

Participatory Plant Breeding Wheat Selection Manual

What is participatory plant breeding (PPB)?

PPB is a collaboration between breeding institutions and farmers that aims to develop cultivars relevant to farmers needs. The main difference between a participatory and conventional breeding program is that in PPB most of the early selections takes place on farm.

Overview of the participatory wheat breeding program

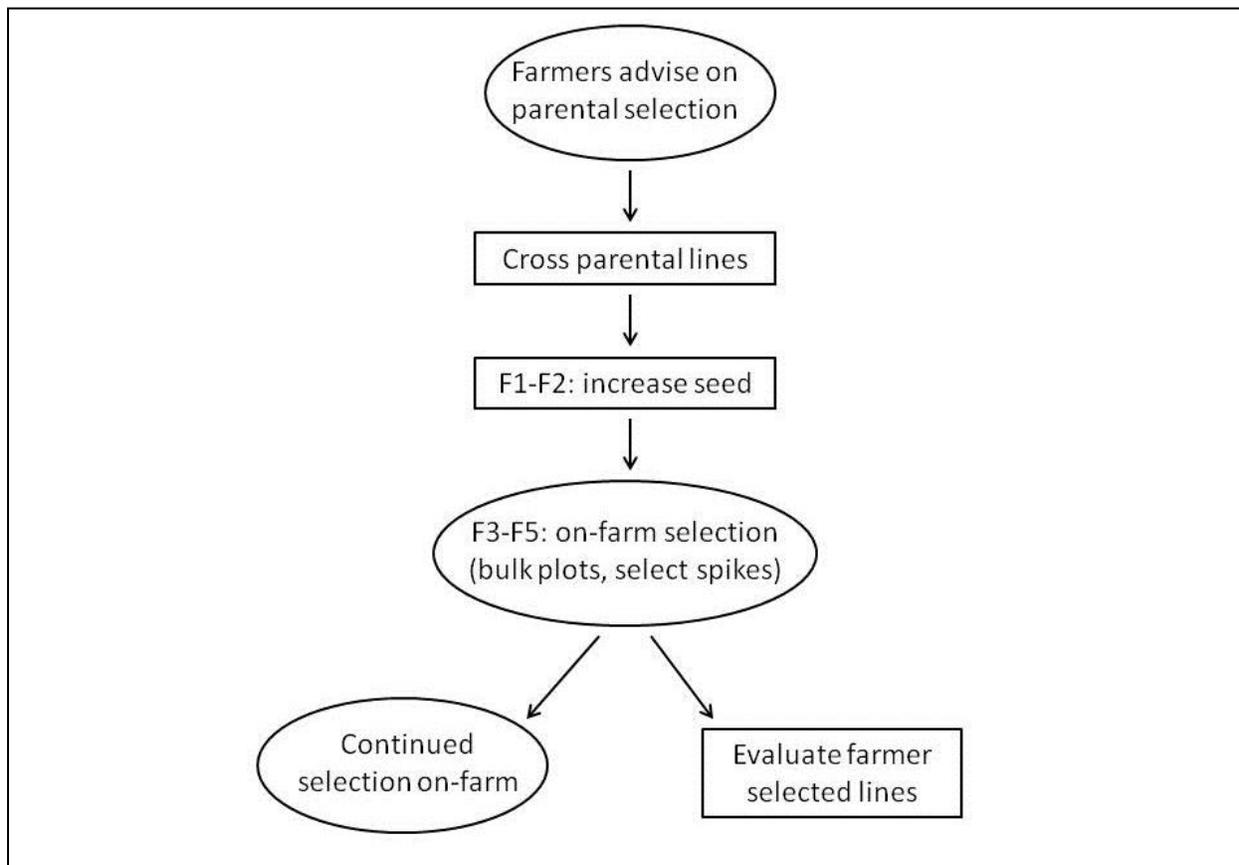


Figure 1. General model for the on-farm participatory plant breeding program. Activities that involve farmers are represented by circles while activities that involve researchers are represented by squares. Participating farmers are involved in parental selection, early generation on-farm selection (F3-F5) and continued selection on-farm, if interested. Breeders/researchers make the crosses, increase seed and will evaluate farmer selected lines after three years of on-farm selection.

Crosses for the PPB wheat program have been made at the AAFC Cereal Research Centre by Dr. Stephen Fox and at the University of Manitoba by Anne Kirk. Seed resulting from the initial cross is

F1, or first generation seed. The F1 seed is planted in a greenhouse or research station to increase the amount of seed available, creating the F2 generation. Typically, the F2 generation will also be planted on a research station to produce enough seed to distribute to farmers. Participants will receive F3 seed, which contains a lot of genetic variability. Participants will make selections for 3 years at which point the populations will be returned to the research station for further testing and potential varietal development. If interested, farmers may keep a portion of this seed and continue selection on farm.

Implementation of the trial

Location – The populations should be planted in an area representative of the conditions where you would normally grow wheat. Ideally, your populations should be grown under normal management practices in part of a wheat field.

Populations – Each farmer will receive 3 populations of F3 spring wheat

- The populations provided to each farmer are chosen based on the geographic location and preferences of the participant
- Each population is typically grown by three different farmers

Amount of seed provided – 7,000 seeds/population (about 220 g/population)

Seeding rate – 350 seeds/m² (or use your typical seeding rate)

Plot size – At a seeding rate of 350 seeds/m² 7,000 seeds will cover 20 m². You are not required to plant all of the seeds provided; however, the larger the plot the more genetic diversity

Width – 1 m wide plots are recommended for ease of making selections

Row spacing – typical of your equipment

- If your equipment has 6” row spacing, 1 m wide plots will accommodate 6 rows
- Six 20 m long rows planted at 6” row spacing = 20 m² plots
- To achieve a seeding rate of 350 seeds/m² one seed should be sown approximately every 2 cm

Seeding - can be done with a push garden seeder or by hand

Checks – registered wheat varieties are included to use as checks. If you choose to some or all of these check varieties can be planted alongside the populations to compare the plots with.

Selection

How does a plant breeder make selections?

In a conventional (non-participatory) breeding program the plant breeder will make selections in the field based on agronomics and disease characteristics. Later on in the breeding process (generally after the F6 generation) quality characteristics are measured.

Agronomics	Disease Characteristics¹	Quality²
Competitiveness with weeds	Leaf rust	Protein
Plant height	Stem rust	Flour yield
Straw strength	Stripe rust	Flour ash
Maturity	Fusarium head blight (FHB)	Flour colour
	Common bunt	Falling numbers
	Loose smut	Dough strength
	Leaf spotting complex	Canadian short process bread making

¹Diseases assessed in the field will differ across wheat growing regions

²Examples of quality traits assessed, not a complete list

How will a farmer make selections?

A participating farmer will also make selections based on agronomics and disease characteristics, but the selection criteria is expected to differ from farmer to farmer. Each individual farmer may choose to focus on certain characteristics that are of great importance to them, for example competitiveness with weeds or rust resistance.

Method of Selection

1) Positive selection: select 500 spikes/population at maturity.

- Spikes should be taken throughout the entire plot

2) Negative selection: remove unwanted plants from your population by bending the plant over or by removing it from the plot. The remaining plants will be bulk harvested.

Timing of Selection: Selection may be conducted shortly before harvest or throughout the growing season. Timing of selection may depend on your goals. For example, if your main goal is to select for plants with good disease resistance then selection should be conducted when the flag leaf is still green.

Harvest

Populations may be harvested in one of two ways:

- 1) Selection of 500 spikes followed by bulk harvesting and disposal of the rest of the plot seed. Selected spikes can be threshed as a bulk.
- 2) Bulk harvest spikes from the entire plot using a sickle or scissors.

In either case the spikes from each population can be put in separate bags (provided) with the name of the population, year and the farmers name and be sent to the University of Manitoba for threshing and cleaning. Shipping expenses will be reimbursed. If you prefer you can thresh and clean the spikes on your farm.

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