Can strip-cropping enhance pollination and fruit set in hokkaido pumpkins?

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Background

In order to meet an increasing demand for food production, diversified cropping systems, which enhance biodiversity and ecosystem services such as pollination, are currently under development (Kremen and Miles, 2012). One such system is strip-cropping (SC), in which different crops are grown in alternating rows. For flower-visitors, SC of insect pollinated vegetables and/or flower strips are thought to provide floral resources during a prolonged period, extending the flowering period of a single crop. In the case of hokkaido pumpkins, flowering of flower strips or faba beans prior to hokkaido flowering, may help to support bumblebees and other pollinators, enhancing pollination during the short flowering period of hokkaido.

Materials and Methods

The experimental set-up was established as an on-farm experiment hosted by an organic farm (Skiftekær Øko, Denmark), and included three fields:
(a) hokkaido mono-culture,
(b) hokkaido mono-culture with flower strips and
(c) strip-cropped hokkaido pumpkin and faba bean and flower strips (Figure 1).

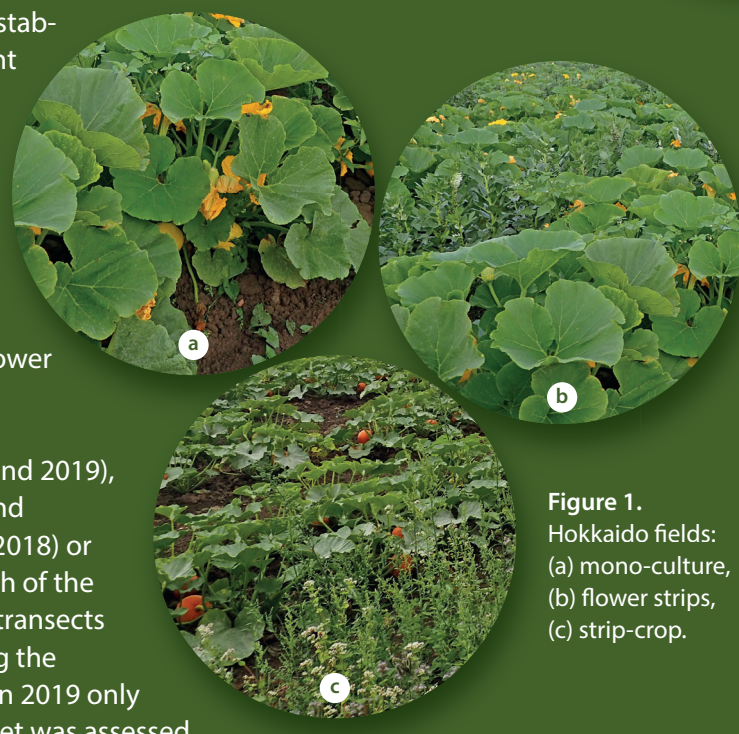

Figure 1. Hokkaido fields: (a) mono-culture, (b) flower strips, (c) strip-crop.

During two study years (2018 and 2019), we monitored flower visitors and marked female flowers in ten (2018) or six (2019) 50 m transects in each of the three hokkaido fields. In 2018, transects were walked three times during the season (early, mid, late), while in 2019 only once during late season. Fruit set was assessed as the proportion of developing fruits relative to the number of re-located flowers.

Results and Discussion

Flowers of hokkaido pumpkin were visited primarily by honeybees, and to a lesser extent by bumblebees (Figure 2). Overall, honeybee abundances were highest in the control field (2018) or flower strip field (2019), while more bumblebees were observed in the SC field (both study years). Visitation rates were generally higher in early and mid than late season (Figure 2). Bees were also observed visiting flowers of faba bean and flowers in the flower-strip (Figure 3).

Fruit set differed between fields: In 2018, fruit set was highest in the SC field followed by flower strip and control field (χ^2 = 7.49, $P < 0.02$). In 2019, fruit set was highest in the flower strip field compared to the other two fields ($\chi^2 = 17.59$, $P < 0.0002$) (Figure 4).

Pollinator abundances could not be directly linked to fruit set of hokkaido pumpkins. Our study suggests that SC and floral strips may enhance visitation by native bumblebees. However, as the study did not include replicated fields, it cannot be concluded if other factors than cropping practice may have affected pollination and fruit set in hokkaido pumpkins.

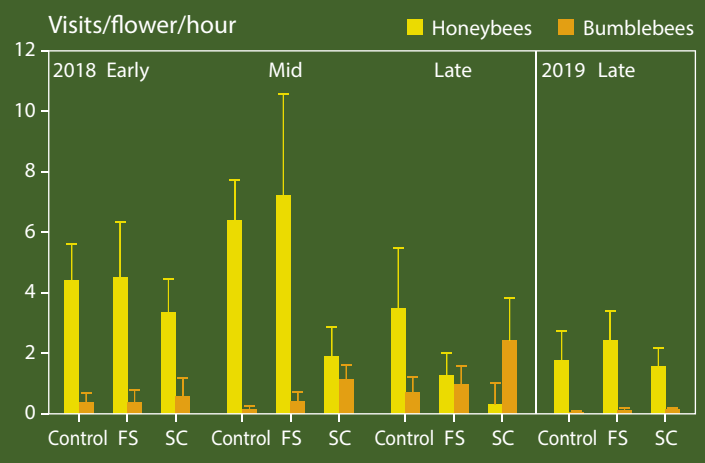

Figure 2. Visitation (visits/flower/hour) in a 50 m transect (N=10 in 2018; N=6 in 2019).

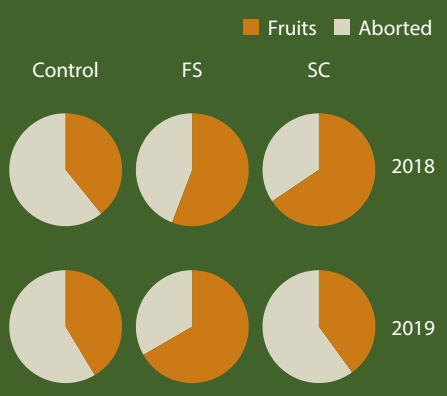

Figure 4. Proportion fruit set in three fields during two years. A total of 74 (control), 59 (FS) and 32 (SC) female flowers were marked in 2018, and 94 (control), 105 (FS) and 75 (SC) female flowers were marked in 2019.

Figure 3. Pollinators of (a) hokkaido, (b) phacelia, (c) buckwheat, and (d) faba beans.

References

Kremen, C., Miles, A., 2012. Ecosystem services in biologically diversified versus conventional farming systems: benefits, externalities, and trade-offs Ecology and Society 17, article 40.

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http://projects.au.dk/coreorganiccofund/