

BIOAG PROJECT FINAL REPORT

TITLE: Development of winter pea lines for intercropping purposes

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KEY WORDS: COLD TOLERANCE, NITROGEN FIXATION

ABSTRACT

The objective of the project was to identify pea lines that can be fall planted and will fix the maximum amount of nitrogen by early spring. Such lines would be suitable for intercropping with winter wheat over the winter and destruction by cultivation or herbicides to release nutrients to the developing wheat crop. The peas could also be used as a winter cover crop. The main difference between the lines under development and existing winter pea varieties will be the fact that they are selected for high N fixation as well as other traits that should enhance their utility for intercropping. We will also determine how much genotypic variation is present in winter pea lines for the ability to fix N and see if traits like early flowering and hypernodulation are associated with early spring N fixation.

PROJECT DESCRIPTION

The specific objectives of the proposal were to screen pea breeding lines segregating for traits potentially associated with good N fixation over the winter and to see if the traits actually contributed to N fixation over the winter and early spring. We hired undergraduate workers to dig plants in late May and early June from three different pea variety nurseries. The plants were then washed and the roots and shoots dried and weighed separately. After weighing, the tissues were ground and nitrogen contents were analyzed. In addition to biomass and N content, other traits were measured for the different pea lines to determine if there were associations with N fixation. Other traits that were analyzed included flowering time, winter survival and a genetic mutation (*nod3*) for hypernodulation. We also analyzed some of the pea lines for seed size since in an attempt to introduce a small seed size into the germplasm. A very small size is not an advantage for edible pea quality, but could be an advantage in costs for establishing a good stand for minimal costs since over 100 lbs of seed per acre are generally used to plant field peas.

OUTPUTS

- Work Completed:

Winter pea lines were analyzed as planned. Genetic variation for the amount of nitrogen fixed was observed among the experimental lines developed to segregate for various traits. Pilot experiments with the *nod3* mutation in a spring pea (variety *Rondo*) background had indicated it accumulated more N in the tissue than the wild type isolines. This was not observed in the winter pea backgrounds in the field. The reason for this was not clear, but it seems that there is more genetic variation segregating in the winter pea germplasm that can compensate for or overshadow the *nod3* gene effects. As would be expected, winter hardiness was associated with N fixation since pea lines that don't survive the winter don't fix N and those that are severely damaged have low levels of biomass in the spring. Flowering time was also not well associated with early spring N levels, as might be expected if the lines fixed N at a higher rate if they are beginning to flower. We have been working towards a very small seeded pea line that is suitable for winter green manures to reduce seed costs, hoping to achieve two or more times the number of plants per pound of seed. The current small seeded lines did not have the level of winter survival needed, so further crossing and selection will need to be performed.

Genetic variation for N fixation in the advanced pea lines from Rebecca's program was less apparent and both green pea and Austrian winter peas had less genetic variation than environmental variation. Green pea lines were identified that had very good winter survival, similar to or better than the Austrian winter pea lines. One line, designated PS03101269, had good early season biomass

and N content and excellent winter survival and will be suitable for experiments to determine the feasibility and economics of using peas to provide N to wheat crops in various systems.

- Publications, Handouts, Other Text & Web Products: None yet
- Outreach & Education Activities: The project has been introduced in grower talks to gauge support and get ideas.

IMPACTS

- Short-Term:

We have identified a good green winter pea line for experiments to determine the feasibility of intercropping with winter grains or winter cover cropping before planting spring grains.
- Intermediate-Term:

We have also identified good parents for the next cycle of breeding for the project, and have made crosses. We have also identified traits that we will select for in the future, like shoot N content and others that we will not, like root weight, root N content, and nodule number.
- Long-Term:

It will take some time to combine the traits identified into one or a few lines that should be optimal for winter intercropping or winter season green manures.

ADDITIONAL FUNDING APPLIED FOR / SECURED: None yet. The project is probably not appropriate for funding by the pea commission at this point because they are not very interested in non-food use of peas. Programs that fund organic agriculture research may be more appropriate after some pilot experiments are conducted with one or more of the best pea lines identified.

GRADUATE STUDENTS FUNDED: Three summer undergraduates were only personnel.

RECOMMENDATIONS FOR FUTURE RESEARCH:

Experiments to determine the practicality of growing winter peas either with winter wheat or before planting spring wheat should be performed in the higher rainfall eastern Palouse region. The PS03101269 line should be suitable for these purposes. The spring wheat system might be more appropriate for organic production since the peas can be tilled in before planting and should provide N for the current crop. If a winter pea system is tried, the peas could be eliminated by herbicides at the time applications are usually made for weed control.

Additional breeding efforts should be made to improve on the PS03101269 line for winter N fixation with hopes to maintain its excellent winter hardiness, but try to improve its early spring growth, N fixation and possibly decrease its seed size.