Characterization of the nature of potato virus Y resistance in potato variety Bistra

Background

Growing resistant potato varieties is one of the most effective options for controlling potato virus Y (PVY). Among the different types of PVY resistance, extreme resistance has been most effective in controlling PVY because plants with this kind of resistance do not get infected at all with the virus (including the destructive PVYNTN and PVYN-Wilga and multiple other strains and isolates). This type of resistance has been found in wild potato and in the Solanum Andigena Group and has been used to develop some commercial potato varieties. Knowledge of the type of resistance in varieties is important to breeders in identifying and developing new resistant varieties and to both commercial and seed potato growers in selecting resistant varieties with minimal losses associated with the virus in their crops. Bistra is a potato variety that has shown the potential for use as a potato variety with extreme resistance. Previous research efforts to prove this using markers have not been successful in identifying an Ry resistant gene responsible for its resistance. This leaves a question as to whether it truly has extreme resistance to PVY (Elison et al. 2024). To answer this, we resorted to the classic method of graft inoculation. Graft inoculation involves putting a healthy top onto PVY infected root-stock to prove whether a potato variety has extreme resistance to PVY. In addition, we confirmed this using sap, spray gun and field spreader row inoculation. Plants will be observed for symptoms and tested for virus in the grafted top of the plants.

Objective

To determine the type of PVY resistance in potato variety Bistra

Materials and methods

Virus inoculation tests: Greenhouse rub (sap) inoculation; graft inoculation, field spreader row inoculation (aphids) and spray gun inoculation.

Varieties tested: Bistra, Castle Russet (PVY resistant), Russet Burbank (PVY susceptible) and A98345-1 (PVY susceptible)

PVY strains inoculated: PVY^{O}, PVY^{NTN} and $PVY^{N\text{-}Wilga}$

Results

Preliminary results in Table 1 indicate that potato variety Bistra was not infected with all the three PVY strains when subjected to graft inoculation and also the three other types of inoculation.

Table 1: Preliminary ELISA test results of plants inoculated with each of the three PVY strains (respectively) at 21 days after inoculation where (–) means virus not detected (meaning the variety is PVY resistant) and (+) means PVY detected (meaning the variety is susceptible)

Experiment	Variety		PVY strain inoculated			Type of resistance
		Healthy	PVY^{O}	PVY^{NTN}	$PVY^{N\text{-}Wilga}$	
Graft inoculation	Bistra	-	-	-	-	Extreme resistance
	Castle Russet (Rysto)	-	-	-	-	Extreme resistance
	A98345-1	-	+	+	+	Susceptible
	Russet Burbank	-	+	+	+	Susceptible
Sap/rub inoculation	Bistra	-	-	-	-	Extreme resistance
	Castle Russet (Rysto)	-	-	-	-	Extreme resistance
	A98345-1	-	+	+	+	Susceptible
	Russet Burbank	-	+	+	+	Susceptible
Spay gun inoculation	Bistra	-	-	-	-	Extreme resistance
	Castle Russet (Rysto)	-	-	-	-	Extreme resistance
	A98345-1	-	+	+	+	Susceptible
	Russet Burbank	-	+	+	+	Susceptible
Field (aphid) spreader row Inoculation	Bistra	-	-	-	-	Extreme resistance
	Castle Russet (Rysto)	-	-	-	-	Extreme resistance
	A98345-1	-	+	+	+	Susceptible
	Russet Burbank	-	+	+	+	Susceptible

Fig 1: Graft inoculation

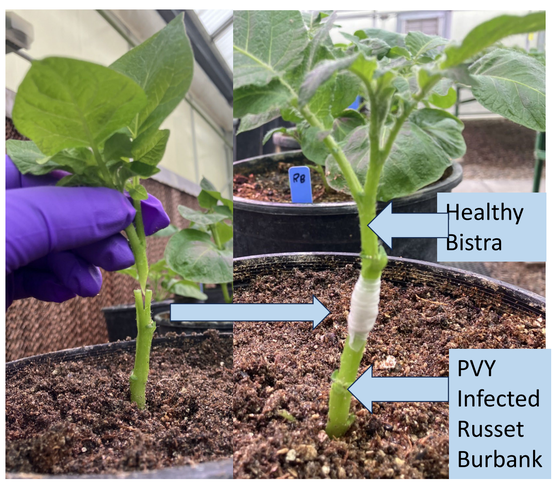
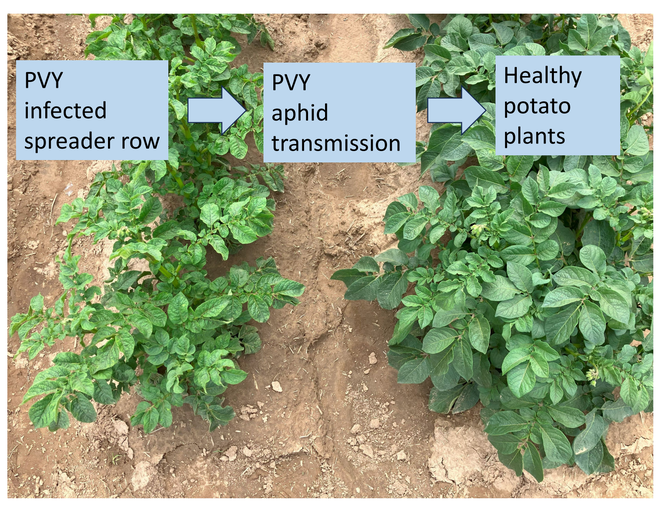


Fig 2: Sap inoculation

Fig 3: Field spray gun inoculation

Fig 4: Field spreader row inoculation



Discussion and conclusions

- *Unanswered research questions:*
  - ✓ *Are there Ry genes, (Rysto, Ryadg or Rychc) for extreme resistance in Bistra (Elison et al. 2024)?.*
  - ✓ *Is variety Bistra truly having extreme resistance if above genes were not detected using markers?*
  - ✓ *Graft inoculation: Classic method for determining PVY extreme resistance.*
- *Bistra not infected (ELISA tests) in graft inoculations: an indication of extreme resistance.*
- *Bistra not showing any visible PVY symptoms: an indication of extreme resistance.*
  - ✓ *Hypersensitive resistance: PVY can be detected, and hypersensitive reaction shows on leaves.*
  - ✓ *Extreme resistance: PVY not detected and no symptoms after graft inoculation.*
  - ✓ *Susceptibility: PVY detected and showing PVY symptoms*
- *Bistra can be classified as potato variety with extreme resistance if grafting tests show no virus movement into Bistra from infected Russet Burbank.*
- *Field inoculation: an indication of real-life application of PVY resistance.*
- *PVY resistant varieties: Long term solution to PVY problem and cutting the cost of PVY control.*
- *Knowledge of reaction of Bistra to inoculation tests is the basis for its commercial utilization for PVY control and further research in breeding programs.*

Fig 5: Tuber potato variety Bistra

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References

Elison, G.L., Park, J., Novy, R.G. and Whitworth, J.L., 2024. A Potential New Source of Extreme Resistance to Potato Virus Y in the Potato Variety Bistra. American Journal of Potato Research. Am. J. Potato Res. 101, 248–256 (2024). https://doi.org/10.1007/s12230-024-09954-6

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