

## Bumblebees (Apidae: Hymenoptera) are the main pollinators of common buckwheat, *Fagopyrum esculentum*, in Hokkaido, Japan

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### Abstract

A survey of the insects visiting common buckwheat flowers and examination of the pollen attached to the insects captured at the field in Hokkaido was carried out in order to determine their role as pollinator. Two bumblebee species, *Bombus ardens sakagamii* and *B. hypocrite sapporoensis*, were captured as the predominant species (75.4%) and 97.6% of *B. ardens sakagamii* and 96.0% of *B. hypocrite sapporoensis* had tetraploid common buckwheat pollen attached to their body surface even though they were captured in a diploid common buckwheat field. From these results, these two bumblebee species were thought to be the main pollinators of common buckwheat in Hokkaido for the first time.

**Key words:** Common buckwheat; pollinator; *Bombus ardens sakagamii*; *Bombus hypocrite sapporoensis*; Hokkaido

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### INTRODUCTION

Common buckwheat (*Fagopyrum esculentum*) is one of the most typically cultivated plants, and its flowers display dimorphic heterostyly and self-incompatibility (Tatebe, 1953). Although it is well known that pollination occurs both by wind and insects (Namai, 1990, 1991), the study of insects that act as pollinators is still incomplete; however, farmers in Hokkaido have observed that bumblebees frequently visit buckwheat flowers. In addition, 10% of domestic buckwheat is produced in Hokkaido, and no study of the pollinators of common buckwheat in Hokkaido has been performed previously.

A survey of the insects visiting common buckwheat flowers, and an examination of the pollen attached to insects captured in a field in Hokkaido was performed to determine their role as pollinators.

In this paper, we describe the role of bumblebees as pollinators of common buckwheat in Horokanai, Hokkaido, Japan.

### MATERIALS AND METHODS

Insects visiting common buckwheat flowers were collected from the Horokanai Agricultural Technology Center experimental field in the summer of 2000. The field is 50 m long and 40 m wide, and divided into two (Fig. 1). A tetraploid common buckwheat cultivar 'Hokkai No. 3' (its pollen is twice the size of diploid pollen) was sown in one half, and a diploid cultivar 'Kitawasesoba' in the other half in May 2000. The crops were cultivated conventionally. Insects visiting the common buckwheat flowers were captured with a 36 cm diameter sweeping net with a 1 m handle for 5 min by 5 investigators in the 'Kitawasesoba' (diploid) field every hour from 0700 to 1800 from July 29 to 31, the peak flowering period of the crops. The five investigators captured the insects around them as best as they could.

The captured insects were pinned, identified into species from their characteristics (Ito, 1991; Washitani et al., 1997), and the numbers of each species were recorded.

The pollen attached to the body surface of the captured insects was gathered using the glycerin

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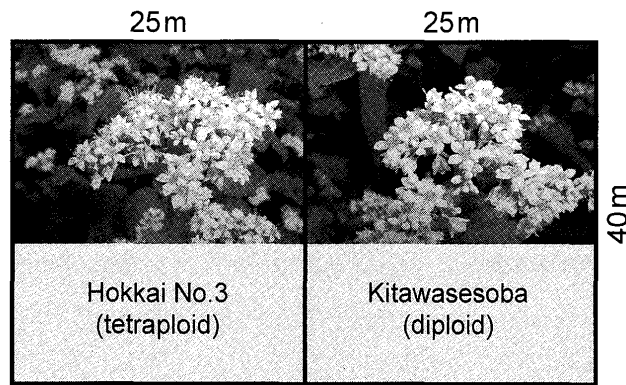


Fig. 1. Design of the field where the survey was performed.

Table 1. Insects captured in the buckwheat field

Species	Number	(%)
<i>Bombus ardens sakagamii</i>	372	51.1
<i>B. hypocrite sapporoensis</i>	177	24.3
<i>B. beaticola moshkarareppus</i>	2	0.3
<i>B. hypnorum koropokkrus</i>	1	0.1
<i>Apis mellifera</i>	14	1.9
Apidae subtotal	566	77.7
Other Hymenoptera	27	3.7
Hymenoptera total	593	81.5
<i>Eristalis (Eoseristalis) cerealis</i>	19	2.6
<i>Episyrphus balteatus</i>	7	1.0
<i>Eristalis (Eristalis) tenax</i>	5	0.7
<i>Syritta pipiens</i>	4	0.5
<i>Melanostoma scalare</i>	4	0.5
Other Syrphidae	7	1.0
Syrphidae subtotal	46	6.3
Other Diptera	85	11.7
Diptera total	131	18.0
Other Insecta	4	0.5
Total	728	100.0

jelly method (Ikuse, 1956), and examined under a microscope after staining with acetocarmine.

## RESULTS

A total of 728 insects belonging to 3 orders were captured in this survey (Table 1). Among them, *Bombus ardens sakagamii* was the most predominant species (372 individuals, 51.1%) followed by *B. hypocrite sapporoensis* (177 individuals, 24.3%). Only a few other species, including *Apis mellifera*, were captured.

Table 2. Buckwheat pollen attached to two major bumblebee species

Species	Attached pollen			
	tetra+di No. (%)	tetra No. (%)	di No. (%)	no pollen No. (%)
<i>Bombus ardens sakagamii</i>	359 (96.5)	4 (1.1)	9 (2.4)	0 (0.0)
<i>B. hypocrite sapporoensis</i>	169 (95.5)	1 (0.5)	4 (2.3)	3 (1.7)

tetra: tetraploid pollen; di: diploid pollen.

All *B. ardens sakagamii* individuals had one or both of tetraploid and diploid common buckwheat pollen attached to their body surface, and among them, 97.6% (363 individuals) had tetraploid pollen attached. On the other hand, 98.3% (174 *B. hypocrite sapporoensis* individuals) had one or both of tetraploid and diploid common buckwheat pollen attached to their body surface, and among them, 96.0% (170 individuals) had the tetraploid attached (Table 2).

## DISCUSSION

Two species of bumblebees, *B. ardens sakagamii* and *B. hypocrite sapporoensis* were captured as the predominant species (75.4%) that visited the common buckwheat field in this survey. Moreover, most bumblebees were observed to have tetraploid common buckwheat pollen together with diploid pollen attached even though they were captured in the diploid common buckwheat field next to the tetraploid field. It has been determined that the two bumblebee species usually come and go between the two fields from this pollen examination. Although farmers in Hokkaido observe bumblebees visiting buckwheat flowers frequently, there is no record of this; therefore, these two bumblebee species were recorded as the main pollinators of common buckwheat in Hokkaido for the first time.

However, Namai (1986) reported that the major pollinators of common buckwheat in Honshu, the main island of Japan, are *Apis mellifera* and some hoverflies (Diptera: Syrphidae).

Bumblebees are considered to be established in cool climatic areas (Heinrich, 1979) and have many species from semi-frozen zones to the northern part of the temperate zone. In addition, bum-

blebees generally act as the main pollinators instead of honeybees in cold latitudes. Hokkaido is the northern island of Japan and cooler/colder than Honshu. A beekeeper was observed with honeybees next to the field at the same time; however, the relatively low temperature condition might make the honeybees inactive. Therefore, based on this survey, bumblebees were recorded to be the main pollinators of common buckwheat in Hokkaido, instead of honeybees.

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