Gefördert durch
Bundesministerium für Ernährung und Landwirtschaft
aufgrund eines Beschlusses des Deutschen Bundestages

Projektträger
Bundesanstalt für Landwirtschaft und Ernährung

UNIKASSEL VERSITÄT | ORGANIC AGRICULTURAL SCIENCES

Project title: Improving the resilience of faba beans to the pathogens causing legume fatigue and infestation by black bean aphids (*Aphis fabae*) and pea aphids (*Acyrthosiphon pisum*) (FABARobust)

Partners:

- Dr. Andreas Stahl (Coordinator) – JKI Quedlinburg
- Dr. Amine Abbadi – NPZ Innovation GmbH (NPZi), Holtsee
- Dr. Adnan Šišić – FB11, FÖP, UNIKASSEL

Period: 01.02.2025 - 31.12.2027

Overall Ambition:

Organic farming requires varieties that, in addition to superior agronomic and qualitative traits are characterized by highly effective resistances and tolerances. Also in conventional production systems a reduction in the use of chemical pesticides in line with the Green Deal is enforced and urgently requires an improvement in the resistance and tolerance profile of future varieties. Breeding offers the most ecologically and economically sustainable form of plant protection. However, the resistance/tolerance to factors such as legume fatigue and aphid infestation are extremely multi-layered, highly complex due to their interactions and largely not sufficiently understood. FABARobust addresses this need for action by systematically analyzing the two biotic stressors from a genetically diverse plant material by identifying adequate resistance/tolerance traits and narrowing down their genetic determinants. To this end, it is planned to carry out crosses between promising resistance donors with non-resistant elite varieties, which are at a high level in terms of criteria that are decisive for cultivation and relevant in practical farming. In this way, a multiparental mapping population will be established, which will be used for the genetic mapping of fungal resistance and, depending on the genetic architecture, will ultimately lead to the development of molecular markers or the estimation of genome-wide marker effects. Such

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knowledge should be further used in practical breeding and combined with excellent agronomic and qualitative traits in order to increase the biotic resistance of faba beans.

The project is divided into two parallel research strands to investigate resistance/tolerance to soil-borne fungal pathogens causing foot and root diseases (F) and to insect pests (S). The work packages F and S are linked by the superordinate breeding package (Breeding, B), which comprises the propagation of seeds, the establishment of populations and the molecular genetic characterization of the genotypes. In the Breeding work package, the NPZi will provide and upscale a diversity set and establish a multiparental mapping population. These collections will be genotyped using the Illumina iSelect 50k SNP chip and genome-wide markers will be used to identify chromosomal regions coding for the traits studied here.

Our role:

The University of Kassel, Section of Ecological Plant Protection (FÖP), is involved in Work Package F responsible for the collection and analysis of data on phytopathogenic foot and root diseases. The overarching goal is to evaluate and validate the resistance of various faba bean lines against soil-borne fungal pathogens, as well as to assess the screening system for predicting resistance to foot and root rot in the field. The aim is to provide breeders with a rapid selection tool already at the seedling stage.

A key involvement in the project is resistance screening tests in the greenhouse of approx. 200 faba bean genotypes, using pathogen-contaminated soil(s) in order to test a broad genetic diversity with regard to resistance to soil-borne phytopathogenic fungi. For this purpose, legume fatigue soil(s) will be used, on which legumes have been cultivated continuously for many years and show serious root rot disease problems. The most resistant and most susceptible reference genotypes will be selected for further artificial pathogen inoculation, with a focus on *Didymella pinodella*. Based on these results, in the second and third project year, field trials are conducted with resistant and highly susceptible reference varieties. These trials follow an alpha design with plot sizes of 1.5 x 8 m and four repetitions. The standard evaluations include assessments of root rot, emergence, weed infestation, flowering onset, root nodule index, biomass, and yield.

The identification and quantification of relevant fungal pathogens, as well as the content of arbuscular mycorrhizal fungi (AMF) in the roots of representative genotypes, are conducted at various stages of the project and include samples from other partners.

See also sister project: LegumeMIX.

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Expected outcomes:

FABA Robust offers multiple opportunities to apply the results in agricultural practice, particularly in organic farming. The project aims to improve resistance to soil-borne pathogens and aphids, which will lead to the identification of valuable genetic material that breeding companies can use as trait donors. Furthermore, the identification of relevant chromosomal regions responsible for the inheritance of traits, using markers developed in the project, will enable breeding companies to accurately test crossing parents and offspring. This will help avoid unproductive crosses in faba bean breeding and allow for the early identification of potentially resistant lines during breeding, thereby optimizing resource allocation to other important traits.

In addition, the findings from the testing methods will be utilized and can be applied to future research with federal and state institutions. Regular exchange formats between the partners and annual visits to field trials will ensure a continuous flow of information, facilitating the implementation of results into breeding practices. The dual focus of the project on fungal and insect resistance ensures the efficient use of research resources. The project aims to create synergies with the FABA initiative, which deals with abiotic stress, and enable effective networking between the two projects. This collaboration will enable breeders to make selection decisions that accelerate breeding progress.

See also sister project: **LegumeMIX.**