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Genetic diversity and host-specific adaptation of *Beauveria bassiana* strains to improve efficacy against fall armyworm *Spodoptera frugiperda*

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Background

The fall armyworm (FAW, *Spodoptera frugiperda*) is a highly destructive insect pest that attacks maize and many other crops (Day et al., 2017; Goergen et al., 2016). Since its first detection in Africa in 2016, it has posed a serious threat to farmers and food security (Early et al., 2018). Farmers primarily rely on synthetic insecticides for their control, yet alternative and complementary strategies are urgently needed to reduce chemical dependence and environmental risks (Bateman et al., 2018; Tindo et al., 2021). This study aimed to (i) molecularly confirm the taxonomic identity of three indigenous *Beauveria bassiana* isolates obtained from insect hosts and soil (current study), (ii) assess how maize genotype influences fungal pathogenicity, and (iii) evaluate the infectivity and virulence of the three *B. bassiana* isolates under laboratory and field conditions.

Methods

- Sequencing of 18S rRNA gene and BLAST analysis.
- Laboratory bioassays on FAW larval instars 2 & 3
- Field Trials: Maize genotypes × fungal isolate Bb115

Results

- Bb11 and Bb115 from insects, and DL1.1 from soil were confirmed as *B. bassiana* showing ≥ 99% similarity to reference sequences (Fig. 1).

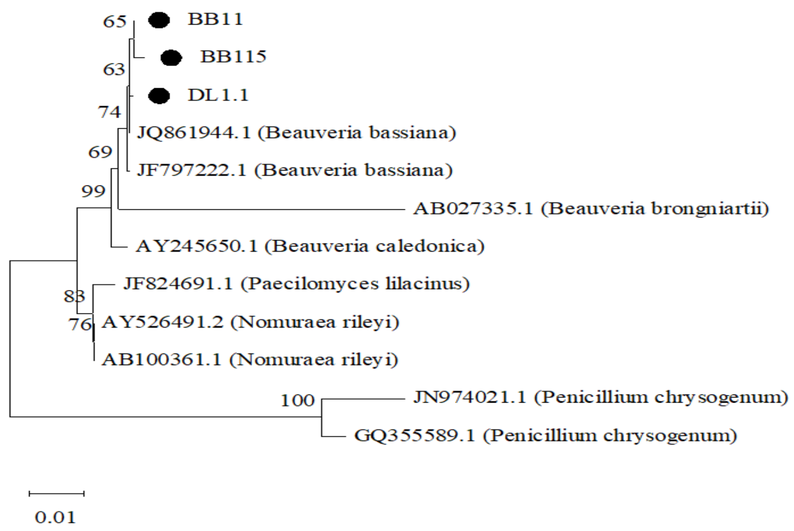

Figure 1. Phylogenetic analysis of *Beauveria bassiana* strains

- **Laboratory bioassays** : Bb115 caused highest mortality: L2 = 67% ± 3%, L3 = 45% ± 9% (Fig. 2).
- FAW larvae treated with Bb115 and Bb11 had shortest larval survival times (7.6 ± 0.5 and 9.5 ± 0.5 days). The soil isolate DL1.1 was less effective (12.9 ± 0.3 days), while the natural mortality time was 13.6 ± 0.3 days.

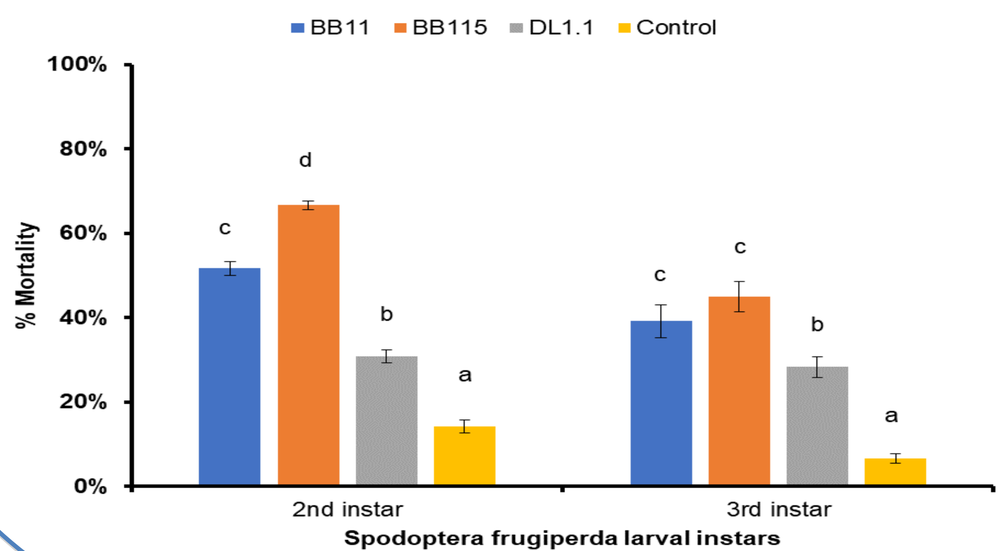

Figure 2. Mean mortality of FAW larvae under LAB conditions

Field evaluation showed:

- Variety effects: Significantly influenced FAW egg (p = 0.014) and larval counts (p < 0.001), with Faaba-QPM attracting more eggs and supporting higher larval densities than Kokoli Daneri (Fig. 3).
- Fungal inoculation (Bb115): Successfully colonized both maize varieties, infected FAW larvae, and strongly reduced egg laying (up to 95%) and larval numbers (up to 73%) (p < 0.001).
- Variety × fungal interaction: Significant for both eggs (p < 0.05) and larvae (p < 0.001), indicating that Bb115 suppression varied slightly between varieties but was effective in both.

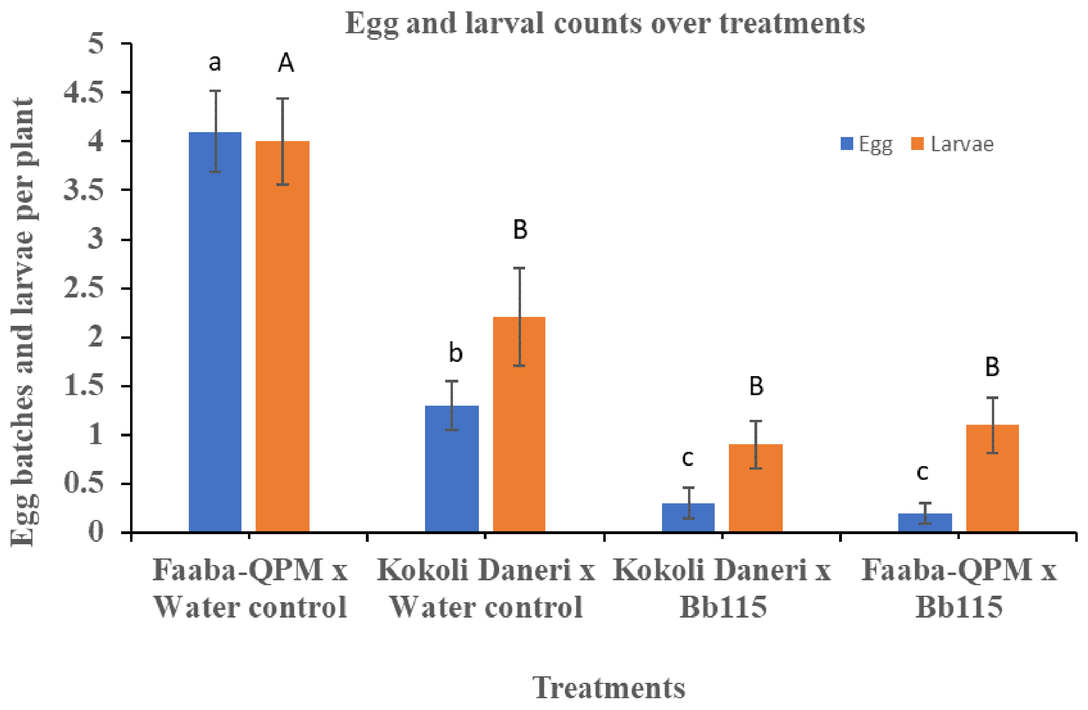

Figure 3. Mean FAW egg and larval counts under field conditions.
Egg and larval counts across maize varieties (Faaba-QPM, Kokoli Daneri) and treatments (water control, *Beauveria bassiana* Bb115). Bars show mean ± SE. Different letters indicate significant differences (Tukey's test, p < 0.05).

Conclusions and outlook

- Bb115 showed the highest virulence against FAW larvae in both lab and field experiments, significantly reducing egg laying and larval densities.
- Combining Bb115 with susceptible maize varieties will enhance FAW control, especially in varieties like the inbred maize Faaba-QPM.
- Future studies should explore Bb115's genetic basis of virulence, endophytic colonization, and long-term field performance for optimized IPM use.

Reference

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