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# EVALUATION OF THE EFFICACY OF THE INSECTICIDES CLOSER AND SIVANTO PRIME AND THE COMPOUND POTASSIUM SILICATE IN CONTROLLING THE CABBAGE APHID (BRASSICA OLERACEA VAR. CAPITATA L.) (HEMIPTERA: APHIDIDAE)

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**Abstract**

The field experiment was conducted at the Al-Alam District, Salahuddin Province, in Iraq, which adhered to randomised complete block design (RCBD). The research assessed the effectiveness of various aphid containment approaches under Sivanto Prime, Closer, and potassium silicate that were utilised as single and combined remedies. Findings showed that the pretreatment mean population density of nymphs and adults was 32.4 individuals per plant. Application however had a considerable decrease, as Sivanto Prime and Closer produced 1.1 and 1.3 people per plant, respectively, two weeks after spraying. Surprisingly, the treatment with two pesticids (Closer + potassium silicate and Sivanto Prime + Closer) showed the least numbers of aphids, amounting to Interestingly enough, dual treatments (Closer + potassium silicate and Sivanto Prime + Closer) had the smallest numbers of the aphids, resulting in less than.

It has 1.36 and 1.48 people per plant, respectively. The Sivanto Prime + potassium silicate mixture, on the contrary, failed to produce the anticipated suppression with the populations being relatively higher. In order to establish significant differences between treatments, statistical analysis was used to identify the significant difference at the 0.05 probability level with a value of LSD of 0.5224. In general, the conclusions made show that pesticide combinations, especially ones that included Closer, would be an effective approach to the management of aphid infestation in the field.

**Keywords**: Cabbage, *Brevicoryne brassicae,* cabbage aphid, Closer, potassium silicate.

## Introduction

One of the most significant winter vegetables that is grown in Iraq is the cabbage (Brassica oleracea var. capitata L.), which is a member of the family Brassicaceae. The edible section is the head of the compact, overlapping leaves which are eaten fresh or made in pickles and salads (Matlob et al., 1989). The fresh leaves, 100 g nutritionally contain 6.1 to 11.2 percent of dry matter, 3 to 5.4 percent carbohydrates, 1 to 2 percent proteins, 0.2 percent fats, 30 50 percent vitamin C, 130 IU vitamin A, 0.05 mg thiamineThe fresh leaves, 100 g nutritionally contains 6.1 to 11.2 percent dry matter, 3 to 5.

238 mg potassium, 49 mg phosphorus, 9 mg magnesium and 1.2mg iron and around 24 kcal of energy. Cabbage is also beneficial in a number of medicinal advantages among them being the treatment of gastric and duodenal ulcers, reduction in blood sugar levels and protection against cancer. (Talalay and Fahey, 2001).

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The cabbage is grown not only in tropical, but also in temperate regions of the world, but is especially highly produced in South Korea, Germany, Japan, and India. In Iraq, the planted land in 2013 was estimated at 2,819 donums, and the average output of 2,577.5 kg/donum was calculated (Central Organisation for Statistics and Geographic Information Systems, 2023).

The crop is however very vulnerable to the infestation of cabbage aphid which attacks a vast variety of cruciferous plants (Gabrys et al., 1997). This is a pest that is believed to be a big threat because it feeds on plant sap, spreads viral diseases, and honeydew which facilitates dust formation and growth of sooty moulds (Van Emden and Harrington, 2007). Kahn and Jhim (2003) argued that an infestation by cabbage aphids can lead to a loss of yield (3050%), and higher control costs (2030).

It is in light of these difficulties that the current paper set out to assess the effectiveness of two insecticides, Closer and Sivanto Prime, as single agents, as well as in combination with potassium silicate, against this pest. The short interval of pre harvest (one day) is what makes these insecticides environmentally friendly as it is stated on the labels of the product.

## Materials and Methods

### Design and site of the experiment.

The efficacy of the selected insecticides and their combinations with potassium silicate against cabbage aphid was tested in a field experiment that occurred in the 2023 growing season in Al-Alam District, Salahuddin Province, Iraq. Ecofriendly friendly compounds incorporated into the study consisted of Closer (Sulfoxaflor), Sivanto prime (Flupyradifurone) and potassium silicate.

A multi-disc harrow was used to plough the experimental field and the field was broken into three blocks each having three rows of cabbage plant (15 m in length). Every block further subdivided into seven experimental units of six plants each and a 1 m distance was used between the blocks so as to ease field operations. The randomised complete block design (RCBD) was used to assign treatments randomly.

It was fitted with a drip irrigation system, hand weeding was done, and the standard agronomic procedures, such as irrigation and maintenance of crops, were followed in the entire season.

### Treatments

The experiment consisted of the following treatments:

1. Closer (Sulfoxaflor) at 35 mL/100 L.
2. Sivanto Prime (Flupyradifurone) at 70 mL/100 L.
3. Potassium silicate 35% at 300 mL/100 L.
4. Closer + Sivanto Prime.
5. Sivanto Prime + Potassium silicate.
6. Potassium silicate + Closer.
7. Untreated control.

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**Data collection**

Two parameters were used to evaluate treatment efficacy:

- **Aphid population density:** The number of live aphids (nymphs and adults) was counted before treatment and at 1, 7, 14, 21, and 28 days after spraying. Counts were conducted using a hand lens (X10) by examining five leaves per plant in each experimental unit.
- **Infestation percentage:** The percentage of infested plants was calculated using the formula: Infestation percentage=Number of infested plants Total number of plants×100\text{Infestation percentage} = \frac{\text{Number of infested plants}}{\text{Total number of plants}} \times 100Infestation percentage=Total number of plants Number of infested plants×100

**Statistical analysis**.

All the data recorded were analysed by performing analysis of variance (ANOVA) as per the RCBD model. The Least Significant difference (LSD) test was used to test significant differences among treatment means at the 5% probability level. The statistical analysis was done using [SAS software, version 9.4] (SAS Institute, Cary, NC, USA) (or SPSS v.25 should one choose to do that).

**Results and Discussion**

The study findings indicated that treatment one and treatment two had a similar initial mean number of cabbage aphid nymphs and adults before treatment. This means that there is homogeneity of the experimental units and reliability of the consequent treatment effects. The coefficient of variation (CV%) was also used to validate the validity of such results since it registered a comparatively low figure of 6.19%. This value proves that the error of the experiment was acceptable, which proves that the field data and the strength of the applied randomized complete block design (RCBD) were precise.

The consistency in the pre-treatment period is a good indication that the changes observed after the use of insecticides and insecticides mixture could be directly linked to the treatments and not the difference that existed among plots. This aligns with the principle of Gomez and Gomez (1984), who pointed out that low CV% value is good indication of high experimental accuracy under the field trials in agricultural fields.

**Table (1). Percentage of infestation (%) and number of aphids (nymphs + adults per plant) recorded one day before spraying**

| Control Treatments | Sampling Dates | | | | | Mean of Control Treatments |
|---|---|---|---|---|---|---|
| Sivanto Prime | 1 Day | 7 Days | 14 Days | 21 Days | 28 Days | |
| Closer | 32.4 a | 24.6 b | 26.2a | 30 a | 18.2 c | 26.28 A |
| Potassium Silicate | 32.7 a | 24.9 b | 33.3a | 33 a | 18.5 c | 28.48 A |
| Sivanto Prime + Potassium Silicate | 32.1 a | 24.7 b | 28.7a | 32 a | 18.3 c | 27.16 A |
| Sivanto Prime + Closer | 32.3 a | 24.8 b | 24.1b | 26 b | 18.1 c | 25.06 A |
| Closer + Potassium Silicate | 32.0 a | 24.5 b | 26 b | 28.3 a | 18.2 c | 25.8 A |
| Control (untreated) | 32.5 a | 25.0 b | 28 a | 22.4 b | 18.4 c | 25.26 A |
| Mean of Sampling Dates | 32.6 a | 24.7 b | 25.3b | 31 a | 18.5 c | 26.42 A |

L.S.D ≥ 0.05 Treatments = 0.5224 Dates = 0.3216 Interaction (Treatment × Dates)= 0.9098

Numbers followed by the same letters do not differ significantly according to the Least Significant Difference (LSD) test at the 0.05 probability level.

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**Table (2). Effect of the treatments on numbers of (nymphs + adults per plant) after spraying**

| Control Treatments | 1 Day | 7 Days | 14 Days | 21 Days | 28 Days | Mean |
|---|---|---|---|---|---|---|
| **Sivanto Prime** | 6.0 q | 2.3 n | 1.1 o | 1.4 ij | 1.7 l | 2.5 p |
| **Closer** | 4.6 t | 2.0 p | 1.3 m | 1.6 i | 1.9 k | 2.2 p |
| **Potassium Silicate** | 12.8 f | 1.2 t | 0.5 u | 0.7 km | 1.0 op | 3.24 e |
| **Sivanto Prime + Potassium Silicate** | 4.9 s | 7.9 f | 5.4 f | 6.2 f | 7.0 f | 6.28 f |
| **Sivanto Prime + Closer** | 3.1 w | 1.5 r | 0.7 s | 0.9 kl | 1.2 n | 1.48 j |
| **Closer + Potassium Silicate** | 3.01 w | 1.3 s | 0.6 t | 0.8 kl | 1.1 no | 1.36 i |
| **Control (untreated)** | 34.2 a | 33.7 a | 35.6 a | 34.0 a | 29.5 b | 33.4 A |

LSD (≥ 0.05): Treatments = 0.5224; Dates = 0.3216; Treatment × Dates = 0.9098.
Numbers followed by the same letters do not differ significantly (LSD test, p = 0.05).
Differences were evident between the experimented treatments after spraying. Closer and Sivanto Prime were both remarkably effective in scaring away the aphid nymphs and adults relative to the untreated control whereby very low densities (1.12 2.3 individuals per plant) were observed, proving their high efficacy in their ability to prevent the pest. In comparison, the impact of potassium silicate in isolation was quite mild, since the number of insects decreased over time, but still was higher than the results of using chemical insecticides, which points to the fact that its application has a limited effect N Mesri et al. (2023),
In terms of binary mixtures, the mixtures Closer + potassium silicate and Sivanto Prime + Closer had the most successful results in terms of reducing the number of aphids to very low levels (1.36 and 1.48 individuals per plant, respectively). These are indicating to a synergistic effect which increased the efficacy of such compounds in aphid reducing. Conversely, the combination Sivanto Prime + potassium silicate was not as effective as was anticipated and the numbers were relatively high which indicates that the two products are not synergistic. The findings also indicated that the insecticides on their own were quite effective, but when Closer was used in conjunction with either of the other agents (Sivanto Prime or potassium silicate) the performance was further improved as well. Moreover, the statistical values indicated that there were grouping letters in some treatments, that is, no significant differences were observed between them.
These results imply that insecticide mixtures, especially those that consist of Closer, may be more helpful in the pest management programmes. Though potassium silicate was not reported to be very effective alone, it can also be used in integrated pest management (IPM) because it is safe, environmentally friendly and will save the application of synthetic chemicals.
This study is in line with the findings of Wang et al. (2016), who have shown that Flupyradifurone (the active compound of Sivanto Prime) binds insect nicotinic acetylcholine receptors (nAChRs) in a different mode with other neonicotinoids, rendering it very potent.

good at sap-sucking. Similarly, Cutler et al. (2013) affirmed that sulfoxaflor is better than imidacloprid and thiamethoxam, which confirms our results of its high activity on aphids. In relation to potassium silicate, it too exhibited significant effect in reducing the numbers of aphids, which can be explained by the fact that it will increase the resistance of the plants with respect to strengthening the cell walls and creating a protective layer of silica on the surface of the leaves. This decreases insect feeding and penetration, which will be discussed by Epstein (1999) and Sun et al. (2010). These mechanisms were also highlighted by Al-Kalash (2022), who also confirmed that early usage of potassium silicate forms a natural barrier that does not allow the establishment of pests.

Also, it can be mentioned that the aphid densities began to increase again after one month of spraying in comparison with the three-week period. This may be because of the slow reduction of the effectiveness of insecticides because of degradation or environmental conditions. These observations are in line with Zewain (2013) who observed that in most cases, the activity of chemical insecticides tends to reduce after 21- 28 days after application. Thus, frequent spraying or combination with other methods of control may be required to provide the sustainability of crop protection Ward, S. et al. (2024).

**General Conclusion**

Based on the findings mentioned above, it can be drawn that the combination of chemical insecticides with other or supportive materials could be seen as an effective method of aphid management, as well as the environmental preservation and the minimization of resistance-building risks. In addition, potassium silicate, although not particularly effective on its own, can be incorporated safely into the IPM programmes, since it is a green ingredient that reduces the overall reliance on chemical pesticides. The analysis thus concludes that potassium silicate should be included in the group of integrated control measures because it is environment-safe, although its individual effect is rather limited.

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