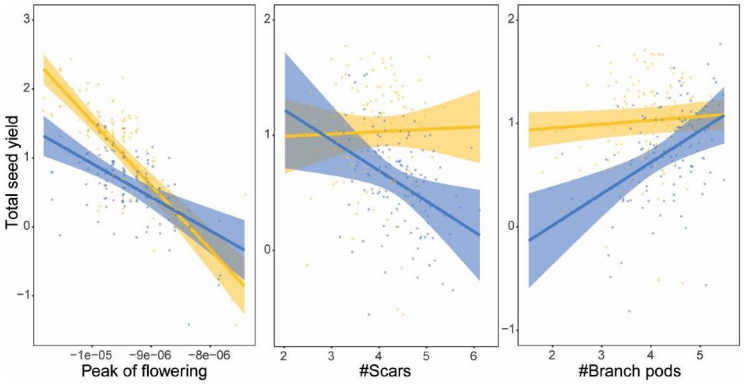
Project: Getting more bang for your buzz: Does pollination compensate for canola yield lost under sub-optimal soil moisture, nitrogen fertilization and/or seeding rates?

Rationale: We generally know that canola yield increases with insect pollination, but recent work suggests another way that pollinators can increase farming profits: by maintaining yields while reducing other, more costly inputs, like fertilizer, water, and seeds. Is this a crazy idea?

Objectives: We designed a series of experiments that examined how a wide range of varieties of commodity canola respond to pollinators (Expt 1), and then, for a subset of these varieties, focused on using pollinators to enhance or maintain canola yields in the face of declining inputs of either water (Expt 2), nitrogen, or seed (Expt 3). Other than an interest in pollinators, another thread connecting these studies was the interest in relating yield to mechanism (i.e., to the traits of individual plants).

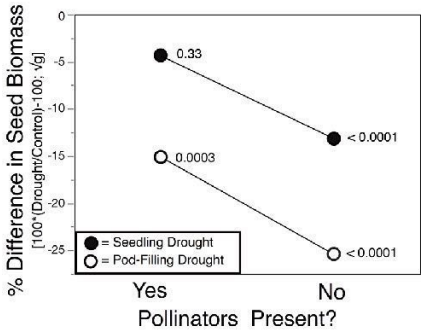
Methodology: We grew varieties of canola in the presence or absence of pollinators (mostly bees), and examined their reproductive responses to pollinators (Expt 1), particularly in situations with lower inputs (low watering at seedling or seed-filling stages (Expt 2), and in the field with low nitrogen fertilizer, and low density of seeds at planting (Expt 3).

Summary and conclusions:

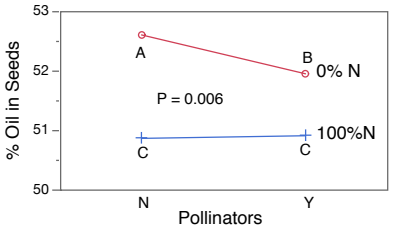


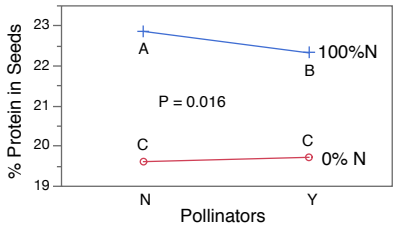
Expt 1: Pollinators influenced reproductive outcomes in canola, particularly in controlled greenhouse circumstances where other inputs were at prescribed levels. Insect pollination modified the functional characteristics (related to flower timing, flower effort, plant size & shape, seed packaging and root biomass) of canola crops, increasing yield quantity and quality. The figure shows pollinators in yellow and no pollinators in blue. By shifting the flowering phenology to earlier (peak of flowering), pollinators increased yield, and reduced its dependency on aborted pods (scars) or later reproduction (branch pods).

Expt 2: In this greenhouse experiment, pollinators reduced the negative effects of drought on plant yield, increasing yield by ~20% in drought, regardless of whether the drought was experienced during the seedling or the pod-filling stage. The fitness “bump” provided by pollinators was accomplished primarily by shifting the plant’s flowering phenology earlier and narrower.



Expt 3: In the field, over two summers, pollinators did not buffer yield in the face of less costly inputs (lower seeding amounts, lower N fertilization). Instead, pollinators were usually associated with equal or lower yields relative to plants in a screen tent (the no-pollinators treatment). Two examples of this are in seed quality, where pollinators reduced the oil content of seeds grown in the low-N treatment, and they reduced the protein content of seeds grown in the high-N treatment. Overall, the importance of pollinators in field trials was dwarfed in importance by the strong driver of canola yield: nitrogen.





Taken together, pollinators increased yield by advancing the timing of reproduction and reducing loss associated with drought. But their in-field relevance regarding changes in N and seeding rate was lacking.

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