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Effect of introduction of *Chrysoperla carnea* (Steph.) on certain soybean-yield parameters of SbMV-infected plants by using viruliferous *Aphis craccivora* Koch

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ABSTRACT

Isolation of soybean mosaic virus (SbMV) was carried out by Indirect ELISA method to detect local isolate (from Minia Governorate) of SbMV in soybean infected plants. The impact of healthy aphids, SbMV-viruliferous aphids on soybean plants, and the combined effects by releasing *Chrysoperla carnea* Stephens larvae were tested during three different stages of plant development. Parameters of treatment evaluation were the number of seeds/pod, seeds/ plant, weight of seeds/ plant and weight of 100 seeds. No obvious effect was observed on the number of seeds per pod among all treatments. The effect of viruliferous aphids was drastic on the treated plants. The release of *Chrysoperla* larvae on soybean infected plants (either by healthy or viruliferous aphid) resulted in increasing the number and weight of seeds regardless to the stage of plant development. Release of *C. carnea* took place in the early phenological stage of the plants, as soon as aphid appearance, in order to prevent spread of virus infection.

Key Words: *Aphis craccivora, Chrysoperla carnea,* Soybean, Soybean mosaic virus, Yield parameters.

INTRODUCTION

In Egypt, soybean *Glycine max* (L.) is considered to be an important crop in many regions especially in the new reclaimed areas. Soybeans are known to be susceptible to at least 111 viruses (Demski *et al.*, 1993). Several virus diseases of soybeans are not known to occur in nature and more than 30 viruses are believed to have some economic significance. Infected seeds play an important role in epidemiology of the virus and the resultant seedlings are considered as the primary sources of virus inocula. Insects have an important role in epidemiology and spread of different plant virus diseases in the world.

Trials of insect for virus transmission of soybean mosaic virus were carried out using the following insect species: *Anlacorthum pseudosolani, Aphis glycine, Aphis gossypii, Aphis craccivora, Doralis frangulae, D. rhammi, D. craccivora, Macrosiphum solanifolii, Macrosiphum pisi , Myzus persicae, Neomyzus circumflexus, Rhopalosiphum prunifoliae, Thrips tabaci,* and *Toxoptera citricida* as mentioned by different investigators allover the world (Conover, 1948; Sabek, *et al.*, 1979; Morales, *et al.*, 1990 and Demski *et. al.*, 1993;).

Biocontrol studies using *Chrysoperla* spp. were carried out and many species have been used for instance: *Chrysoperla* carnea (Beglyarov and Ushchekov, 1974; Bondarenko, 1975; Hassan, 1978; and Beglyarov *et al.*, 1980), *Chrysopa perla* (Kowalska, 1976) and *Chrysopa formosa* (Lyon, 1979). The authors used the predator against several pests on various vegetable crops, most of which were carried out in greenhouses. This predator has been mainly used against aphids, where the lacewings can be transferred to the greenhouse either as eggs or as second instar larvae (El Arnaouty *et al.*, 1993). The efficacy of lacewings depended on the date of the first release, and the larvae needed to be present before the first winged aphids (Collet *et al.*, 1998).

El Arnaouty and Gamal (1998), reported that the use of *C. carnea* released either at the egg or larval stage for several subsequent weeks, gave good results for the control of aphid pests on cotton.

The present work aimed to investigate the effect of releasing *C. carnea* on certain soybean yield parameters of SbMV-infected plants by using viruliferous *Aphis craccivora.*

MATERIALS AND METHODES

Isolation of SbMV.

Isolation of SbMV was carried out by using single local lesion technique previously described by (Kuhn, 1964).

Biocontrol Experimental Treatments:

In the present experiment, four treatments were conducted using soybean cv. Giza 111. Plastic pots (measuring 20 cm in diameter) were filled with sand

and paet moss (1:1). Five Giza 111 seeds were sown in the pots. Five days after sowing, seedlings were thinned to only two plants in each pot. Each series of treatments was carried out during soybean: seedling stage (A), flowering stage (B) and podsetting stage (C). For each treatment, 10 replicates of pots were prepared and arranged in the greenhouse located at the Virus Research Department, Plant Pathology Research Institute, Agricultural Research Center (ARC). Giza, Egypt. The greenhouse temperature was maintained at 27°C.

At each stage of A, B and C plant development, four treatments were designed as follows:

- Treatment 1: healthy (virus-free) *A. craccivora* nymphs (50 individuals/pot) alone.
- Treatment 2: healthy *A.craccivora* + *C. carnea* (5 larvae /pot).
- Treatment 3: viruliferous *A.craccivora* alone
- Treatment 4: viruliferous *A. craccivora* + *C. carnea*

Treated pots were daily observed starting at the 10th day of the introduction. At the end of the plant development, number and weight of harvested soybean pods and seeds were recorded.

RESULTS AND DISCUSSION

Isolation of SbMV

Samples of naturally infected soybean plants exhibiting disease symptoms that were suspected to be due to virus infection that were collected from soybean *cvs.* Giza 111, Giza 35 and Giza 82 grown at El-Minia Governorate, strongly reacted positively with indirect ELISA using antisera specific for SbMV to confirm presence of the disease.

Biocontrol Treatments:

Concerning the group A (treatments on the seedling stage), as shown in Table (1), treatment 1, average number of seeds/pod was 2.5 seeds (varied between 1 and 4), while the number of seeds/plant varied between 25 and 41, with an average of 32.7 seeds/plant. Average weight of total seeds/plant was 10 g (8–12), while the average weight of 100 seeds was 18.8 g (16–20). When the healthy aphids plus *C. carnea* were introduced to the plants (treatment 2), average number of seeds/pod was 1.8 (1–3), the average of 38.6 seeds /plant (29–47) was observed. The average weight of total seeds/plant was 15.1 g (13–17). While the average weight of 100 seeds was 23 g (21–25).

For the treatment 3, where soybean plants average number of seeds/pod was 1.5 (1-2), while the average number of seeds/plant was 26 seeds (19–31), and the average weight of total seeds/plant was 5.2 g (3–7) compared with 9.1 g (7-11) for the average weight of 100 seeds. When the viruliferous aphid plus *Chrysoperla* were placed on soybean plants, average number of seeds/pod was 2 (1–3), while 40.3 (31–49) seeds /plant were observed. The total weight of seeds/ plant was 17.4 (15–19) and the average weight of 100 seeds was 26.1 (23–29) (Table 1).

Concerning the group B (treatment on the flowering stage) when the viruliferous aphids were introduced to the plants, the pod gave only 1.5 seeds in average and 27.1 (21–33) seeds per plant. The weight of total seeds per plant was 7 g (5–9), while the weight of 100 seeds was 17.1 g (13–21). When the *Chrysoperla* larvae were released the viruliferous aphids (Table 2), the number of seeds/pod was 2 g (1–3), while the number of seeds/plant was 47 (37–57). The weight of total seeds was 21.1 g (17–25), while the weight of 100 seeds was 29 (25–33) g. In case of group C, (treatment on podsitting stage), where only the viruliferous aphids were placed on the plants, number of seeds/pod was 2 (1–3) and the number of seeds/plant was 30.2 (23–37). The weight of total seeds was 8.2 g (5–11 gm), while the weight of 100 seeds was 19 g (15–23). When the *Chrysoperla* larvae were placed to the viruliferous aphids, during the flowering stage, the number of seeds/pod was 2 (1–3) and the number of seeds/plant was 49.4 (39–59), the total weight of seeds was 26.2 g (19–31) and weight of 100 seeds was 33.3 g (28–38) (Table 2).

Obtained results proved that both the viruliferous aphid and the release of *Chrysoperla* had a significant effect on the number of seeds per pod among all tested stages of plant development (seedling, flowering and podsitting). Throughout the seedling stage, the treatment of viruliferous aphids alone resulted in reducing the number of seeds/plant (average of 26 compared with 33.7 for the healthy aphids alone), concerning the same parameter, the effect of *Chrysoperla* was almost similar on the viruliferous aphid (average of 40.3 seeds/plant) against (average of 38.1 seeds/plant) in case of the healthy aphids alone. The effect of *Chrysoperla* was also detected in the treatment during the flowering and podsetting stages, where the average number of seeds/plant increased from 27.1 to 47 and from 30.2 to 49.4 for the treatment in flowering and podsetting stage, respectively.

For the group A (treatment on seedling stage), the

Table (1): Results recorded for the 4 tested parameters (no. seeds/pod, seeds/plant, weight seeds/plant and weight 100 seeds) of the 4 evaluated treatments (healthy aphids alone, aphids+*Chysoperla*, viruliferous aphids+*Chrysoperla*) determined at soybean seedling stage (A).

Treatment /Replicate	Treat. 1 (Healthy aphids alone)				Treat. 2 (Healthy aphids + *Chrysoperla*)				Treat. 3 (Viruliferous aphids alone)				Treat. 4 (virus infected aphids + *Chrysoperla)*			
Pot No.	No. s/po	No. s/p	W total s	W 100 s	No. s/po	No. s/p	W total s	W 100 s	No. s/po	No. s/p	W total s	W 100 s	No. s/po	No. s/p	W total s	W 100 s
1	2	40	9	19	2	46	15	24	2	30	5	9	2	36	17	28
2	3	39	10	18	1	45	17	23	2	31	7	11	1	38	18	29
3	1	25	11	18	2	30	13	21	1	29	5	10	2	48	15	23
4	4	26	11	19	2	27	14	25	1	28	6	9	1	39	19	24
5	2	41	12	18	3	29	13	23	2	19	3	8	3	49	19	25
6	4	32	8	20	1	47	17	22	2	21	4	7	3	31	18	28
7	1	37	10	18	1	43	16	22	1	22	7	10	3	37	15	27
8	2	29	11	20	2	41	15	25	1	28	5	11	1	36	17	26
9	3	28	9	20	3	42	15	21	2	25	4	8	2	45	18	26
10	3	30	9	18	1	28	16	24	1	27	6	8	2	44	16	25
Mean	2.5	32.7	10	18.8	1.8	38.6	15.1	23	1.5	26	5.2	9.1	2	40.3	17.4	26.1

Table (2): Results recorded for the 4 tested parameters (no. seeds/pod, seeds/plant, weight seeds/plant and weight 100 seeds) of the 2 evaluated treatments (healthy aphids alone, aphids+*Chysoperla*, viruliferous aphids+*Chrysoperla*) determined at flowering stage (B).

Pot No.	Treat. (1) (Viruliferous aphids alone)				Treat. (2) (Viruliferous aphids+*Chrysoperla*)			
	No. s/ po	No. s/p	W total s	W 100 s	No. s/ po	No. s/p	W total s	W 100 s
1	2	29	6	21	2	52	18	30
2	2	32	7	19	3	41	25	28
3	2	26	9	13	3	53	23	31
4	1	25	5	15	2	57	21	33
5	2	33	6	16	1	51	17	27
6	1	30	7	17	2	38	22	25
7	1	29	8	21	2	37	19	29
8	1	21	5	14	1	44	20	32
9	2	22	9	18	2	45	25	25
10	1	24	8	17	2	52	21	30
Mean	1.5	27.1	7	17.1	2	47	21.1	29

Table (3): Results recorded for the 4 tested parameters (no. seeds/pod, seeds/plant, weight seeds/plant and weight 100 seeds) of the 2 evaluated treatments (healthy aphids alone, aphids+*Chysoperla*, viruliferous aphids+*Chrysoperla*) determined at podsetting stage (C).

Pot No.	Treat. 1 (Viruliferous aphids alone)				Treat. 2 (Viruliferous aphids + *Chrysoperla*)			
	No. s/ po	No. s/p	W total s	W 100 s	No. s/ po	No. s/p	W total s	W 100 s
1	2	35	10	22	2	53	27	36
2	3	28	7	23	1	59	25	30
3	1	31	8	19	3	48	21	35
4	2	37	5	15	2	56	29	29
5	3	25	6	16	2	50	28	38
6	1	33	11	20	3	54	23	28
7	1	24	11	23	1	41	19	31
8	2	32	7	22	1	39	31	36
9	2	23	9	19	3	52	29	33
10	3	34	8	21	2	42	30	37
Mean	2	30.2	8.2	19	2	49.4	26.2	33.3

*s=seed, po=pod, p=plant, W=weigth

viruliferous aphids had a destructive effect on the weight of total seeds/plant (average of only 5.2 g., compared with 10 g for the plants infested with healthy aphids). The same trend was observed on the weight of 100 seeds parameter. Releasing *Chrysoperla* increased seed weight to 17.4 and 15.1 g for the viruliferous and healthy aphids, respectively. Concerning treatment during the flowering stage, the release of *Chrysoperla* was highly important as the total weight of seeds/plant increased to attain 21.1 g compared with only 7 g for the plants infested by viruliferous aphid without release of *Chrysoperla.* Similar trend was recorded for the same treatment during the podsetting stage, the average weight of seeds/plant in the soybean infested with viruliferous aphid in presence of *Chrysoperla* was 26.2 g compared with 8.2 g in absence of *Chrysoperla.* The average weights of 100 seeds for the same treatment were 33.3 g and 19 g, respectively.

These results are in agreement with El-Tahlawy and El-Arnaouty (2006) who studied that the impact of healthy aphids, BYMV viuliferous aphid on faba bean plants, and the combined effect by releasing *C. carnea* larvae during the stages of plant development. It can be concluded, that if plants in an early phenological stage, are infested by aphids carrying virus disease, high damage is observed causing a drastic loss in seed yield. Thus, the release of *C. carnea* has to be carried out in the early phenological stage of soybean plants, as soon as aphids appear in order to suppress virus infestation. The early control of the viruiferous aphid is the effective alternative for the suppression of the virus incidence.

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