Clubroot on Canola: Survey & Quantification of Resting Spores of *Plasmodiophora brassicae* from Field Collected Soil Samples in North Dakota

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Take Home Message: An ongoing clubroot survey for over five years in various counties of North Dakota indicates a threat to the canola crop if proper attention is not given towards longer crop rotations **(1 in 3 years)**. In addition, growers should consider growing an available clubroot resistant canola variety in endemic areas and follow proper equipment sanitation. Cleaning equipment thoroughly after working in a clubroot infected field is highly recommended since the primary mechanism of spread between fields is the movement of infested soil on farm equipment.

Survey Procedure:

The survey involved three components 1. visual survey, 2. soil sampling and 3. molecular quantification of resting spores of the clubroot pathogen.

Components 1&2. Visual survey and soil sampling: Clubroot scouting was done visually by inspecting canola crop roots. The disease survey was conducted in over 40 counties in North Dakota. In each county, one field in every 5000 acres was targeted for scouting. Soil samples were collected from fields with an intent to know the pH of the soil and to determine the number of resting spores per gram of soil. In all, a minimum of 3-10 fields per county were targeted for scouting.
The survey was done in two phases.

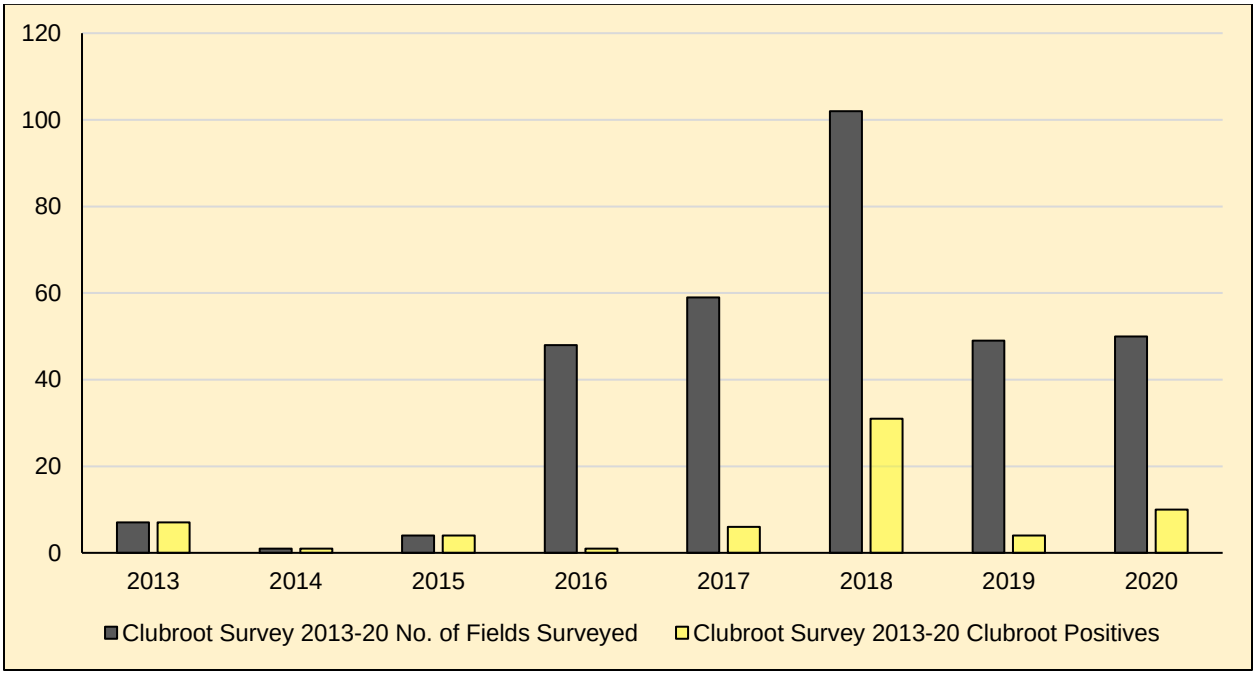
1st phase: at flowering (10% of flowering onwards)

In the growing season, plants were sampled from distinct stunted patches or prematurely senescing plants in the field. Patches visible from the edge of the field were checked by digging and observing the roots for symptoms of clubroot and soil samples were collected from those areas.

2nd phase: after swathing
Scouting at swathing was based on the methodology followed in Canada by the Alberta Agricultural and Rural Development (AARD) for their annual clubroot disease survey. Reports of AARD indicated that the incidence of clubroot is increased in the field entrances. Hence, the survey was done from the main entrances/approaches in each field. The survey group walked a "W" pattern stopping at 5 spots and uprooting 10 consecutive stems from the ground at each spot. Each sampling point was separated by 100 meters or 328 feet. In all, roots of 50 stems were evaluated for the presence of clubroot and incidence was noted. Excess soil was removed. Roots were visually examined for the presence of galls. At sample sites where infection was observed or suspected, root specimens with galls, along with soil, were double bagged and labeled with the field location. Infected roots and soil samples from all the fields surveyed were collected and a representative sample was submitted to Dr. Zhaohui Liu's laboratory for molecular quantification of resting spores per gram of soil and another half-pound of soil to the NDSU Soil Testing Laboratory for pH determination.

Results: Over 40 counties in North Dakota were surveyed in 2020 for visual symptoms of galls on canola roots. Clubroot galls on canola roots have only been found in Cavalier County, in 10 out of 50 canola fields surveyed (Figure 1).

Figure 1: Fields surveyed from 2013 to 2020 for prevalence of clubroot in Cavalier County, North Dakota.



Component 3. <u>Molecular detection of soil samples to quantify *Plasmodiophora brassicae* (the clubroot pathogen) resting spores:</u>

The objective of this procedure is to quantify resting spores of the clubroot pathogen in the soil and to inform growers prior to the occurrence of visible gall symptoms in canola.

<u>Results from molecular assays on soil samples in 2019</u>: The molecular assays indicated the clubroot spread occurred to the neighboring counties (Table 1). However, there were no visible symptoms observed when the roots were uprooted. To date, results received from 125 fields collected from 34 counties have shown that 18 counties have fields with clubroot resting spores (Figure 2 & Table 1). Quantified resting spores of *P. brassicae* from those samples ranged from 500 to 40 million per gram of soil (minimum detection limit of the assay being 10 resting spores/g of soil). Lack of visible galls in the surveyed fields but positive in the molecular soil quantification assay indicate either the resting spore population may not have reached required spores per gram of soil in acidic soils to show galls or the pH of soil is basic. In general, clubroot infections are expressed on canola plants where soil population is about 80,000 spores per gram of soil (Canadian Research). These results indicate that there is a need for continuous annual monitoring.

Notice: Growers who want to know about the presence of clubroot/resting spores in their field(s) are encouraged to contact Dr. Venkat Chapara at the Langdon REC (701-256-2582), Dr. Anitha Chirumamilla at the NDSU Cavalier County Extension Office (701-256-2560) or NDSU Extension (701-231-8363).

Figure 2: Number of fields with *P. brassicae* spores found in soil samples collected from various counties in North Dakota through molecular assays.

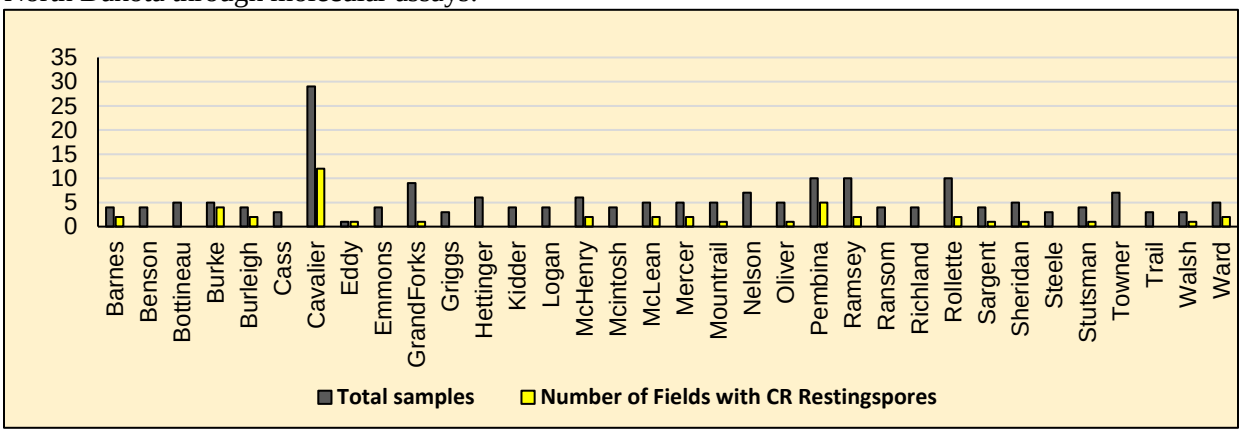


Table 1: Number of fields with *P. brassicae* spores found in soil samples collected from various counties in North Dakota.

Number	County Name	Total samples	Number of Fields with CR Resting Spores
1	**Barnes**	**4**	**2**
2	**Burke**	**5**	**4**
3	**Cavalier**	**29**	**12**
4	**Eddy**	**1**	**1**
5	**Grand Forks**	**9**	**1**
6	**McHenry**	**6**	**2**
7	**McLean**	**5**	**2**
8	**Mercer**	**5**	**2**
9	**Mountrail**	**5**	**1**
10	**Oliver**	**5**	**1**
11	**Pembina**	**10**	**5**
12	**Ramsey**	**10**	**2**
13	**Rollette**	**10**	**2**
14	**Sargent**	**4**	**1**
15	**Sheridan**	**5**	**1**
16	**Stutsman**	**4**	**1**
17	**Walsh**	**3**	**1**
18	**Ward**	**5**	**2**