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# Varietal Resistance in Aonla, *Emblica officinalis* L. to Gall Forming Black Caterpillar, *Betousa stylophora* Swinhoe

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**ABSTRACT**

**Gall forming black caterpillar, *Betousa stylophora* Swinhoe is an important pest of aonla, *Emblica officinalis* L. Among the fourteen aonla varieties screened for their resistance to this pest at Anand, aonla varieties Faizabad and Kanchan are found less susceptible to *B. stylophora* than local varieties Gujarat Amla-1, Anand-1 and Anand-3.**

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## INTRODUCTION

Aonla, *Emblica officinalis* L. is an important fruit crop of arid and semi-arid tropics. It's cultivation is increasing in middle and north Gujarat. It is a rich source of vitamin C and used in various ayurvedic medicines. The aonla orchards are found severely infested with gall forming black caterpillar, *Betousa stylophora* Swinhoe (Thyrididae : Lepidoptera) in middle Gujarat. It forms gall on tender shoot and twig hence, growth remains restricted. (Wadhi & Batra, 1964). To overcome the pest problem, selection of resistant veriety is preferable. No information on resistant variety of aonla to *B. stylophora* is available, therefore, the present investigation on aonla varietal screening against gall forming black caterpillar, *B. stylophora* was carried out during 1991 to 1993.

## MATERIAL AND METHODS

To study vatietal resistance against gall forming black caterpillar, *B. stylophora,* a field experiment was planned with fourteen different aonla varieties including the local three varieties viz., Anand-1, Anand-3 and Gujarat Amla-1 (Table 1) at Horticultural farm of the B. A. College of Agriculture, Anand. Five year old, uniformly planted at a distance of 8 m X 8 m aonla orchards of each variety were selected for screening purpose. Each variety was replicated thrice. To assess the degree of infestation, 10 tender twigs were randomly selected from each tree and number of galled and healthy twigs were recorded at monthly interval starting from April to November in unprotected aonla orchards. Among the infested twigs number of galls per twig was also recorded. The data were subjected to analysis of variance and are presented in the Table 1.

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TABLE 1

**Varietal resistance in aonla to *B. stylophora* (1991-93).**

| Variety | Galled formed twig (%) | | Av. No. of galls per twig | |
|---|---|---|---|---|
| Gujarat Amla-1 | 3043* | (26.81) | 1.36** | (1.40) |
| Anand-1 | 29.42 | (25.85) | 1.35 | (1.45) |
| Anand-3 | 27.35 | (23.21) | 1.30 | (1.35) |
| LS-1 | 21.35 | (16.03) | 1.17 | (0.96) |
| LS-2 | 18.45 | (13.56) | 1.12 | (0.87) |
| LS-3 | 21.47 | (17.30) | 1.18 | (1.00) |
| LS-4 | 20.75 | (16.61) | 1.13 | (0.92) |
| LS-5 | 22.93 | (18.39) | 1.19 | (1.00) |
| LS-6 | 24.76 | (20.32) | 1.22 | (1.10) |
| Krishna | 20.44 | (14.49) | 1.15 | (0.88) |
| Banarsi | 22.00 | (18.14) | 1.14 | (0.90) |
| Chakaiya | 19.00 | (14.25) | 1.09 | (0.81) |
| Kanchan | 17.16 | (12.19) | 1.06 | (0.74) |
| Faizabad | 16.47 | (11.64) | 1.05 | (0.72) |
| S. Em. | 1.29 | | 0.03 | |
| C. D. at 5% | 3.59 | | 0.09 | |
| C. V. % | 32.52 | | 18.69 | |

*ARC sin transformed values.

** $\sqrt{x + 0.5}$ transformed values.

Figures in the parentheses are original values.

## RESULTS AND DISCUSION

It is found from the three yrs results (Table 1) on the susceptibility of 14 aonla varieties to gall forming black caterpillar, *B. stylophora* that none of the variety was free from the infestation of this pest during study period. However, considering the per cent gall formed twigs, aonla varieties Faizabad and Kanchan were found considerable less

TABLE 1

**Relative efficacy of granular and emulsifiable concentrates of different insecticides for the control of whitefly (Rainy season (late) of 1987, 1988 and (rainy season 1988).**

| Tr. | Treatments | Average No. of whitefly adults/20 leaves | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Days after germination | | | | | | | | | | Days after foliar application | | | | | | | | | | |
| | | 7 | | | 14 | | | 21 | | | | 3 | | | 7 | | | 15 | | | 25 | |
| | | 1987-late | 1988 late | 1988 | 1987 late | 1988 late | 1988 | 1987 late | 1988 late | 1988 | 1987 late | 1988 late | 1988 | 1987 late | 1988 late | 1988 | 1987 late | 1988 late | 1988 | 1987 late | 1988 late | 1988 |
| 1. | Phorate 1.0 G kg a.i./ha + Triazophos 40 EC 0.25 kg a.i./ha | 0.33 (0.83) | 0.33 (0.83) | 0.50 (1.00) | 1.00 (1.50) | 3.33 | 1.50 (2.00) | 3.00 | 8.00 | 2.50 | 0.00 (0.50) | 0.00 (0.50) | 0.75 (1.25) | 0.33 (0.83) | 1.33 | 2.00 | 3.33 | 2.67 | 1.50 | 1.83 | 1.83 | 1.50 |
| 2. | Phorate 10 G 1.66 kg a.i./ha + Acephate 75 sp 0.5 kg a.i./ha | 0.00 (0.50) | 0.33 (0.83) | 0.25 (0.75) | 0.67 (1.17) | 2.67 | 1.25 (1.75) | 2.33 | 5.67 | 2.00 | 0.00 (0.50) | 0.00 (0.50) | 0.75 (1.25) | 0.33 (0.83) | 1.33 | 2.00 | 3.33 | 2.67 | 1.75 | 1.83 | 1.83 | 1.50 |
| 3. | Carbofuran 3 G 0.5 kg a.i./ha + Deltamethrin 2.8 EC 0.1 kg a.i./ha | 0.33 (0.83) | 0.33 (0.83) | 0.50 1.00) | 1.00 (1.50) | 3.33 | 1.50 (2.00) | 3.00 | 5.67 | 2.25 | 0.33 (0.83) | 0.33 (0.83) | 1.00 (1.50) | 0.33 (0.83) | 1.00 | 1.25 | 3.00 | 2.00 | 1.25 | 1.17 | 1.67 | 1.50 |
| 4. | Carbofuran 3 G 1.0 kg a.i./ha + Fenvalinate 20 EC 0.1 kg a.i./ha | 0.00 (0.50) | 0.00 (0.50) | 0.25 (0.75) | 0.67 (1.17) | 2.67 | 1.00 (1.50) | 1.00 | 3.67 | 1.50 | 0.67 (1.17) | 0.33 (0.83) | 0.50 (1.00) | 33 (0.83) | 1.00 | 1.25 | 2.67 | 1.67 | 1.25 | 1.17 | 1.67 | 1.50 |
| 5. | Mephosfolan 5 G 1.0 kg a.i./ha + Methyl demeton 25 EC 0.15 kg a.i./ha | 1.33 (1.83) | 1.33 (1.83) | 1.25 (1.75) | 1.67 (2.17) | 5.67 | 4.00 (4.50) | 4.00 | 9.67 | 3.00 | 1.33 (1.83) | 0.33 (0.83) | 1.75 (2.25) | 1.33 (1.83) | 2.00 | 2.25 | 4.00 | 3.00 | 2.25 | 3.17 | 1.83 | 1.75 |

| Tr. | Treatments | Average No. of Whitefly adults/20 leaves | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Days after germination | | | | | | | | | Days after foliar application | | | | | | | | | |
| | | 7 | | | 14 | | | 21 | | | 3 | | 7 | | | 15 | | | 25 | |
| | | 1987-late | 1988 late | 1988 | 1987 late | 1988 late | 1988 | 1987 late | 1988 late | 1988 | 1987 late | 1988 late | 1988 | 1987 late | 1988 late | 1988 | 1987 late | 1988 late | 1988 | 1987 late | 1988 late | 1988 |
| 6. | Carbosulfan 25 sp 5 gm a.i./100 gm seeds + Endosulfan 35 EC 0.25 kg a.i./ha | 0.00 (0.50) | 0.00 (0.50) | 1.00 (1.50) | 1.00 (1.50) | 2.67 | 1.50 (2.00) | 3.00 | 8.33 | 1.75 | 1.33 (1.83) | 1.00 (1.50) | 1.25 (1.75) | 1.33 (1.83) | 2.00 | 2.25 | 4.00 | 2.67 | 2.25 | 3.50 | 2.17 | 2.00 |
| 7. | Carbosulfan 25 sp 5 gm a.i./100 gm seeds + Neem oil 25 EC 2.5 kg a.i./ha | 0.00 (0.50) | 0.00 (0.50) | 0.75 (1.25) | 1.33 (1.83) | 3.00 | 1.50 (2.00) | 2.67 | 8.67 | 1.75 | 2.00 (2.50) | 1.67 (2.17) | 2.00 (2.50) | 2.00 (2.50) | 2.67 | 3.00 | 4.33 | 3.33 | 2.75 | 4.17 | 2.17 | 2.25 |
| 8. | Control | 2.33 (2.83) | 1.67 (2.17) | 1.75 (2.25) | 3.67 (4.17) | 6.67 | 5.75 (6.25) | 4.67 | 13.33 | 3.75 | 3.00 (3.50) | 5.00 (5.50) | 3.00 (3.50) | 4.00 (4.50) | 5.67 | 4.25 | 6.00 | 5.67 | 3.75 | 5.83 | 2.83 | .2.50 |
| | S. Em. ± | (0.24) | (0.27) | (0.29) | (0.41) | 0.65 | (0.66) | (0.45) | 1.19 | (0.38) | (0.25) | (0.33) | (0.25) | (0.30) | 0.45 | 0.31 | 0.62 | 0.37 | 0.25 | 0.31 | 0.31 | 0.25 |
| | C.D. at 5% | (0.74) | (0.82) | (0.85) | (1.24) | 1.97 | (1.95) | (1.38) | 3.61 | 1.13 | (0.91) | (1.01) | (0.74) | (0.91) | 1.36 | 0.91 | 1.88 | 1.11 | 0.75 | 0.94 | NS | NS |

Figures in parentheses are X + 0.50 Values. H = Higher dose L = Lower dose

operations were followed to prepare the experimental plots. Fresh seeds of cowpea 779 were used for the trials.

In all seven treatments, combination of granular and emulsifiable concentrate insecticides were tested, the detail of which is given in table 1.

**Method of application of insecticides**

**Seed treatment**

Cowpea seeds of 100 gm were treated with 20 gm carbosulfan 25 SP using *Acasia* gum solution as an adhesive material. The seed treatment (*ST*) was done one day before sowing.

Weighed quantity of the granular insecticides was applied uniformly in furrows and mixed with the soil to avoid direct contect of the seed with the insecticide. The spray fluid was prepared by mixing measured quantity of water and the insecticides were sprayed 30 days after germination (DAG).

Pre and post treatment observations were recorded on the population of whitefly from 20 randomly selected plant (One trifoliate leaf/plant) to evaluate the efficacy of the treatments. Whiteflys were counted during early morning without disturbing the plant. To evaluate the efficacy of granular insecticides and carbosulfan (*ST*), observations on whitefly were recorded 7, 14 and 21 days after germination. Whitefly population was recorded 3, 7, 15 and 25 days after spraying to evaluate the efficacy of emulsifiable concentrate insecticides. Number of diseased and total number of plants per plot was recorded 30, 45 and 60 DAG and percentage of disease incidence was calculated. Grain yield per plot was recorded from net plot area and converted to q/ha. During rainy season (late) of 1987 grain yield was not recorded.

Correlation between mean number of whiteflys per 20 leaves (cumulative value) and per cent disease incidence (60 DAG) was worked out. Similarly, correlation between whitefly population and grain yield and per cent disease incidence and grain yield were also worked out for each trial. From grain yield data the avoidable loss and increase in yield over control were calculated for each treatment.

## RESULTS AND DISCUSSION

From the table 1 it is seen that phorate (*H*) and carbofuran (*H*) were found more effective in controlling whitefly as compared to carbofuran (*L*) and phorate (*L*) as well as carbosulfan 5% (*ST*) 7, 14 and 21 DAG in rainy season (late) of 1987, 1988 and rainy season 1988. Whitefly population was 0.0 to 0.33, 0.67 to 2.67 and 2.0 to 5.67 in phorate (*H*), 0.0 to 0.25, 0.67 to 2.67 and 1.0 to 3.67 in carbofuran (*H*), while in control it was 1.67 to 2.33, 3.67 to 6.67 and 3.75 to 13.33 whiteflies per 20 leaves on 7,14 and 21 DAG, respectively during all the seasons. Mephosfolan 1.0 kg a.i./ha was found to be least effective in reducing whitefly population. Earliar workers also found the effectiveness of carbofuran and phorate than mephosfolan in reducing whitefly population (Kapoor *et al.* 1986, Rataul and Singh, 1976). Vadodaria and Vyas (1987) observed that basal application of phorate 10 G @ 1 kg a.i./ha was found most effective in controlling whiteflies in greengram.

Insecticides applied 30 DAG provided good protection against whitefly infestation. Maximum whitefly population (2.50 to 5.0) was recorded in control and it increased gradually after foliar application. Triazophos (0.0 to 2.0

whiteflies/20 leaves) and acephate (0.0 to 2 whiteflies/20 leaves) were found to be effective upto 7 days after spraying in controlling the whitefly population, while deltamethrin (0.33 to 2.00 whiteflies) and fenvalerate (0.33 to 2.67 whiteflies) gave good results upto 15 days after spraying during rainy season (late) of 1987 and 1988 and rainy season 1988. Methyl demeton and endosulfan were almost equally effective but average population of whitefly was less in methyl demeton while, neem oil was found to be least effective in reducing whitefly population. None of the insecticide treatments was effective in controlling whitefly population 25 days after spraying during all the seasons. Mishra (1984) reported the effectiveness of deltamethrin and fenvalerate in tomato while, Satyavir (1983) reported that endosulfan was inferior to methyl demeton in controlling whitefly in moth bean. Similarly, Vadodaria and Vyas (1987) reported that acephate 0.1 per cent effectively controlled whitefly in green gram. Thus the present findings are in close agreement with the earlier studies.

From the table 2 it is seen that all the insecticidal treatments were found significantly superior to control. Percentage of diseased plants was low (3.81 to 7.10) in carbofuran (*H*) + fenvalerate followed by phorate (*H*) + acephate (5.00 to 10.54) as compared to control (25.0 to 34.18) on 60 DAG during rainy season (late) of 1987, 1988 and rainy season 1988. Amongst insecticidal treatment maximum disease incidence (22.25 to 28.95) was recorded in mephosfolan + methyl demeton on 60 DAG. Similar observations were recorded by Rataul and Singh (1976), Sharma and Verma (1982) and Reddy and Verma (1986).

Maximum grain yield of cowpea (13.10 q/ha) was recorded in the treatment of carbofuran (*H*) + fenvalerate during rainy season (late) of 1988 while it was 11.21 q/ha in the treatment of phorate (*H*) + acephate followed by carbofuran (*H*) + fenvalerate (10.97 q/ha). Mephosfolan + methyl demeton and carbosulfan (*ST*) + Neem oil were less effective in increasing the grain yield during rainy season (late) of 1988 and rainy season 1988. Kooner *et al.*, (1986) reported that when phorate and carbofuran were applied @ 2.0 kg a.i./ha in two split doses to soybean crop, the grain yield was increased. Similarly Rataul and Singh (1976) reported that carbofuran treatment gave the higher yield in soybean as compared to aldicarb.

Negative and highly significant correlation was observed between whitefly population and grain yield where the correlation coefficient ( r ) was -0.897 and -0.940 during rainy season 1988 and rainy season (late) of 1988, respectively. Similarly, negative and highly significant correlation was observed between disease incidence and grain yield, where the correlation coefficient ( r ) was -0.934 and -0.96 during rainy season 1988 and rainy season (late) of 1988, respectively. Positive and highly significant correlation was noticed between whitefly population and disease incidence where the value of ' r ' was 0.95, 0.98 and 0.95 during rainy season (late) of 1987, 1988 and rainy season 1988, respectively. Yellow mosaic disease of horsegram and greengram was closely related to size of the vector population. Muniyappa *et al.* (1978). Gangadharan and Jayarajan (1986) and Singh and Sharma (1981) reported that YMV had negative and significant correlation with yield.

Maximum per cent increase in grain yield over control (69.34) was obtained in the treatment phorate (*H*) + acephate during

and rainy season (late) of (1988), respectively (Fig. 1 and 2). Sharma and Verma (1982) reported that maximum yield reduction (69 to 78 per cent) occured when greengram plants were infected by YMV within two weeks after germination.

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