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Plant products for the management of yellow mosaic disease of mungbean and urdbean

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A B S T R A C T

An experiment was designed to test the efficacy of a few botanical extracts on the yellow mosaic of mug bean. Maximum reduction in disease incidence recorded were 66.70 and 63.65 percent in mungbean and Urdbean, respectively by eight sprays of *Clerodendrum aculeatum*. Whereas, eight sprays of *Boerhaavia diffusa* root extract could reduce the disease incidence by 60.27 and 58.20 per cent followed by *Azadirachta indica* leaf extract by 42.43 and 42.92 percent in mungbean and urdbean, respectively. Maximum plant height (70.90 and 56.20 cm), primary branches (6.36 and 6.38 per plant), secondary branches (13.56 and 10.68 per plant), nodules (27.48 and 37.69 per plant), pods (17.25 and 22.85 per plant), seed yield (4.43 and 3.89 g per plant) were recorded in eight sprays with *Clerodendrum aculeatum* leaf extract followed by eight sprays with *Boerhaavia diffusa* root extract and *Azadirachta indica* leaf extract. On the other hand maximum disease incidence (80.85% and 73.56%) with minimum plant height, primary and secondary branches, nodules, pod and seed yield were recorded in untreated (control) plots in both mungbean and urdbean crops.

Introduction

The findings presented in this communication have got significant importance in the present day scenario when crop production has been drastically reduced due to infection of many viral diseases. Apart from this, the quality of produce, deteriorated due to the excessive use of chemical insecticides to protect the crops against viruses by killing their vectors in the field. Chemicals used to protect crops cause human health hazards, environmental pollution and is not cost effective. Now alternate ways to protect these crops have been tried by the use of substances of plant origin as antiviral agents which have proved to be successful in the management of mungbean and urdbean crops against viral diseases. Mungbean [*Vigna radiata* (L.) Wilczek] and Urdbean [*V. mungo* (L.) Hepper] are the most important pulse crops. In India, these crops are extensively grown in Uttar Pradesh, Madhya Pradesh, Rajasthan, Maharastha, Orissa, Karnataka, Andhra Pradesh, Gujarat, Bihar, Haryana and Delhi during *kharif* and *zaid* season. These crops suffer a large number of diseases incited by fungi, bacteria, viruses, and nematodes. Among viral diseases, yellow mosaic disease is caused by mungbean yellow mosaic virus, a member of germinivirus group. It is transmitted through whitefly (*Bemisia tabaci* Gen.), and produces a very severe disease. The paired particles of the causal virus measure 30 x 15 nm having ssDNA (Honda *et al.* 1981). Yield losses due to this disease vary from 5 to 100 percent depending upon disease severity, susceptibility of cultivars and population of whitefly (Nene 1972; Singh 1980; Rathi 2002). The infection not only drastically reduces yield but also severely impaired the grain size and quality. The affected plants showed typical symptoms of mild scattered yellow spots on young leaves. The next trifoliate leaf emerging from the growing apex showed irregular alternating yellow and green patches. The leaves showed slight puckering with reduction in size. The size of yellowing areas increased further resulting with complete yellow of apical leaves. The infected plants usually mature late and bear very few flowers and pods. So far, no feasible measures are available to control this disease. Therefore tplant products were tested to protect these crops for mungbean yellow mosaic virus infection under field conditions.

Materials and Methods

Healthy seeds of mungbean cultivar K-851 and urdbean cultivar Barabanki Local were directly sown in 3×2 m plot accommodating ten rows with row to row distance of 30 cm and plant to plant 10 cm during *Kharif* season of 2001-02 and 2002-03 with 13 treatments and three replications under Randomized Block Design. The roots of *Boerhaavia diffusa* (BD) plants were collected from the field, washed with tap water and cut into small pieces. Green leaves of *Clerodendrum aculeatum* (CA) and *Azadirachta indica* (AI) were also collected from the field. The roots/green leaves were allowed to dry separately under shade at room temperature. Dried roots/leaves were ground to powder and stored at low temperature. The crude extract was prepared by making the suspension of roots/leaves powder in tap water (1 g.10ml^{-1}). The pulp was strained through two folds of cheese cloth and homogenate clarified by centrifugation at 3000 g for 15 min. The suspension was diluted to 1:2 with tap water and used for spray on experimental plots. The first spray of the antiviral substances (5.0%) was done after 15 days of sowing and remaining sprays of same concentration of antiviral substances were done at weekly interval following the first spraying. In control plots water alone was sprayed instead of the antiviral substance. Observations were recorded on disease incidence, plant height, primary and secondary branches, nodulation, pod formation and seed yield per plant, from five plants from each plot selected randomly.

Results

The evaluation of plant products against mungbean yellow mosaic virus disease in mungbean and urdbean crops exhibited reduction in disease incidence accompanied by significant increase in plant height, primary and secondary branches, nodulation, pods formation and yield. In case of mungbean, minimum disease incidence of 26.92 percent was recorded with T_9 (eight sprays of CA) followed by T_5, T_8, T_{13}, T_4, T_7, T_{12}, T_3, T_6, T_{11}, T_{12} and T_{10}, respectively. On the other hand, control plot showed severe infection with higher disease incidence (80.80 percent). Maximum reduction (66.70%) in disease incidence was found in T_9 followed by T_5, T_8, T_{13}, T_4, T_7, T_{12}, T_3, T_6, T_{11}, T_2 and T_{10} (10.15%). Maximum primary branches of 6.93 per plant were found in T_9 which was at par with T_8 and T_5 and statistically significant over rest all the treatments. Same trend was found in secondary branches, more secondary branches (13.56 plant^{-1}) were recorded in T_9, which was at par with T_5 (11.89 plant^{-1}) and T_8 (11.58 plant^{-1}) and significantly superior over rest of the treatments. Maximum nodules (27.48 plant^{-1}) were recorded on T_9 followed by T_5, T_8, T_{13}, T_4, T_7, T_{12}, T_3, T_6, T_{11}, T_2 and T_{10}. Maximum pods of 17.25 plant^{-1} was found in T_9 treatment followed by T_5, T_8, T_{13}, T_4, T_7, T_{12}, T_3, T_6, T_{11}, T_2 and T_{10}. Seed yield also increased by spraying of botanicals. The most effective treatment was T_9 with maximum seed yield of 4.43 g plant^{-1} followed by T_5, T_8, T_{13}, T_4, T_7, T_{12}, T_3, T_6, T_{11}, T_2 and T_{10} respectively, whereas in untreated plot exhibited minimum 2.63 g plant^{-1} seed yield (Table 1).

In case of urdbean, most effective treatment found was T_9 (eight sprays of CA). It exhibited minimum (26.70%) disease incidence followed by T_5, T_8, T_{13}, T_4, T_7, T_{12}, T_3, T_6, T_{11}, T_2 and T_{10} while in untreated plot disease incidence was recorded maximum 73.50 percent. On the other hand most effective treatments was T_9 which reduced the disease incidence by 63.65% followed by T_5, T_8, T_{13}, T_4, T_7, T_{12}, T_3, T_6, T_{11}, T_2 and T_{10}. Maximum plant height of 56.82 cm was recorded in T_9 which was at par with T_5 (54.92 cm), T_8 (54.00 cm) and significantly superior over rest of the treatments. Same trend was observed for all the parameters. Maximum primary and secondary branches of 6.38 and 10.68 per plant, respectively was found in T_9 followed by T_5, T_8, T_{13}, T_4, T_7, T_{12}, T_3, T_6, T_{11}, T_2 and T_{10}. Maximum nodules of 37.69 per plant was recorded treatment T_9 which was at par with treatments T_5 and T_8 and significantly superior over rest of the treatments. Maximum pods (22.85 plant^{-1}) was recorded in treatment T_9 which was at par with T_5, T_8 and significantly superior over rest of the treatments. The most effective treatment was T_9 which exhibited maximum (3.89 g plant^{-1}) seed yield followed by T_5 (3.35 g plant^{-1}), T_8 (3.12 g plant^{-1}), T_4 (2.89 g plant^{-1}), T_7 (2.67 g plant^{-1}), T_{12} (2.65 g plant^{-1}), T_3 (2.55 g plant^{-1}), T_6 (2.36 g plant^{-1}), T_{11} (2.30 g plant^{-1}), T_2 (2.30 g plant^{-1} and T_{10} (2.13 g plant^{-1}). However, minimum seed yield of 2.10 g plant^{-1} was recorded in untreated plots (Table 2).

Discussion

The inhibitory effect of *Azadirachta indica, Boerhaavia diffusa* and *Clerodendrum aculeatum* may be due to preexisting resistance inducers in these plants. Similar results were obtained by Verma *et al.* (1985) and Singh *et al.* (2004) on mungbean and Urdbean through leaf extract of *Clerodendrum aculeatum* and root extract of *B. diffusa*. *Boerhaavia diffusa* induces strong systemic resistance against several viruses in hypersensitive as well as systemic hosts (Awasthi *et al.* 1984). It is presumed that the inhibitors in *B. diffusa* root and *C. aculeatum* leaf which applied before virus inoculation induces synthesis of some translocatable virus inhibitory or protective substances in the host plants (Verma and Awasthi 1979) and Verma *et al.* 1985). Awasthi *et al.* (1987) suggested that virus inhibition occured through an alternation in the host physiology that inhibited virus multiplication in the cells. It also acted as a repellent as well as antifeadent for vectors (Awasthi and Rizvi 1999). Verma and Verma (1993) reported that leaf extract of *Clerodendrum aculeatum* along with soil amendment of its dry powder showed two folds increase in nodulation and grain yield with 50% reduction in incidence of mungbean yellow mosaic virus disease. Verma and Singh (1994) reported that inhibition of natural mungbean yellow mosaic virus infection by spraying with leaf extract of *Clerodendrum aculeatum,* together with soil amendment with dry leaf powder or fresh extract. Suvendran *et al.* (1999) observed the antiviral activity of plants extract, against brinjal mosaic virus and reported that pre-inoculation sprays of 10% leaf extract or oil formulation of *Azadirachta indica* were effective against virus infection under field conditions. Rajappan *et al*. (2000) reported the reduction in transmission of rice tungro virus under field conditions by *Azadirachta indica*.

The mungbean and urdbean plants may be protected against infection and spread of mungbean yellow mosaic virus by aqueous extracts of *B. diffusa* roots, *C. aculeatum* and *A. indica* leaves. If strategies are developed to prolong the effect of this inhibitor, it may prove as a source of possible prophylaxis against the yellow mosaic disease of mungbean and urdbean at commercial levels. Since, the antiviral substance present in these plants are of the same origin like many other common constituents of a majority of plant systems, it may be easily absorbed into the leaves and translocated systemically to induce the production/synthesis of some protein (s) which are actually antiviral and defends the plants against infection.

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Table 1
Effect of plant products on the incidence of yellow mosaic disease, plant growth parameter and yield of mungbean (Mean data of two years)

Treatments	**Disease incidence (%)**	**Disease control (%)**	**Plant height (cm)**	**Primary branches /plant**	**Secondary branches /plant**	**Nodules/plant**	**Pods.plant^{-1}**	**Seed yield.plant^{-1} (g)**
T_1 = Untreated (water alone)	80.80 (64.01)*	0.00	58.92	4.65	7.50	19.36	9.89	2.63
T_2 = Two sprays of B.D.	70.30 (56.98)	13.00	60.25	5.00	8.15	20.60	10.48	2.94
T_3 = Four sprays of B.D.	60.00 (50.77)	25.74	62.10	5.36	8.95	22.25	11.84	3.25
T_4 = Six sprays of B.D.	48.90 (44.37)	39.48	65.33	5.78	10.00	23.86	13.66	3.67
T_5 = Eight sprays of B.D.	32.10 (34.45)	60.27	67.50	6.40	11.89	25.65	15.86	4.20
T_6 = Two sprays of C.A.	65.60 (54.09)	18.21	61.29	5.15	8.49	21.29	11.75	3.08
T_7 = Four sprays of C.A.	54.70 (47.64)	32.30	64.56	5.57	9.20	23.10	13.34	3.48
T_8 = Six sprays of C.A.	41.40 (40.05)	48.76	68.65	6.36	11.58	25.44	15.46	4.00
T_9 = Eight sprays of C.A.	26.90 (31.24)	66.70	70.90	6.93	13.56	27.48	17.25	4.43
T_{10} = Two sprays of A.I.	72.60 (58.44)	16.96	59.85	4.82	7.80	19.87	10.00	2.76
T_{11} = Four sprays of A.I.	67.10 (55.00)	17.03	61.95	5.20	8.23	21.00	11.20	3.00
T_{12} = Six sprays of A.I.	56.50 (48.73)	30.07	63.00	5.48	9.00	22.36	12.84	3.28
T_{13} = Eight sprays of A.I.	42.40 (40.63)	47.53	65.50	5.84	9.52	24.00	14.34	3.72
SEm±	1.84	-	1.14	0.24	0.75	0.74	0.76	0.24
CD at 5%	5.31	-	3.26	0.69	2.16	2.13	2.17	0.68

***** Figures in parentheses are angular transformed values

Table 2
Effect of plant products on the incidence of yellow mosaic disease, plant growth parameter and yield of urdbean (Mean data of two years)

Treatments	Disease incidence (%)	Disease control (%)	Plant height (cm)	Primary branches /plant	Secondary branches /plant	Nodules/plant	Pods.plant^{-1}	Seed yield.plant^{-1} (g)
T_1 = Untreated (water alone)	80.80 (64.01)*	0.00	58.92	4.65	7.50	19.36	9.89	2.63
T_1 = Untreated (water alone)	73.50 (59.02)	00.00	47.82	4.11	6.52	27.38	14.57	2.10
T_2 = Two sprays of B.D.	65.40 (53.97)	11.00	49.69	4.67	7.18	29.76	15.26	2.30
T_3 = Four sprays of B.D.	57.10 (49.08)	22.31	50.95	5.14	8.00	31.46	16.49	2.55
T_4 = Six sprays of B.D.	45.90 (42.65)	37.55	52.56	5.32	8.94	33.90	18.72	2.89
T_5 = Eight sprays of B.D.	30.70 (33.71)	58.23	54.92	5.72	9.80	35.86	20.39	3.35
T_6 = Two sprays of C.A.	60.70 (51.18)	17.41	50.38	4.89	7.65	31.25	16.29	2.36
T_7 = Four sprays of C.A.	54.40 (47.52)	25.99	51.65	5.06	8.85	33.35	18.20	2.67
T_8 = Six sprays of C.A.	41.00 (39.82)	44.22	54.00	5.60	9.70	35.13	20.15	3.12
T_9 = Eight sprays of C.A.	26.70 (31.11)	63.67	56.82	6.38	10.68	37.69	22.85	3.89
T_{10}= Two sprays of A.I.	67.70 (55.37)	7.89	48.45	4.30	6.87	28.84	15.00	2.13
T_{11}= Four sprays of A.I.	61.00 (51.35)	17.00	49.78	4.70	7.27	30.14	16.95	2.30
T_{12}= Six sprays of A.I.	55.30 (48.04)	24.76	51.00	5.00	8.48	32.00	18.87	2.65
T_{13}= Eight sprays of A.I.	41.10 (39.87)	44.08	53.25	5.45	9.12	33.99	19.96	3.00
SEm±	2.14	-	1.00	0.32	0.43	0.99	0.96	0.30
CD at 5%	6.14	-	2.86	0.91	1.25	2.84	2.76	0.86

***** Figures in parentheses are angular transformed values