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Control of the pink borer, *Sesamia cretica* Led. (Lepidoptera: Noctuidae) in maize field using a granulosis virus in Egypt.

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ABSTRACT

The pink borer, *Sesamia cretica* Lederer (Lepidoptera: Noctuidae), is a main pest of maize in Egypt. Attacks by *S. cretica* are usually high on early plantations of April, when the first generation of adults emerge after a period of larval hibernation. The present study aimed to evaluate the feasibilty of the granulosis virus of *S. cretica*, recently isolated by Fediere *et al.* (1993) (C.R.A.S., 316, 1350-1354) as a microbiological agent.

A field experiment was conducted in 1997 at Sakha Agricultural Research Station, Kafr El-Sheikh governorate, North of the Nile delta, where heavy natural infestation by *S. cretica* is of frequent occurrence on early plantations. The experimental design was randomized blocks with seven replications and five treatments. Treatments were control (T1), the currently recommended chemical insecticide (methomyl, 640g active ingredient per hectare) (two sprayings, three and five weeks after sowing) (T2), and three treatments with highly purified suspensions of virus in water at three different doses (two sprayings, three and five weeks after sowing). The lowest dose of the virus insecticide (T3) was 60g of granules per hectare (*i.e.* 7.4×10^{15} I.B./ha). The other doses were double this dose (T4) and five times this dose (T5). Molasses was added to the virus suspension at a rate of 10% as a sticker and a feeding stimulant. Samples of 20 plants per plot were taken every week for four successive weeks from the day of the first treatment.

Population density in the control was close to one borer per stem during the first three weeks and decreased to 0.2 borer per stem during the fourth week. Comparison between tested treatments using analysis of variance and Newman-Keuls test showed that the viral suspensions had an efficiency not different from that of methomyl, and that populations were significantly reduced in the sprayed plots in comparison with the control (about 70% reduction). This population reduction occurred throughout one week after viral spraying. It is concluded that, under the conditions of this pilot trial, the virus insecticide was as efficient as the chemical insecticide, thus bringing to light that it seems to be a promising biological agent. Since no difference was observed between the tested virus doses, the next step in the experiment will be the determination of the lowest efficient dose of the virus suspension.

KEY-WORDS: *Sesamia cretica*, Maize borers, Granulosis virus, Baculoviridae, Egypt, field trials.

INTRODUCTION

Maize *(Zea mays* (L.)) is infested by three borer species in Egypt: *Sesamia cretica* Led. (Lepidoptera: Noctuidae), *Chilo agamemnon* Blesz. and *Ostrinia nubilalis* Hbn. (Lepidoptera: Pyralidae). *S. cretica* may cause severe damage to maize plantations, particularly when infestation occurs shortly after plant emergence (Semeada, 1985 & 1988). Population densities of *S. cretica* are high in several regions of the Nile delta, particularly on early maize plantations sown between late March and mid-May (Mostafa, 1981). Control of the pest in these highly infested plantations is currently done using chemical insecticides.

Recent studies successfully isolated two viruses from *S. cretica*: a small RNA virus belonging to family Picornaviridae (Fediere *et al.*, 1991) and a granulosis virus from family Baculoviridae (Fediere *et al.*, 1993).

Granulosis viruses (GV) are potentially promising agents for microbiological control of pests. Large scale applications of GV in pest management programs have been made against several pests, such as the potato tuber moth, *Phtorimea operculella* (Zeller) (Lepidoptera: Gelechiidae) (Matthiessen *et al.*, 1978; Kroschel *et al.*, 1996), the codling moth, *Cydia pomonella* (L.) (Lepidoptera: Tortricidae) (Huber and Dickler, 1977), the cabbage worm, *Pieris rapae* (L.) (Lepidoptera: Pieridae) (Tatchell and Payne, 1984) and *Agrotis segetum* Schiff. (Lepidoptera: Noctuidae) (Caballero *et al.*, 1991).

In Egypt, the GV isolated from *S. cretica* (ScGV) was first tested in maize field in comparison with the currently recommended insecticide and control (untreated plants) (Fediere *et al.*, 1996). This preliminary test showed that population density and yield in the virus treated plot lay between those of the chemical insecticide and the control.

To reach a better understanding of the precise effect of ScGV as a microbial control agent of *S. cretica* at a high infestation area in the North of the Nile Delta (Sakha region, Kafr-El-Sheikh governorate), the present investigation was aimed using the virus suspension at different doses applied in a randomized design.

MATERIAL AND METHODS

Virus production and purification

A stock culture of *S. cretica* larvae was maintained under laboratory conditions and infected with the wild type Granulosis virus isolated from Egypt described by Fediere *et al.* (1993). The virus suspension used in the field experiment was a highly purified preparation of ScGV at the concentration of 1.0 OD 420/ml in distilled water (1 OD 420/ml = 1.48×10^{10} capsules/ml = 0.125 mg capsules/ml) (Chang and Tanada, 1978).

Experimentation

The experiment, which was carried out under natural infestation conditions, took place at Sakha Agricultural Research Station, Kafr El-Sheikh governorate, *ca.* 150 km north of Cairo.

Plots were arranged in a randomized complete blocks design with seven replications and five treatments. These treatments were a control (T1), the currently recommended insecticide, methomyl at 640g active ingredient per hectare (T2), ScGV at 60g of granules per hectare (i.e. 7.4 10^{15} I.B./ha) (T3), ScGV at 120g of granules per hectare (T4) and ScGV at 300g granules per hectare (T5). For each treatment two sprays were done, at three and five weeks after sowing. Molasses was added to the virus solution at a rate of 10% as a sticker and feeding stimulant. The maize variety used was SC10 and sowing was done on the first of May 1997.

Each plot was 8m long and 16.1m wide and containing 21 rows (5 central rows for yield estimation, 7 rows on each side for sampling, and one border row on each side). Twenty plants per plot were sampled every week as of the day of first spray. Ten successive plants were taken from a row on the right side of the yield rows and another ten successive plants were taken from a row on the left side of the yield rows following a zig-zag sampling method. Plants were dissected and numbers of the different stages of *S. cretica* were recorded.

Statistical Analysis

Analysis of variance was carried out to determine if there were a treatment effect and, if so, a Newman-Keuls test was done to distinguish the treatment means.

RESULTS AND DISCUSSION

Population changes in the control

The only borer collected in the dissections was *S. cretica*. This confirms previous observations about the infestation by the other borers, *C. agamemnon* and *O. nubilalis*, which occurs generally late in the season (Tantawi, 1981; Temerak, 1983).

Egg-layings by *S. cretica* were high during the week of the first sampling (Figure 1) as well as the week before (about one egg per plant and more than one first or second instar larva were found). Very few older larvae were present. Very few egg-masses were layed during the two weeks following the first treatment. During these two weeks population density was close to one borer per stem. In the fourth sample, larval population decreased to about 0.2 borer per stem. These changes suggest that the first high decrease in population density between the first and the second sampling resulted from the high mortality of newly hatched larvae. A second peak of mortality was observed between the third and fourth samples, which highly reduced the populations of older larvae (mainly 4th instars). There is some evidence that at least this late mortality was caused by virus infection. Indeed, all the dead larvae found in the stems (about 10% of larvae in the third sample) died from virus infection. Most of the dead larvae were however not found because the sick larvae generally tend to leave the stem before dying.

Efficacy of the virus suspension

The analysis of variance of the sample taken one week after the first spraying (Figure 2) showed no significant treatment effect on larval populations (F[4,24]=2.18, p=0.101) but a significant block effect (F[6,24]=2.63, p=0.042). Indeed two blocks (3 and 4) had very low infestation levels in this sample, and particularly, the very low larval density observed in the control plots (0.15 larva/plant in both plots) prevented from detecting any treatment effect. When these two low infested blocks were removed a significant treatment effect appeared (F[4,16]=4.01, p=0.019). The Newman-Keuls test showed then that two treatments (T2 and T3) were significantly different from the control at the level p=0.05 and the other two treatments (T4 and T5) lay between the control and the aforementioned treatments.

The analysis of variance of the sample done one week later (Figure 3) showed a significant treatment effect (F[4,24]=6.86, p=0.0008) and no block effect (F[6.24]=1.21, p=0.33). The Newman-Keuls test showed that the chemical insecticide and the virus insecticides were not different and had all significantly lower population densities than the control.

Similar results were found again one week later, in spite of the severe reduction of population density in the control (Figure 4) (treatment effect: F[4,24]=5.45, p=0.011, block effect F[6,24]=0.99, p=0.46).

In this experiment, the population density of *S. cretica* in the control was fairly low during the first two weeks after spraying, slightly less than one borer per stem, then decreased suddenly to a very low level. Such low densities and the aggregative distribution of larvae made it difficult to get an accurate estimation of the infestation level. This was compensated by sampling a high number of plants (140 plants per treatment). However, in spite of this high sampling rate, the sample taken one week after the first spray showed very low infestation in the control plots of two blocks, which prevented from showing the efficacy of the treatments. However, in the other blocks the treatments were efficient and this was confirmed by the two next samples. No significant difference was noticed between the chemical insecticide and the virus suspensions. This shows the great efficacy of the virus sprayings since population density was reduced by about 70% in comparison with the control.

Several authors got promising results, not different from the chemical insecticide, when spraying Granulosis virus against pests, such as for instance Caballero *et al.* (1991) against *A. segetum* in maize, Glen and Payne (1984) and Jaques *et al.* (1994) against *C. pomonella* in orchards.

With the particular case of *S. cretica* that lays its egg-masses well-protected under the leaf-sheaths and where larvae enter directly into the whorl without wandering on the leaves, an efficacy of the virus suspension similar to that of a systemic insecticide like methomyl seemed difficult to reach. However, the tentative results presented hereabove show that a good exposure and direct contact between the virus and the larvae was achieved and that the virus suspension applied at a suitable time reduced quickly the populations of newly hatched larvae, in a way not different from, and nearly similar to, that of the chemical insecticide. The considerable efficacy of all the virus doses tested suggests that lower doses could probably be efficient. Further trials will be carried out to determine an optimal efficient dose.

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FIGURE CAPTIONS

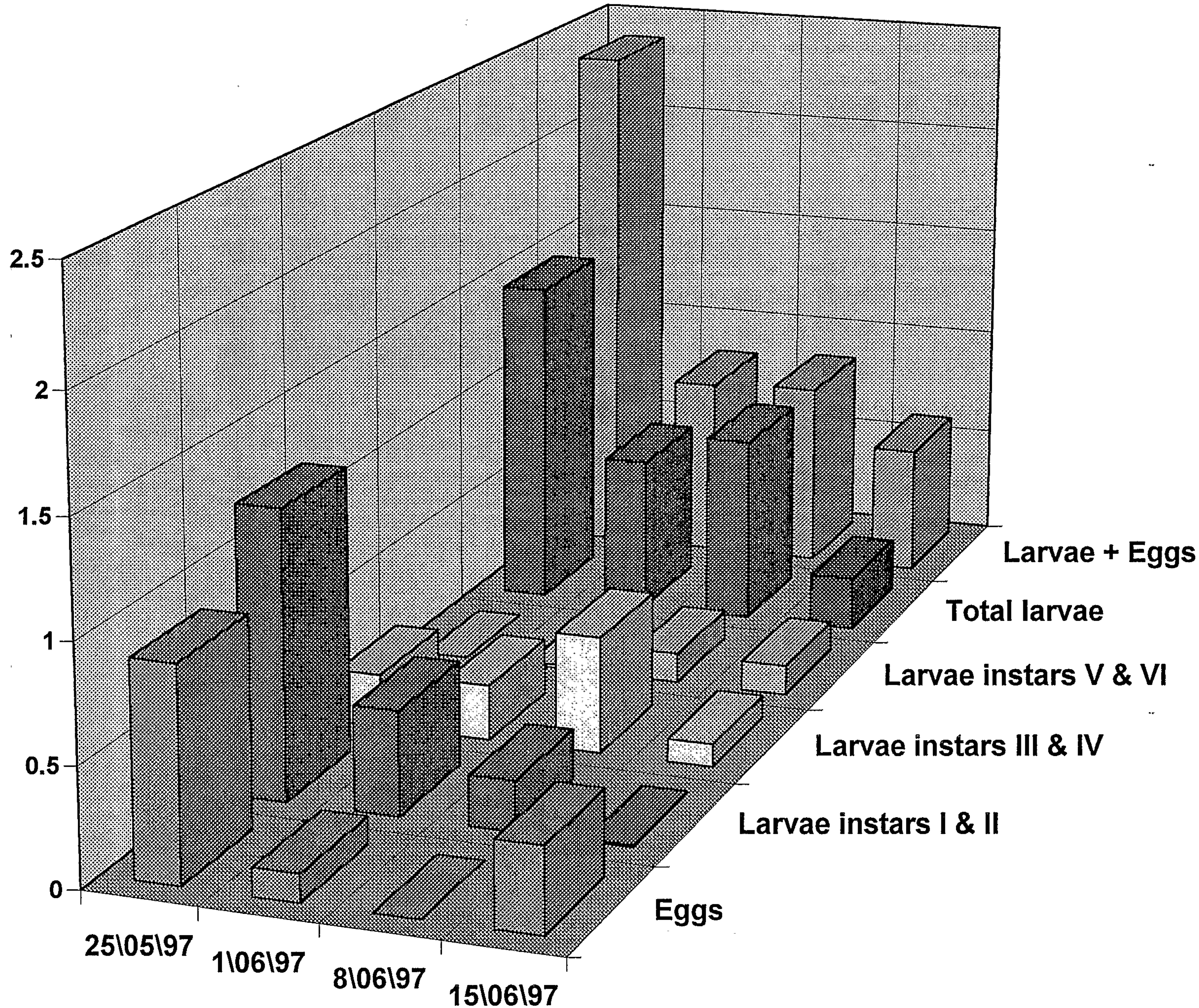
Figure 1: Changes in the number of borers per plant in the control.

Figure 2: Number of borers per plant in the different treatments one week after the first spraying (01 June 1997).

Figure 3: Number of borers per plant in the different treatments one week after the first spraying after removal of two little infested blocks (blocks 3 and 4) (01 June 1997).

Figure 4: Number of borers per plant in the different treatments two weeks after the first spraying (08 June 1997).

Figure 5: Number of borers per plant in the different treatments one week after the second spraying (15 June 1997).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Larvae + Eggs
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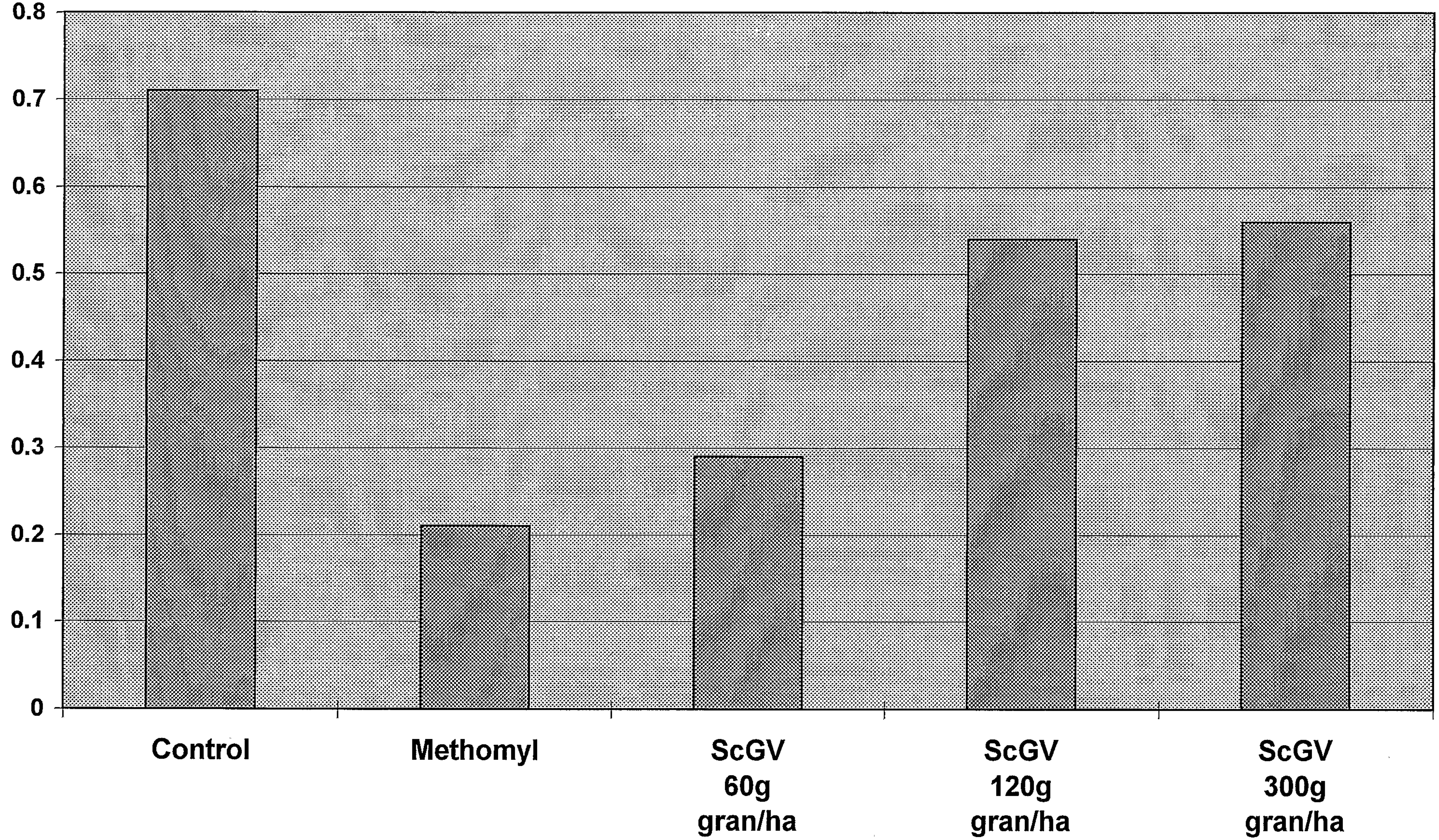
Larvae instars I & II
Eggs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Control
Methomyl
ScGV 60g gran/ha
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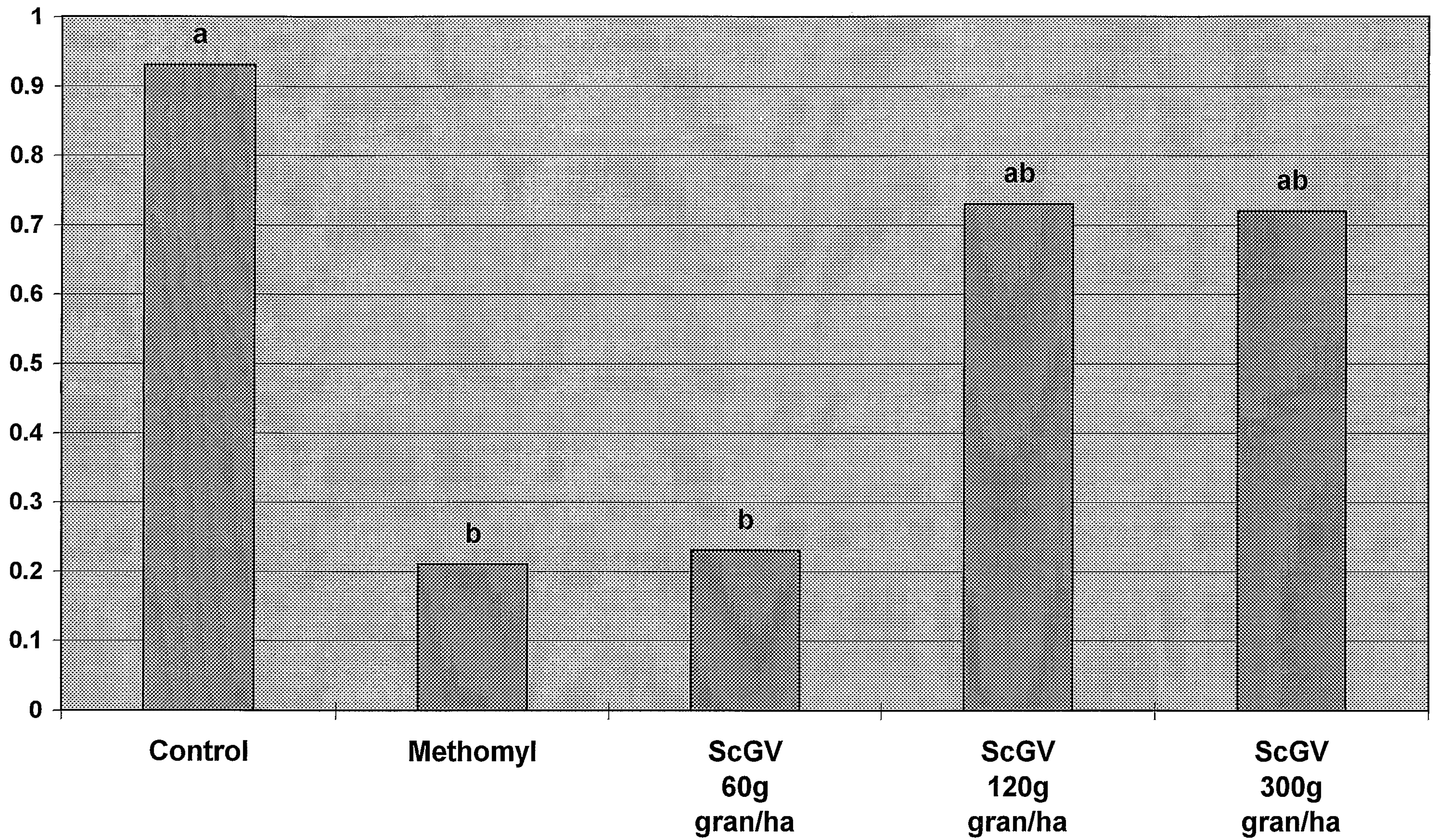
ScGV 300g gran/ha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Control
Methomyl
ScGV 60g gran/ha
ScGV 120g gran/ha
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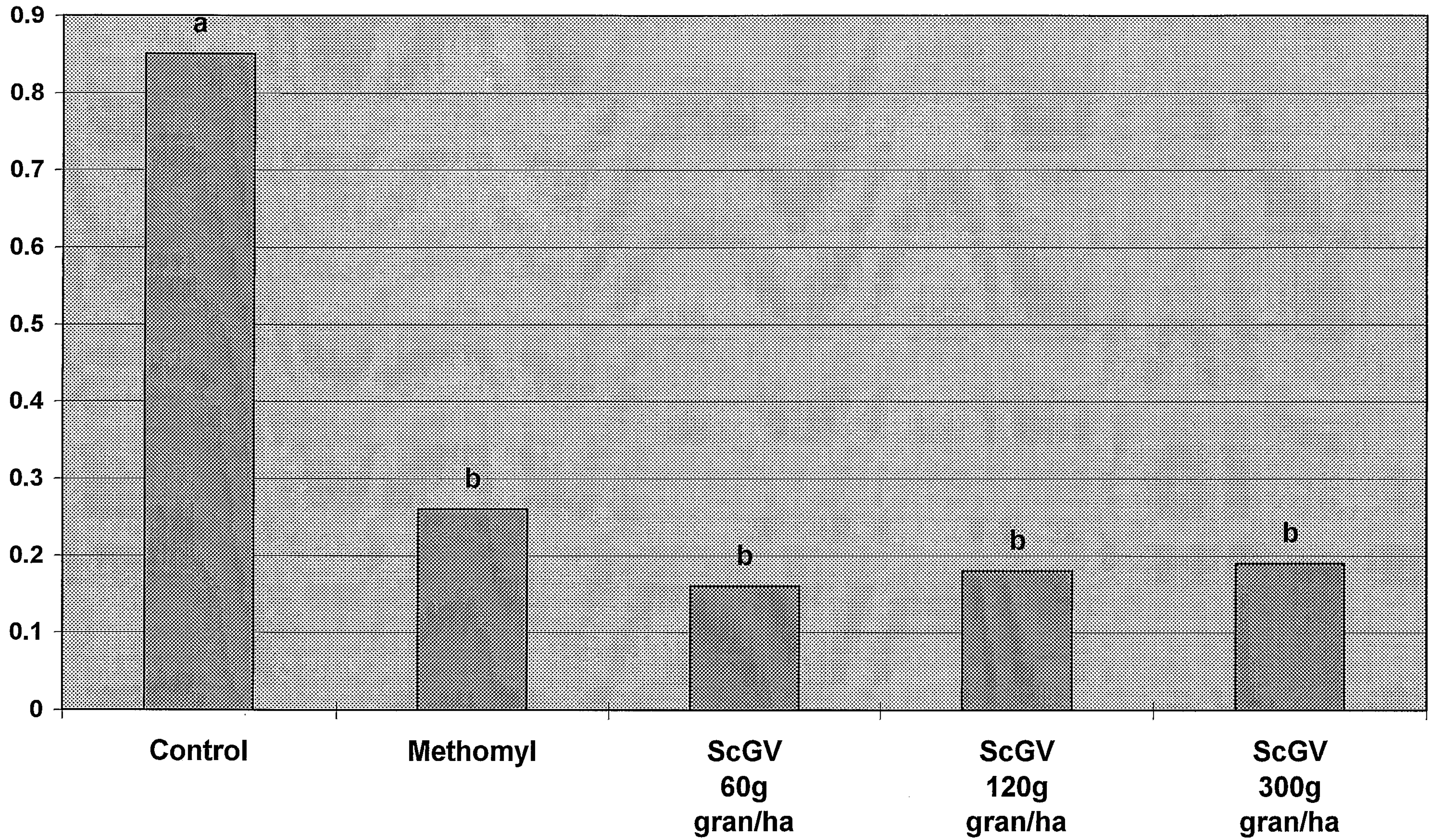
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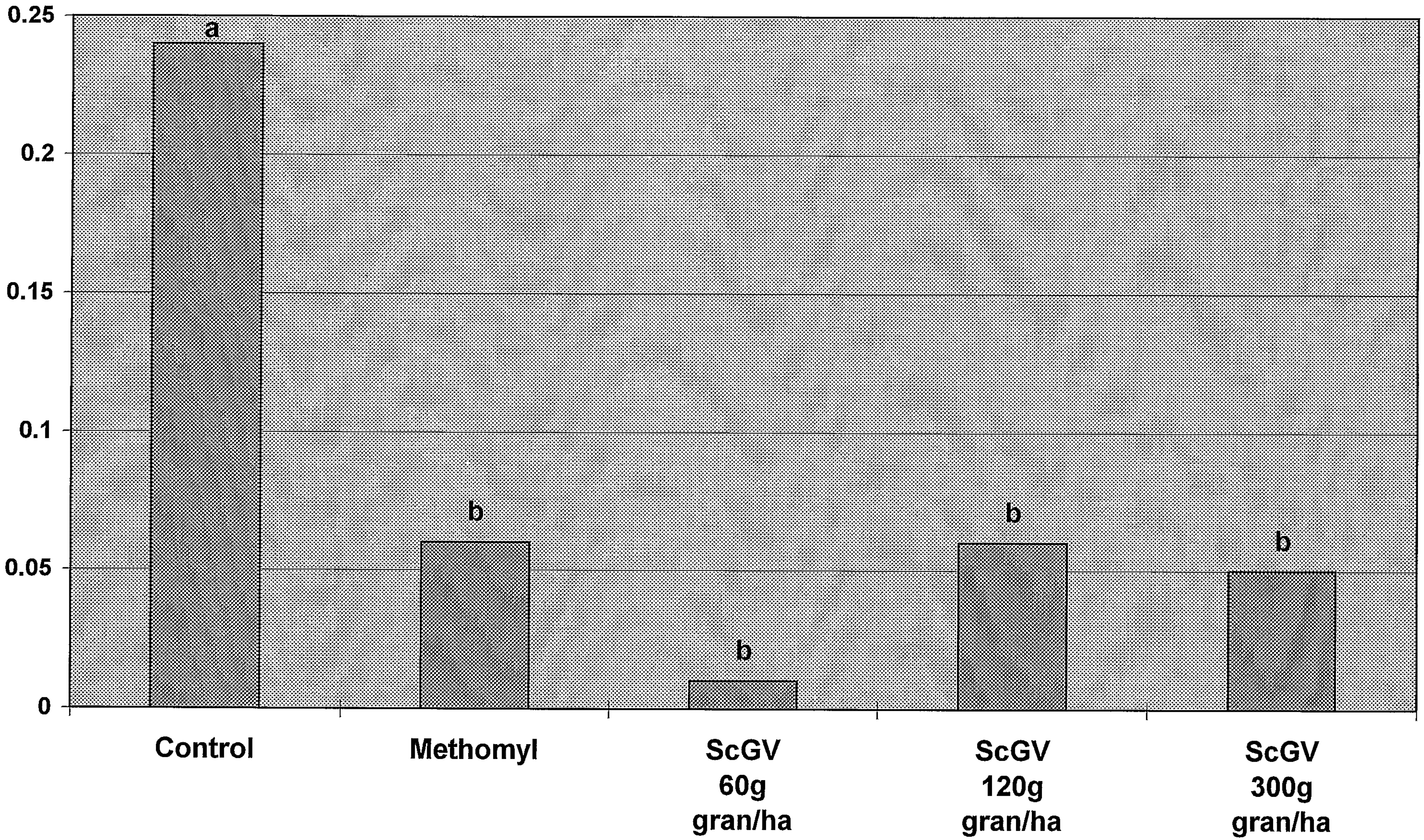

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ScGV 120g gran/ha
ScGV 300g gran/ha