

## EFFICACY OF BIOSTIMULANTS AGAINST CABBAGE STEM FLEA BEETLES IN WINTER OILSEED RAPE UNDER FIELD CONDITIONS IN THE UK

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### Abstract

*This field study evaluated the efficacy of Yokosan and Converta biostimulants in mitigating cabbage stem flea beetle damage on winter oilseed rape (cv. Acacia). Treatments included control (no biostimulants) and varying doses of Yokosan (0.5, 1, and 2 L/ha) and Converta (1, 2, and 4 L/ha), applied at cotyledon, 6-leaf, and 8-leaf stages. The randomised complete block design included four replicates, with biostimulants applied at 300 L/ha per spray. Both biostimulants reduced beetle damage significantly compared to controls, which showed severe damage (60–70% of new growth affected). Yokosan was particularly effective at 1 L/ha, while Converta at 4 L/ha minimised leaf infestation (6.95 leaves/plant) and stem infestation (8%). Yokosan performed best at 0.5 L/ha for reducing stem larvae, though higher rates offered no further improvement. Conversely, Converta displayed dose-dependent efficacy for reducing beetle activity and infestation. Results suggest Yokosan and Converta can enhance plant health and resistance, with Converta at 4 L/ha emerging as the optimal treatment. These findings emphasise the importance of dose optimisation for integrated pest management strategies.*

**Key words:** biostimulants, Yokosan, Converta, cabbage stem flea beetles, winter oilseed rape, pest management, dose rates.

### INTRODUCTION

Oilseed rape (*Brassica napus*) is a key crop in the UK. It is grown for its oil, animal feed, and as a break crop to reduce pathogen and pest in cereal dominated rotations (Nicolls, 2016). Globally, it is the third-largest source of vegetable oil (Hegewald et al., 2018) and the second-largest source of protein meal (AHDB, 2023). In the UK and much of Europe, oilseed rape ranks as the third most widely grown crop after wheat and barley, and the fourth most productive arable crop following wheat, barley and oats (Defra, 2024).

A major threat to oilseed rape cultivation is the cabbage stem flea beetle (CSFB, *Psylliodes chrysocephala*), a stem mining pest, which attacks the crop during its establishment, significantly reducing yield and quality. Losses can exceed 20%, valued at over £120 million annually. Narrow profit margins have led to a more than 60% decline in UK oilseed rape cultivation in 2020 (Withall et al., 2024). It can also damage other brassica crops such as

turnip, mustard and cabbage (Ahuja et al., 2011).

Adult CSFB feed on young OSR plants in autumn, while larvae mine within the petioles and stems until pupation in spring. Heavy feeding by adults can kill young plants if pest pressure is high. Controlling the pest is increasingly difficult due to limited effective treatments. The EU ban on neonicotinoid seed treatments in 2013 exacerbated the issue, further compounded by widespread resistance to pyrethroids, the only remaining conventional insecticides used for its control (Willis et al., 2020; Hoarau et al., 2022; Rude et al., 2025).

Given these challenges, sustainable and environmentally friendly pest control alternatives are urgently needed. Many farmers have abandoned oilseed rape due to persistent pest pressure, but improved crop management practices could help mitigate damage. Companion planting, for example, has been shown to reduce cabbage stem flea beetle damage (Admin, 2024). Another promising approach is the use of plant biostimulants, which could offer an eco-friendly alternative to

synthetic pesticides (Rouphael and Colla, 2020).

Biostimulants contain a wide range of products used in agriculture to increase productivity, nutrient use efficiency, and improve plant tolerance to biotic and abiotic stresses (Bulgari et al., 2015). They can contain natural substances from plants and animals, as well as microorganisms. Due to their complex nature, often consisting of multiple molecules, identifying the specific active components responsible for their benefits on crops remain challenging (Yakhin et al., 2017). Moreover, their effects are not always consistent among the plant species (Bartwal et al., 2015). Their efficacy primarily depends on careful management before, during, and after application, depending on the biostimulant type. Biostimulants can, however, offer a promising alternative to agrochemicals, which can harm the environment and pose significant health risks to both humans and animals (Mojumdar et al., 2022).

To explore potential cabbage stem flea beetle control strategies, two biostimulants, Converta and Yokosan, were investigated for their ability to enhance oilseed rape resilience under field conditions. Converta is a specialised biofertiliser enriched with nitrogen-fixing, phosphorus-solubilizing, and potassium-mobilising bacteria. It unlocks the nutrients present in the soil, reducing the need chemical fertilisers. It has been developed to enhance plant nitrogen uptake, boost beneficial microbial activity and improve soil fertility to support plant growth. Yokosan is an organic liquid biofertiliser formulated with potassium humate, amino acid, and seaweed extract. It is enriched with beneficial microorganisms and a blend of macro- and micronutrients to promote plant health and productivity. The study compared biostimulant oilseed rape treated plants with an untreated control group to assess their effectiveness in managing cabbage stem flea beetle in oilseed rape.

## MATERIALS AND METHODS

The study assessed the effectiveness of Yokosan and Converta biostimulants in managing the cabbage stem flea beetle on winter oilseed crop (cv. Acacia) under field conditions planted in August 2023. Yokosan

was applied at 0.5, 1 and 2 L/ha, while Converta was applied at 1, 2 and 4 L/ha. Each rate of Yokosan and Converta biostimulants was applied at cotyledon, six leaf, and eight leaf stage. All applications were applied at a spray volume of 300 L/ha per application with the knapsack sprayer. The control plots received no biostimulants.

The trial was set up in a randomised complete block design with four replications. Each plot was 3 m wide and 20 m long. Assessments included beetle damage on new growth, number of leaves infested, and larval infestation in stems and leaf petioles. Beetle damage on new growth was assessed by observing biting spots on at least 10 randomly selected plants per plot 7 days after an application. In mid-February, 10 plants per plot were randomly collected and their leaf petioles and stems were dissected to count larvae using a magnifying glass. Data were analysed using one-way analysis of variance (ANOVA) in Minitab. Tukey's test was applied to separate any treatment differences when ANOVA was found to be significant at the 5% probability level.

## RESULTS AND DISCUSSIONS

Two biostimulants, Converta and Yokosan, were investigated as potential solutions to enhance plant resilience against cabbage stem flea beetles. The key findings are discussed below.

### Cabbage stem beetle (csfb) damage on new growth

The percentage of new growth damaged by cabbage stem flea beetles following the biostimulant application at 6 and 8 leaf stages is presented in Figure 1.

Both Converta and Yokosan biostimulants, applied at different rates, significantly reduced beetle damage on new growth compared to the control. In the control group, 60-70% of new growth showed beetle damage. The damage decreased with higher biostimulant application rates, with Yokosan proving more effective than Converta. The lowest damage was noted in Yokosan plots treated at 1 L/ha. While Converta also reduced damage, its effect was slightly less pronounced at higher rates.

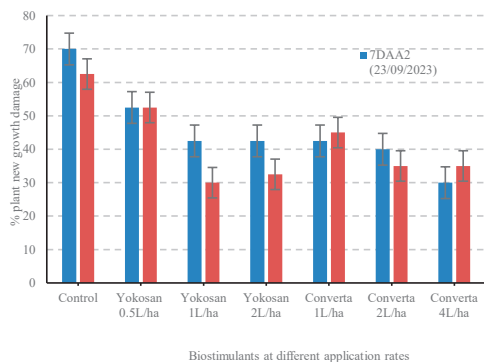


Figure 1. The effect of biostimulants applied at different rates at 6 leaf stage and 8-leaf stage on new growth of the oilseed rape under field conditions, planted in August 2023 ( $P = 0.017$  &  $0.036$  at 6 leaf stage and 8 leaf stage, respectively). Control plots received no biostimulants. Three applications of each rate of Yokosan and Converta biostimulants were made at cotyledon stage, 6 leaf stage and 8 leaf stage, with a spray volume of 300 L/ha per application. New growth damage was recorded 7 days after application at both leaf stages. Error bars represent the standard error of means ( $n = 10$ )

The reduction in beetle activity may be attributed to better overall plant health, induced systemic resistance, increased nutrient uptake or a combination of all, making the plants less palatable or more resistant to beetle attack. Additionally, the biostimulants may have altered cell sap composition or taste, reducing plants less susceptible to beetle attack. More likely, the potassium-mobilising bacteria in Converta following application, may have enhanced potassium availability and uptake, consequently improving the plants' ability to withstand or deter beetle attack. This could also involve the production of secondary metabolites that acted as deterrents.

Plant secondary metabolites play a crucial role in plant-environment interactions and defence. They contribute to resilience against biotic and abiotic stresses by acting as phytoalexins, signal molecules and antioxidants (Bartwal et al., 2013). Additionally, biostimulants may have facilitated enhanced nutrient uptake and utilisation (Yakhin et al., 2017; Bhupenchandra et al., 2020), thus leading to stronger and more resilient plants that are less susceptible to damage.

#### Plant leaves infested with beetle larvae

The average number of plant leaves infested with cabbage stem flea beetle larvae by mid-

February are summarised in Figure 2. Although statistically non-significant ( $P = 0.263$ ), all biostimulant treatments reduced larval infestation compared to the control, indicating a potential positive impact on pest management. The 1 L/ha treatment had the highest larval infestation rate among the Yokosan treatments, with an average of 9.05 infested leaves per plant. The 0.5 L/ha and 2 L/ha treatments showed slightly lower infestation levels, at 8.30 and 8.72 infested leaves per plant, respectively. There was, however, no clear trend suggesting that higher rates of Yokosan significantly reduced leaf infestation.

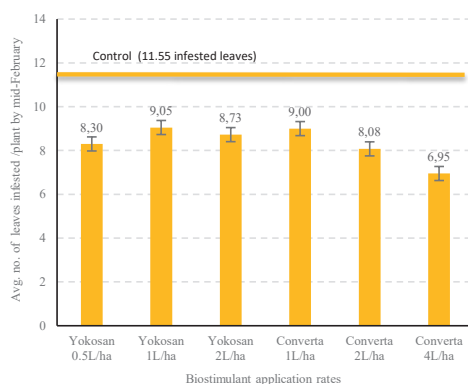


Figure 2. The effect of biostimulants applied at different rates on the number of OSR plant leaves infested with cabbage stem flea beetles' larvae by mid-February, planted in August 2023 ( $P = 0.263$ ). Control plots received no biostimulants. Three applications of each rate of Yokosan and Converta biostimulants were made at cotyledon stage, 6 leaf stage and 8 leaf stage, with a spray volume of 300 L/ha per application. Error bars represent the standard error means ( $n = 10$ )

In contrast, Converta showed a decreasing trend in the number of infested leaves with increasing rates. The 4 L/ha Converta treatment appeared to be the most effective rate, with only 6.94 infested leaves per plant, followed by the 2 L/ha treatment, with 8.07 infested leaves per plant. The 1 L/ha treatment had an average of 9 infested leaves per plant, which is comparable to the control group.

Overall, the results indicate that higher biostimulants rates generally led to lower leaf infestation levels, with Converta at 4 L/ha being the most effective treatment, indicating a dose-dependent effect. The higher rate might

have increased nutrient availability and uptake (Bhupenchandra et al., 2020), promoting healthier plants and enhancing resilience against adult beetles and larvae during the establishment phase. Additionally, the increased rate might have triggered physiological defence mechanisms in the treated plants, such as changes in sap composition and taste, making them less palatable to adult beetles and subsequently reducing larval infestation.

### Beetle larvae in petioles and stems in mid-February

A summary of the mean number of cabbage stem flea beetle larvae found in the petiole and stem in mid-February is shown in Figure 3.

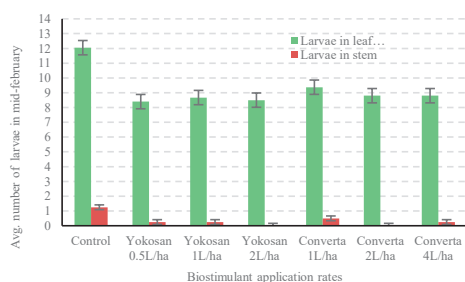


Figure 3. The effect of biostimulants applied at different rates on the number of cabbage stem flea beetle larvae found in the leaf petiole ( $P = 0.945$ ) and stems ( $P = 0.247$ ) of oilseed rape in mid-February, planted in August 2023. Control plots received no biostimulants. Three applications of each rate of Yokosan and Converta biostimulants were made at cotyledon stage, 6 leaf stage and 8 leaf stage, with a spray volume of 300 L/ha per application. Error bars represent the standard error of the means ( $n=10$ )

There were no significant differences between treatments for larvae in petioles ( $P = 0.945$ ) and stems ( $P = 0.247$ ). On average, both biostimulants, Yokosan and Converta, were effective in reducing the cabbage stem flea beetle larvae numbers compared to the untreated control. Among the two, Yokosan appeared to be more effective in reducing larvae. Interestingly, the lowest application rate of Yokosan (0.5 L/ha) was more effective than higher rates. This suggests that there might be an optimal dose rate for Yokosan where it is most effective and increasing the rate beyond this would not further significantly enhance its effectiveness against the larvae. It is also postulated that Yokosan treated plants might

have triggered a strong immune response, thus reducing larval infestation in leaf petioles and subsequently in the stems. For Converta, there was a slight trend indicating that higher application rates may be more effective, but the differences were not noticeable. This might imply that beyond a certain point, increasing the rate may not substantially improve Converta's effectiveness in reducing larvae. Additionally, the results suggest that Converta treated plants, regardless of application rate, may have undergone physiological changes that enhanced their resilience to larval attack. Since newly hatched larvae feed on the stems and lower petioles over winter and into spring (Willaims, 2004), these changes may have contributed to reduced petiole and stem infestation during the establishment phase.

### CONCLUSIONS

This study indicates that biostimulants have the potential to enhance plant resilience and reduce cabbage stem flea beetle damage in oilseed rape. Yokosan was more effective overall, with optimal rate at 0.5 L/ha, while Converta showed a dose dependent reduction in infestation, with 4 L/ha being the most effective. Further research is, however, needed to validate their effectiveness and optimise application strategies, potentially providing a sustainable pest management solution for oilseed rape growers.

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