.0)^{d}	(50.0±0.0)^{d}	(60.0±0.0)^{c}	(28.0±0.0)^{c}
Control		4.0±0.0^{b}	3.0±0.0^{c}	13.0±0.0^{d}	4.0±0.0^{e}	20.0±0.0^{g}	35.0±0.0^{i}	43.0±0.0^{g}	20.0±0.0^{g}
		(3.0±0.0)^{b}	(3.0±0.0)^{c}	(14.0±0.0)^{c}	(5.0±0.0)^{d}	(21.0±0.0)^{g}	(36.0±0.0)^{i}	(45.0±0.0)^{g}	(24.0±0.0)^{g}

Seed density based on the means of 1000 seed weight, Data based on 400 seeds, According to Duncan's Multiple range test (DMRT 1955), values in each column followed by different superscript in are significantly different at $p \leq 0.05$

Table 6: Combined effect of fungicides on the quality and yield of okra under green-house and field conditions

		Qualitative and quantitative assessment of okra maintained under different greenhouse and field conditions							
Fungicides	Concentration (%)	No. of leaves/plant on 30th day	Total No. of fruits/plant	Mean length of fruit (cm)	Mean girth of fruit (cm)	Average fruit biomass (g)	Total No. of seeds/fruit	Seed density* (g)	Ascorbic acid/100 g fruit (mg)
A + B	0.3 + 0.2	5.0±0.0^{b}	5.0±0.0^{b}	20.0±0.2^{a}	10.0±0.0^{d}	35.0±0.2^{b}	75.0±0.0^{b}	72.0±0.0^{a}	33.0±0.0^{b}
		(5.0±0.0)^{b}	(5.0±0.0)^{b}	(22.0±0.2)^{a}	(11.0±0.0)^{c}	(38.0±0.2)^{a}	(78.0±0.0)^{b}	(75.0±0.0)^{a}	(35.0±0.0)^{a}
A + C	0.3 + 0.3	4.0±0.0^{c}	4.0±0.0^{c}	16.0±0.0^{d}	6.0±0.0^{g}	25.0±0.0^{d}	55.0±0.0^{f}	55.0±0.0^{c}	34.0±0.0^{b}
		(4.0±0.0)^{c}	(4.0±0.0)^{c}	(17.0±0.0)^{c}	(7.0±0.0)^{f}	(27.0±0.0)^{d}	(57.0±0.0)^{e}	(55.0±0.0)^{c}	(35.0±0.0)^{a}
A + V	0.3 + 0.3	4.0±0.0^{c}	4.0±0.0^{c}	19.0±0.0^{b}	8.0±0.0^{e}	30.0±0.2^{c}	63.0±0.0^{d}	65.0±0.0^{b}	33.0±0.0^{b}
		(4.0±0.0)^{c}	(4.0±0.0)^{c}	(20.0±0.0)^{a}	(10.0±0.2)^{d}	(32.0±0.2)^{c}	(68.0±0.0)^{d}	(70.0±0.0)^{a}	(33.0±0.0)^{b}
A + D	0.3 + 0.3	4.0±0.0^{c}	4.0±0.0^{c}	16.0±0.0^{d}	7.0±0.0^{e}	27.0±0.0^{b}	58.0±0.0^{e}	63.0±0.0^{b}	32.0±0.0^{b}
		(4.0±0.0)^{c}	(4.0±0.0)^{c}	(18.0±0.0)^{b}	(9.0±0.0)^{d}	(29.0±0.0)^{b}	(60.0±0.0)^{a}	(68.0±0.0)^{b}	(34.0±0.0)^{b}
B + D	0.2 + 0.3	5.0±0.0^{b}	4.0±0.0^{c}	17.0±0.0^{c}	9.0±0.0^{d}	34.0±0.0^{b}	74.2±0.5^{c}	70.0±0.0^{a}	35.0±0.0^{a}
		(4.0±0.0)^{c}	(4.0±0.0)^{c}	(18.0±0.0)^{b}	(10.0±0.0)^{d}	(35.0±0.0)^{b}	(76.2±0.5)^{b}	(72.0±0.0)^{a}	(36.0±0.0)^{a}
B + V	0.2 + 0.3	4.0±0.0^{c}	5.0±0.0^{b}	16.0±0.0^{d}	9.0±0.0^{d}	31.0±0.0^{c}	70.0±0.0^{d}	65.0±0.0^{b}	32.0±0.0^{b}
		(4.0±0.0)^{c}	(5.0±0.0)^{b}	(19.0±0.0)^{b}	(10.0±0.0)^{d}	(33.0±0.0)^{c}	(72.0±0.0)^{d}	(70.0±0.0)^{a}	(33.0±0.0)^{b}
B + C	0.3 + 0.3	4.0±0.0^{c}	5.0±0.0^{b}	20.0±0.0^{a}	10.0±0.0^{d}	35.0±0.0^{b}	80.0±0.0^{a}	75.0±0.0^{a}	36.0±0.0^{a}
		(5.0±0.0)^{b}	(5.0±0.0)^{b}	(22.0±0.0)^{a}	(11.0±0.0)^{e}	(38.0±0.0)^{a}	(85.0±0.0)^{a}	(77.0±0.0)^{a}	(38.0±0.0)^{a}
C + V	0.3 + 0.3	5.0±0.0^{b}	4.0±0.0^{c}	21.0±0.0^{a}	11.0±0.0^{c}	36.0±0.0^{b}	80.0±0.0^{a}	76.0±0.0^{a}	35.0±0.0^{a}
		(5.0±0.0)^{b}	(4.0±0.0)^{c}	(23.0±0.0)^{a}	(12.0±0.0)^{c}	(38.0±0.0)^{a}	(86.0±0.0)^{a}	(77.0±0.0)^{a}	(35.0±0.0)^{a}
A + B + C	0.3 + 0.2 + 0.3	5.0±0.0^{b}	6.0±0.0^{a}	22.0±0.0^{a}	12.0±0.0	38.0±0.0^{a}	82.0±0.0^{a}	75.0±0.0^{a}	36.0±0.0^{a}
		(5.0±0.0)^{b}	(6.0±0.0)^{a}	(24.0±0.0)^{a}	(14.0±0.0)^{b}	(40.0±0.0)^{a}	(85.0±0.0)^{a}	(78.0±0.0)^{a}	(38.0±0.0)^{a}
A + B + D	0.2 + 0.2 + 0.3	5.0±0.0^{b}	6.0±0.a^{a}	23.0±0.0^{a}	13.0±0.0^{b}	39.0±0.0^{a}	85.0±0.0^{a}	78.0±0.0^{a}	30.0±0.0^{c}
		(6.0±0.a)^{a}	(7.0±0.1)^{a}	(25.0±0.0)^{a}	(15.0±0.0)^{a}	(41.0±0.0)^{a}	(86.0±0.0)^{a}	(79.0±0.0)^{a}	(30.0±0.0)^{c}
A + C + V	0.2 + 0.3 + 0.3	4.0±0.0^{c}	5.0±0.0^{b}	19.0±0.0^{b}	14.0±0.0^{b}	34.0±0.0^{b}	72.5±0.5^{d}	71.0±0.5^{a}	33.0±0.0^{b}
		(4.0±0.0)^{c}	(5.0±0.0)^{b}	(21.0±0.0)^{a}	(16.0±0.0)^{a}	(35.0±0.0)^{b}	(73.5±0.5)^{d}	(72.0±0.5)^{a}	(33.0±0.0)^{b}

Table 6: Continued

Fungicides	Concentration (%)	Qualitative and quantitative assessment of okra maintained under different greenhouse and field conditions: No. of leaves/plant on 30th day	Total No. of fruits/plant	Mean length of fruit (cm)	Mean girth of fruit (cm)	Average Fruit biomass (g)	Total No. of seeds/fruit	Seed density* (g)	Ascorbic acid/100 g fruit (mg)
B + C + V	0.2 + 0.3 + 0.3	5.0±0.0^{b}	7.0±0.0^{a}	20.0±0.0^{a}	15.0±0.0^{a}	36.0±0.0^{a}	70.5±0.5^{d}	72.0±0.5^{a}	36.2.0±0.2^{a}
		(7.0±0.0)^{a}	(6.0±0.0)^{a}	(22.0±0.0)^{a}	(17.0±0.0)^{a}	(37.0±0.0)^{a}	(73.5±0.5)^{d}	(73.0±0.5)^{a}	(36.2±0.2)^{a}
Control		4.0±0.0^{c}	3.0±0.0^{c}	13.0±0.0^{e}	5.0±0.0^{h}	20.0±0.0^{e}	35.2±0.2^{h}	43.2±0.2^{d}	20.2±0.1^{d}
		(3.0±0.0)^{d}	(3.0±0.0)^{c}	(14.0±0.0)^{e}	(6.0±0.0)^{g}	(21.0±0.0)^{e}	(36.2±0.2)^{g}	(45.2±0.2^{d}	(21.1±0.1)^{d}

*Data based on 400 seeds. *Data represented in parenthesis refers to the field experiment. A = Anucop, B = Bavistin, V = Vitavax, D = Dithane, C = Captan.
* Seed density based on the means of 1000 seeds. According to Duncan's Multiple range test (DMRT 1955), values in each column followed by different superscript in are significantly different at $p \leq 0.05$

Table 7: Role of fungicides and their concentrations on the incidence of mycoflora of okra seeds of treated plants

Seed mycoflora or fungi	Control	Incidence of fungi in okra seeds obtained from fungicides treated plants (%): Seed procured from the plant maintained in green house and field conditions treated with fungicides at different concentration (%): Anucop 0.1	Anucop 0.2	Anucop 0.3	Bavistin 0.1	Bavistin 0.2	Bavistin 0.3	Captan 0.1	Captan 0.2	Captan 0.3
Actinomycete	30.0±0.0^{b}	1.0±0.0^{e}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{b}	0.0±0.0^{a}	0.0±0.0^{a}	1.0±0.0^{d}	0.0±0.0^{a}	0.0±0.0^{a}
	(30.0±0.0)^{b}	(1.0±0.0)^{e}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{b}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(1.0±0.0)^{d}	(0.0±0.0)^{a}	(0.0±0.0)^{a}
Alternaria alternata	32.0±0.0^{b}	2.0±0.0^{d}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{b}	0.0±0.0^{a}	0.0±0.0^{a}	3.0±0.0^{c}	0.0±0.0^{a}	0.0±0.0^{a}
	(32.0±0.0)^{b}	(2.0±0.0)^{d}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{b}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(3.0±0.0)^{c}	(0.0±0.0)^{a}	(0.0±0.0)^{a}
Aspergillus flavus	5.0±0.0^{e}	3.0±0.0^{c}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{b}	0.0±0.0^{a}	0.0±0.0^{a}	4.0±0.0^{b}	0.0±0.0^{a}	0.0±0.0^{a}
	(5.0±0.0)^{e}	(3.0±0.0)^{c}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{b}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(4.0±0.0)^{b}	(0.0±0.0)^{a}	(0.0±0.0)^{a}
Aspergillus fumigatus	4.0±0.0^{f}	1.0±0.0^{e}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{b}	0.0±0.0^{a}	0.0±0.0^{a}	1.0±0.0^{d}	0.0±0.0^{a}	0.0±0.0^{a}
	(4.0±0.0)^{f}	(1.0±0.0)^{e}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{b}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(1.0±0.0)^{d}	(0.0±0.0)^{a}	(0.0±0.0)^{a}
Aspergillus columnaris	5.0±0.0^{e}	1.0±0.0^{e}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{b}	0.0±0.0^{a}	0.0±0.0^{a}	1.0±0.0^{d}	0.0±0.0^{a}	0.0±0.0^{a}
	(5.0±0.0)^{e}	(1.0±0.0)^{e}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{b}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(1.0±0.0)^{d}	(0.0±0.0)^{a}	(0.0±0.0)^{a}
Aspergillus niger	5.0±0.0^{e}	1.0±0.0^{e}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{b}	0.0±0.0^{a}	0.0±0.0^{a}	1.0±0.0^{d}	0.0±0.0^{a}	0.0±0.0^{a}
	(5.0±0.0)^{e}	(1.0±0.0)^{e}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{b}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(1.0±0.0)^{d}	(0.0±0.0)^{a}	(0.0±0.0)^{a}
Botryodiplodia theobromae	5.0±0.0^{e}	0.0±0.0^{f}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{b}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{e}	0.0±0.0^{a}	0.0±0.0^{a}
	(5.0±0.0)^{e}	(0.0±0.0)^{f}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{b}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{e}	(0.0±0.0)^{a}	(0.0±0.0)^{a}
Chaetomium globosum	2.0±0.0^{g}	0.0±0.0^{f}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{b}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{e}	0.0±0.0^{a}	0.0±0.0^{a}
	(2.0±0.0)^{g}	(0.0±0.0)^{f}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{b}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{e}	(0.0±0.0)^{a}	(0.0±0.0)^{a}
Colletotrichum dematium	2.0±0.0^{g}	0.0±0.0^{f}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{b}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{e}	0.0±0.0^{a}	0.0±0.0^{a}
	(2.0±0.0)^{g}	(0.0±0.0)^{f}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{b}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{e}	(0.0±0.0)^{a}	(0.0±0.0)^{a}
Fusarium verticilloides	75.0±0.0^{a}	5.0±0.0^{b}	0.0±0.0^{a}	0.0±0.0^{a}	2.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	8.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}
	(75.0±0.0)^{a}	(5.0±0.0)^{b}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(2.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(8.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}
Fusarium solani	20.0±0.0^{e}	2.0±0.0^{d}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{b}	0.0±0.0^{a}	0.0±0.0^{a}	2.0±0.0^{c}	0.0±0.0^{a}	0.0±0.0^{a}
	(20.0±0.0)^{e}	(2.0±0.0)^{d}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{b}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(2.0±0.0)^{e}	(0.0±0.0)^{a}	(0.0±0.0)^{a}
Macrophomina phaseolina	72.0±0.0^{a}	6.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	2.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	7.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}
	(72.0±0.0)^{a}	(6.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(2.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(7.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}
Rhizoctonia solani	2.0±0.0^{g}	0.0±0.0^{f}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{b}	0.0±0.0^{a}	0.0±0.0^{a}	1.0±0.0^{d}	0.0±0.0^{a}	0.0±0.0^{a}
	(2.0±0.0)^{g}	(0.0±0.0)^{f}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{b}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(1.0±0.0)^{d}	(0.0±0.0)^{a}	(0.0±0.0)^{a}
Rhizopus stolonifer	10.0±0.0^{d}	0.0±0.0^{f}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{b}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{e}	0.0±0.0^{a}	0.0±0.0^{a}
	(10.0±0.0)^{d}	(0.0±0.0)^{f}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{b}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{e}	(0.0±0.0)^{a}	(0.0±0.0)^{a}
Trichothecium roseum	1.0±0.0^{h}	0.0±0.0^{f}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{b}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{e}	0.0±0.0^{a}	0.0±0.0^{a}
	(1.0±0.0)^{h}	(0.0±0.0)^{f}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{b}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{e}	(0.0±0.0)^{a}	(0.0±0.0)^{a}

Seed mycoflora or fungi	Control	Incidence of fungi in okra seeds obtained from fungicides treated plants (%): Seed procured from the plant maintained in green house and field conditions treated with fungicides at different concentration (%): Dithane 0.1	Dithane 0.2	Dithane 0.3	Vitavax 0.1	Vitavax 0.2	Vitavax 0.3
Actinomycete	30.0±0.0^{b}	1.0±0.0^{d}	0.0±0.0^{c}	0.0±0.0^{a}	1.0±0.0^{e}	1.0±0.0^{d}	0.0±0.0^{c}
	(30.0±0.0)^{b}	(1.0±0.0)^{d}	(0.0±0.0)^{c}	(0.0±0.0)^{a}	(1.0±0.0)^{e}	(1.0±0.0)^{d}	(0.0±0.0)^{c}
Alternaria alternata	32.0±0.0^{b}	2.0±0.0^{c}	0.0±0.0^{c}	0.0±0.0^{a}	2.0±0.0^{d}	1.0±0.0^{d}	0.0±0.0^{c}
	(32.0±0.0)^{b}	(2.0±0.0)^{d}	(0.0±0.0)^{c}	(0.0±0.0)^{a}	(2.0±0.0)^{d}	(1.0±0.0)^{d}	(0.0±0.0)^{c}
Aspergillus flavus	5.0±0.0^{e}	2.0±0.0^{c}	0.0±0.0^{c}	0.0±0.0^{a}	4.0±0.0^{c}	2.0±0.0^{c}	1.0±0.0^{b}
	(5.0±0.0)^{e}	(2.0±0.0)^{d}	(0.0±0.0)^{c}	(0.0±0.0)^{a}	(4.0±0.0)^{c}	(2.0±0.0)^{c}	(1.0±0.0)^{b}
Aspergillus fumigatus	4.0±0.0^{f}	1.0±0.0^{d}	0.0±0.0^{c}	0.0±0.0^{a}	1.0±0.0^{e}	1.0±0.0^{d}	0.0±0.0^{c}
	(4.0±0.0)^{f}	(1.0±0.0)^{d}	(0.0±0.0)^{c}	(0.0±0.0)^{a}	(1.0±0.0)^{e}	(1.0±0.0)^{d}	(0.0±0.0)^{c}
Aspergillus columnaris	5.0±0.0^{e}	1.0±0.0^{d}	0.0±0.0^{c}	0.0±0.0^{a}	1.0±0.0^{e}	1.0±0.0^{d}	0.0±0.0^{c}
	(5.0±0.0)^{e}	(1.0±0.0)^{d}	(0.0±0.0)^{c}	(0.0±0.0)^{a}	(1.0±0.0)^{e}	(1.0±0.0)^{d}	(0.0±0.0)^{c}

Table 7: Continued

Seed mycoflora or fungi	Incidence of fungi in okra seeds obtained from fungicides treated plants (%)						
	Seed procured from the plant maintained in green house and field conditions treated with fungicides at different concentration (%)						
	Control	Dithane			Vitavax		
		0.1	0.2	0.3	0.1	0.2	0.3
Aspergillus niger	5.0±0.0^{e} (5.0±0.0)^{e}	1.0±0.0^{d} (1.0±0.0)^{d}	0.0±0.0^{c} (0.0±0.0)^{c}	0.0±0.0^{a} (0.0±0.0)^{a}	0.0±0.0^{f} (0.0±0.0)^{f}	0.0±0.0^{e} (0.0±0.0)^{e}	0.0±0.0^{c} (0.0±0.0)^{c}
Botryodiplodia theobromae	5.0±0.0^{e} (5.0±0.0)^{e}	0.0±0.0^{e} (0.0±0.0)^{e}	0.0±0.0^{c} (0.0±0.0)^{c}	0.0±0.0^{a} (0.0±0.0)^{a}	0.0±0.0^{f} (0.0±0.0)^{f}	0.0±0.0^{e} (0.0±0.0)^{e}	0.0±0.0^{c} (0.0±0.0)^{c}
Chaetomium globosum	2.0±0.0^{g} (2.0±0.0)^{g}	0.0±0.0^{e} (0.0±0.0)^{e}	0.0±0.0^{c} (0.0±0.0)^{c}	0.0±0.0^{a} (0.0±0.0)^{a}	0.0±0.0^{f} (0.0±0.0)^{f}	0.0±0.0^{e} (0.0±0.0)^{e}	0.0±0.0^{c} (0.0±0.0)^{c}
Chaetomium dematium	2.0±0.0^{g} (2.0±0.0)^{g}	0.0±0.0^{e} (0.0±0.0)^{e}	0.0±0.0^{c} (0.0±0.0)^{c}	0.0±0.0^{a} (0.0±0.0)^{a}	10.0±0.0^{a} (10.0±0.0)^{a}	5.0±0.0^{a} (5.0±0.0)^{a}	2.0±0.0^{a} (2.0±0.0)^{a}
Fusarium verticilloides	75.0±0.0^{a} (75.0±0.0)^{a}	5.0±0.0^{a} (5.0±0.0)^{a}	0.0±0.0^{c} (0.0±0.0)^{c}	0.0±0.0^{a} (0.0±0.0)^{a}	2.0±0.0^{d} (2.0±0.0)^{d}	0.0±0.0^{e} (0.0±0.0)^{e}	0.0±0.0^{c} (0.0±0.0)^{c}
Fusarium solani	20.0±0.0^{e} (20.0±0.0)^{e}	1.0±0.0^{d} (1.0±0.0)^{d}	2.0±0.0^{a} (2.0±0.0)^{a}	0.0±0.0^{a} (0.0±0.0)^{a}	2.0±0.0^{d} (2.0±0.0)^{d}	0.0±0.0^{e} (0.0±0.0)^{e}	0.0±0.0^{c} (0.0±0.0)^{c}
Macrophomina phaseolina	72.0±0.0^{a} (72.0±0.0)^{a}	4.0±0.0^{b} (4.0±0.0)^{b}	1.0±0.0^{b} (1.0±0.0)^{b}	0.0±0.0^{a} (0.0±0.0)^{a}	8.0±0.0^{b} (8.0±0.0)^{b}	4.0±0.0^{b} (4.0±0.0)^{b}	2.0±0.0^{a} (2.0±0.0)^{a}
Rhizoctonia solani	2.0±0.0^{g} (2.0±0.0)^{g}	1.0±0.0^{d} (1.0±0.0)^{d}	0.0±0.0^{c} (0.0±0.0)^{c}	0.0±0.0^{a} (0.0±0.0)^{a}	1.0±0.0^{e} (1.0±0.0)^{e}	1.0±0.0^{d} (1.0±0.0)^{d}	1.0±0.0^{b} (1.0±0.0)^{b}
Rhizopus stolonifer	10.0±0.0^{d} (10.0±0.0)^{d}	0.0±0.0^{e} (0.0±0.0)^{e}	0.0±0.0^{c} (0.0±0.0)^{c}	0.0±0.0^{a} (0.0±0.0)^{a}	0.0±0.0^{f} (0.0±0.0)^{f}	0.0±0.0^{e} (0.0±0.0)^{e}	0.0±0.0^{c} (0.0±0.0)^{c}
Trichothecium roseum	1.0±0.0^{h} (1.0±0.0)^{h}	0.0±0.0^{e} (0.0±0.0)^{e}	0.0±0.0^{c} (0.0±0.0)^{c}	0.0±0.0^{a} (0.0±0.0)^{a}	0.0±0.0^{f} (0.0±0.0)^{f}	0.0±0.0^{e} (0.0±0.0)^{e}	0.0±0.0^{c} (0.0±0.0)^{c}

Data based on 400 seeds, According to Duncan's Multiple range test (DMRT 1955), values in each column followed by different superscript in are significantly different at $p \leq 0.05$

Chakrabarti and Basuchauduri (1980) have also screened several systemic fungicides for their efficiency in the control of diseases in case of safflower caused by *F. oxysporum*. Venkatasubbaiah and Muthappa (1981) noticed the effectiveness of Bavistin and Vitavax, which could control the infection of *Rhizoctonia solani* in coffee seeds. Morshed (1995) has conducted experiments in Romania on *Phaseolus vulgaris* and reported the efficacy of Carbendazim and thiram on seed-borne fungi like *Fusarium* sp., *Alternaria* sp., *Botrytis* sp. and *Rhizoctonia solani*. Tripathi (1994) reported the successful control of angular leaf spot due to *Cercospora abelmoschii* in okra through foliar spray of Benlate (0.1%), Bavistin (0.1%) and Dithane M-45 (0.25%). Fungicides were applied at 14 days intervals starting from the first appearance of disease.

Agarwal (1996) reported the reduction of seedling mortality due to Bavistin + Dithane M-45. This was probably due to deeper penetration of the chemicals, which might have resulted in the paralysis of the fungus in the tissues. Present findings with respect to the effect of Bavistin and Dithane M-45 on the reduction in the incidence of mycoflora are similar to the observation of Sharma *et al.* (1996). The frequent and continuous applications of systemic fungicides, which are highly selective pose problems of development of fungicide resistance in the pathogen. These systemic fungicides coupled with contact fungicides proved effective for the control of seed-borne fungal pathogens. The combined formulations are more effective and of high persistence till the maturity of the crop. Hence, they safeguard single the crop to a greater extent than any chemical treatment.

The effect of the fungicides on enhanced germination, vigour and yield of the crop is also in conformation with the findings of Chatrath and Gupta (1978). More fungicides when applied to the seeds as well as to the soil affect the environment and the ecological conditions, which plays an important role in transpiration and other physiological activity of the host. Therefore, application of fungicides in correct dosage and combinations is very important to avoid the adverse effects on the environment and physiology of the host. Agarwal *et al.* (1977) also is in accordance with the present findings in which the combination of different chemicals reduced the seed-borne incidence of *Macrophomina phaseolina, Fusarium verticilloides, Fusarium* sp. and *Alternaria* sp.

Many researchers have recommended various types of fungicides for okra seed treatment to control different seed-borne fungi and to enhance seed germination and ultimately to increase the yield of various crops. Fahim *et al.* (1970) reported the control of seedling blight caused by *Fusarium verticilloides* by fungicides like thiram and orthocide-75. Agarwal and Singh (1975) have inferred that the treatment of linseed with thiram reduced a majority of seed-borne infections and increased the

Table 8: Combined effect of fungicides on the incidence of fungi in okra seeds procured from treated plants

		Incidence of fungi in okra seeds obtained from the plants treated with fungicides combinations (%)										
		Seeds procured from the plants maintained in green house and field condition										
Seed mycoflora	Control	A + B (0.3 + 0.2%)	A + C (0.3 + 0.3%)	A + V (0.3 + 0.3%)	B + V (0.2 + 0.3%)	B + C (0.2 + 0.3%)	B + D (0.2 + 0.3%)	C + V (0.3 + 0.3%)	A + B + C (0.3 + 0.2 + 0.3%)	A + B + D (0.2 + 0.3 + 0.3%)	A + C + V (0.3 + 0.3 + 0.3%)	B + C + V (0.2 + 0.3 + 0.3%)
Actinomycete	30.0±0.0^{e}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	2.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	4.5 ±0.7^{b}	0.0±0.0^{a}
	(30.0±0.0)^{e}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(2.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(4.5 ±0.7)^{b}	(0.0±0.0)^{a}
Alternaria alternata	32.5±0.7^{b}	2.0±0.0^{a}	0.0±0.0^{a}	2.0±0.0^{a}	1.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	2.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	5.5±0.7^{a}	0.0±0.0^{a}
	(32.5±0.7)^{b}	(2.0±0.0)^{a}	(0.0±0.0)^{a}	(2.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(2.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(5.5±0.7)^{a}	(0.0±0.0)^{a}
Aspergillus flavus	5.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{b}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}
	(5.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{b}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}
Aspergillus fumigatus	4.5±0.7^{d}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{b}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}
	(4.5±0.7)^{d}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{b}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}
Aspergillus columnaris	5.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{b}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}
	(5.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{b}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}
Aspergillus niger	5.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{b}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}
	(5.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{b}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}
Botryodiplodia theobromae	5.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{b}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}
	(5.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{b}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}
Chaetomium globosum	2.0±0.0^{c}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{b}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}
	(2.0±0.0)^{c}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{b}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}
Colletotrichum dematium	2.0±0.0^{c}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{b}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}
	(2.0±0.0)^{c}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{b}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}
Fusarium verticilloides	75.0±0.0^{a}	5.5±0.7^{a}	0.0±0.0^{a}	5.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{b}	0.0±0.0^{a}	0.0±0.0^{a}	5.0±0.0^{a}	0.0±0.0^{a}
	(75.0±0.0)^{a}	(5.5±0.7)^{a}	(0.0±0.0)^{a}	(5.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{b}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(5.0±0.0)^{a}	(0.0±0.0)^{a}
Fusarium solani	2.0±0.0^{d}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{b}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}
	(2.0±0.0)^{d}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{b}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}
Macrophomina phaseolina	72.0±0.0^{a}	4.0±0.0^{b}	0.0±0.0^{a}	4.5±0.0^{b}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{b}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}
	(72.0±0.0)^{a}	(4.0±0.0)^{b}	(0.0±0.0)^{a}	(4.5±0.0)^{b}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{b}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}
Rhizoctonia solani	2.0±0.0^{c}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{b}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}
	(2.0±0.0)^{c}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{b}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}
Rhizopus stolonifer	10.5±0.7^{d}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{b}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}
	(10.5±0.7)^{d}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{b}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}
Trichothecium roseum	1.0±0.0^{b}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{b}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}	0.0±0.0^{a}
	(1.0±0.0)^{b}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{b}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}	(0.0±0.0)^{a}

Data based on 400 seeds, Data given in parentheses refers to the field maintained samples, A = Anucop, B = Bavistin, V = Vitavax, D = Dithane, C = Captan, According to Duncan's Multiple range test (DMRT 1955), Values in each column followed by different superscript in are significantly different at p≤0.05

seedling emergence. These findings are also in conformity with the present observations, in which the fungicides were evaluated for their efficacy on the quality of the seeds.

Present study besides providing the usefulness of combination of fungicides also revealed the efficacy of individual fungicide, which could reduce the deleterious effect on seed and seedlings. The fungicides used belong to broad spectrum activity and controlled many seed-borne fungi and thereby enhanced the yield.

The mechanism of action may be either the fungicides interact with the metabolites produced within the tissue and form some complex compounds, which may prove toxic to fungi or it may interfere with the uptake of nutrients by fungi from the host tissue. The increase in germination percentage and vigour of seedlings under certain fungicidal treatment may probably due to increase in the production of phenol reducing sugars and total sugars (Sindhan *et al*., 1996).

It is also clear that the fungicides also induce resistance in plants by enhancing the concentration of phenols and carbohydrates. In support of this, Sindhan *et al.* (1996) reported higher concentration of total phenols and carbohydrates in resistant varieties of groundnut than in susceptible varieties during infection with *Cercospora* species. The antifungal property of systemic fungicides was also due to interference of sterols produced by fungi (Chartrath, 1993; Arinze *et al*., 1975).

Reduction in the occurrence of some fungi under chemical treatment is probably due to the production of certain antifungal compounds and certain enzymes in the host tissues, which are responsible for the inhibition of the growth, spore germination or complete degradation of hyphal tip or cell wall of fungi or suppression by competition for nutrients. Thus fungicidal treatment reduced majority of the seed-borne fungal pathogens and significantly reduced the disease through the induction of systemic resistance in okra seedlings and plants and there by improved the vigour and yield of the crop.

REFERENCES

Abdul-Baki, A.A. and J.P. Anderson, 1973. Vigour determination in soybean seed by multiple criteria. Crop Sci., 13: 630-633.

Agarwal, S.C., 1996. Management of anthracnose of bean by fungicides. Indian J. Pulses Res., 9: 166-168.

Agarwal, V.K. and O.V. Singh, 1975. Seed-borne fungi of lin seed and their response to seed treatment. Seed Res., 3: 26-28.

Agarwal, V.K., H.S. Varma and O.V. Singh, 1977. Treatment of sorghum seeds to control seed borne fungi and improve emergence J. Bull. Grain Technol., 15: 188-120.

Anonymous, 1996. Proceedings of the International Rules for Seed Testing. Seed Sci. Technol., 21: 25-30.

Arinze, A.K., S.H.Z. Naqui and Exundayo, 1975. Storage rot of sweet potato (*Ipomea baticola*) and the effect of fungicides on extracellular cellulolytic and pectolytic enzymes of causal organisms. J. Am. Int. Bioteriorol. Bull., 11: 41-45.

Behrens, W.A. and R. Madere, 1963. Ascorbic acid estimation by DNPH method. Anal. Biochem., 92: 510.

Chakrabarti, D.K. and K.C. Basu Chaudhary, 1980. Nature of action of cersan wet in controlling wilt disease of safflower caused by *Fusarium oxysporum*. Pesticides, 15: 24.

Chartrath, M.S., 1993. Quarter century of systemic fungicides current status and challenges ahead. Ind. Phytopathol., 46: 3-15.

Chatrath, M.S. and J.P. Gupta, 1978. In Improving Crop and Animal Productivity. Sethi, G.R. and M.S. Chatrath (Eds.), Oxford and IBH, New Delhi, pp: 542-554.

Fahim, M.M., M.M. Rayed and N.A. Eisa, 1970. Effectiveness of fungicides and hot water treatment in controlling seed and soil-borne disease caused by *Fusarium meniliforme*. Agric. Res. Rev., Cairo, 48: 157-166.

Fisher, R.A., 1949. The Design of Experiments. Oliver and Bayd, London.

Ghosh, S.K. and N. Das, 1999. Effect of fungicides on seed mycoflora and seed germination of mustard and cauliflower. J. Mycopathol. Res., 37: 37-39.

Kale, P.S., N.R. Holey and S.R. Korda, 1992. Fungicides for controlling seed borne infection in cottonseeds. Seed Res., 20: 60-63.

Mehta, A., S. Chopra and P. Mehta, 1990. Fungicides inhibitory agent of cell wall degrading enzymes. J. Ind. Phytopathol., 43: 117-120.

Misra, D.K. and P. Bhattarcharya, 1999. Prospect of using cowpea Rhizobium and Dithane M-45 for disease management (*Cercospora* leaf spot) and yield of mung bean. J. Mycopathol. Res., 37: 89-91.

Morshed, M.S., 1995. Effect of fungicides on seed borne fungi and nodule formation of bean (*Pheseolus valgaris*) Bangladesh. J. Plant Pathol., 11:1-2, 39-40.

Neergaard, P., 1977. Seed Pathology. Vol. 1, Macmillan Press Ltd., London, pp: 222-237.

Sharma, J.R., M.R. Manrao, H. Baltej Singh and P.S. Kale, 1996. Fungitoxicity of 4-7 Jeiazolidiones derived from 2 hydroxy benzalanilines. J. Plant Dis. Res., 10: 155-157.

Sindhan, G.S., R.D. Parashar and H. Indra, 1996. Effects of chemical seed treatment on incidence of flag smut and biochemical constituents of wheat plant. Indian J. Mycol. Plant Pathol., 26: 60-63.

Tripathi, K.C., 1994. A note on evaluation of fungicides for the control of angular leaf spot of okra caused by *Cercospora abelmoschii.* Progressive-Hortilc., 1-2: 82-84.

Venkatasubbaiah, P. and B.N. Muthappa, 1981. Seed dressing chemicals for coffee against *Rhizoctonia solani.* J. Coffee Res., 11: 1-3.