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Diversity and abundance of flower visitors in rapeseed (*Brassica napus* L.) and spontaneous Brassicaceae: effects on crop yield in the southern Pampas region

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Abstract – Conservation of biodiversity in agroecosystems is essential for the sustainability of insect-pollinated crops. This study aimed to evaluate the importance of areas near the rapeseed crops containing spontaneous Brassicaceae species and to identify the insects visiting both. We assessed the impact of pollinators on rapeseed yield, its components, and seed oil content. The research was conducted in experimental plots in the southeastern Pampas region during 2017, 2018, and 2019. Each year, two rapeseed cultivars (a hybrid and a variety) were tested. The flowering period of spontaneous Brassicaceae extended beyond 90 days, approximately three times longer than the rapeseed crop. In the spontaneous Brassicaceae and the rapeseed plots, the same species of flower visitors were captured. However, in two of the three years, the number of insects was higher in the spontaneous patches. These findings highlight the importance of these plants as food resources for pollinators. When insects had access to the crop, the yield was significantly higher for all tested rapeseed cultivars, with an average increase ranging between 27% and 35%. Pollinators enhanced rapeseed production without affecting the oil percentage, resulting in an increased oil yield per hectare by positively impacting grain yield.

Keywords: Biodiversity / pollination / *Apis mellifera* / *Bombus bellicosus* / *Campsomeris bistrimaculata*

Résumé – Diversité et abondance des visiteurs floraux chez le colza (*Brassica napus* L.) et les Brassicaceae spontanées : effets sur le rendement de la culture du colza dans le sud de la région pampéenne. La conservation de la biodiversité dans les agroécosystèmes est essentielle pour la durabilité des cultures pollinisées par les insectes. L'objectif de cette étude était d'évaluer l'importance des zones proches des cultures de colza contenant des espèces spontanées de Brassicaceae et à identifier les insectes qui les visitent. Nous avons évalué l'impact des pollinisateurs sur le rendement du colza, ses composants, et la teneur en huile des graines. Les recherches ont été menées sur des parcelles expérimentales dans le sud-est de la région pampéenne en 2017, 2018 et 2019. Chaque année, deux cultivars de colza (un hybride et une variété) ont été testés. La période de floraison des Brassicaceae spontanées s'est étendue au-delà de 90 jours, soit environ trois fois plus longtemps que la culture de colza. Dans les parcelles de Brassicaceae spontanées et de colza, les mêmes espèces de visiteurs floraux ont été capturées. Cependant, deux années sur trois, le nombre d'insectes était plus élevé dans les parcelles spontanées. Ces résultats soulignent l'importance de ces plantes en tant que ressources alimentaires pour les pollinisateurs. Lorsque les insectes avaient accès à la culture, le rendement était significativement plus élevé pour tous les cultivars de colza testés, avec une augmentation moyenne comprise entre 27% et 35%. Les pollinisateurs ont amélioré la production de colza sans affecter la teneur en huile. Cela a permis d'augmenter le rendement en huile par hectare en raison de l'impact positif sur le rendement en grain.

Mots-clés : Biodiversité / pollinisation / *Apis mellifera* / *Bombus bellicosus* / *Campsomeris bistrimaculata*

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Highlights

- The most abundant flower visitors captured in rapeseed and spontaneous Brassicaceae patcheswere Campsomeris bistrimaculata, Apis mellifera, and Halictidae.
- Pollinators enhanced rapeseed production without affecting oil percentage, resulting in an increased oil yield by positively impacting grain yield.

1 Introduction

The responsible use of natural resources for food production is one of the major challenges in agriculture. Environmental disturbances caused by crop management practices negatively impact native plant and pollinator communities. Remaining areas of natural habitat that support the development of native species are increasingly fewer, smaller, more isolated, and with limited floral diversity (Agüero *et al.*, 2018; Gómez-Martínez *et al.*, 2022). The conservation of biodiversity in agroecosystems is crucial for crops that interact with pollinators, as they tend to have lower yields without them (Garibaldi *et al.*, 2013; Garibaldi *et al.*, 2016; Potts *et al.*, 2016).

It has been argued that maintaining the diversity of pollinator species is essential for providing ecosystem resilience against future environmental changes (Senapathi *et al.*, 2015). Bee communities are strongly associated with plant species diversity (Potts *et al.*, 2003; Batáry *et al.*, 2010), so management plans that overlook plant diversity are unlikely to support the conservation of diverse native bee species, even when resources are plentiful.

In Europe, the deterioration of biodiversity is a growing concern, and some companies suggest planting nectar- and pollen-producing species along crop edges (Canomanuel, 2011). Blaauw and Isaacs (2014) propose using marginal lands to grow wildflowers that provide resources for bees and improve pollination in adjacent crops. The creation of habitats with floral diversity has been adopted as the primary method for conserving and enhancing the abundance and diversity of bees in agroecosystems (Carvell *et al.*, 2006; Winfree, 2010). Wild species have high value for beneficial insects, typically flowering before, during, and after crops, thus aiding in the survival of pollinators and natural enemies (Altieri and Nicholls, 2004).

The Brassicaceae family includes numerous cultivated and wild species that have been mentioned as sources of pollen and nectar (Crane *et al.*, 1984; Pierre, 2001; Andrada *et al.*, 2005). Among them, the most important is *Brassica napus* L. (rapeseed), which stands out for its significant contribution to global edible oil production (USDA, 2022). Most studies on pollinators visiting rapeseed flowers have been conducted in European countries and North America; there is little information on Argentina and South America, particularly the province of Buenos Aires region (Adegas and Nogueira Couto, 1992; Ouvrard and Jacquemart, 2018; Mazzei *et al.*, 2021).

The Argentine Pampas region is characterized by vast areas suitable for the development of various crops and is one of the largest agricultural regions in the world (~5 Mha) (Leguizamón, 2014). The area has experienced an intensification of agricultural production, requiring adequate crop rotation to reduce pest and disease pressure and improve water storage conditions and fertility. The inclusion of rapeseed in this rotation is a promising alternative in areas where only winter cereals (wheat, barley, oats, etc.) are typically grown (Iriarte and López, 2014). The south-central region of the province of Buenos Aires is very suitable for rapeseed cultivation.

Entomophilous pollination can increase rapeseed crop yield, depending on the cultivar and production region (Ouvrard and Jacquemart, 2018). Given the scarcity of studies on the entomological fauna of the region, the flower visitors of *B. napus* that obtain floral rewards from spontaneous Brassicaceae species as alternative food sources remain unknown. The first step to further understanding these relationships is to assess the importance of areas with spontaneous vegetation near the crop and identify the insects that visit both the crop and the areas occupied by the most abundant spontaneous Brassicaceae species. Additionally, it is important to determine the effect of pollinators on rapeseed yield, its components, and oil content in cultivars commonly used in the south-central region of the province of Buenos Aires.

2 Materials and methods

2.1 Rapeseed and spontaneous patches

The experimental trials were conducted at the Chacra Experimental Integrada Barrow, located in the southern Pampas region (-38.319305, -60.239380), during 2017, 2018, and 2019. Two rapeseed cultivars (a hybrid and a variety) were used each year of the trial. In 2017, samples were taken from the hybrid Hyola 433 and the variety Bioaureo 2486 (hereafter, Bioaureo), planted in 1.75 m × 6.00 m plots. In 2018, the hybrid Hyola 575 CL and the variety Nuvette 2286 (hereafter, Nuvette) were planted in 2.56 m × 6.00 m plots. Finally, in 2019, the hybrid Hyola 830 and the variety Macacha were planted in 2.56 m × 6.00 m plots. The experimental design in 2017 was a randomized complete block with three replications and two replicates per block, while in 2018 and 2019, it was a randomized complete block design with four replications and two replicates per block. Each year, four hives were placed about 200 m from the plots. Additionally, during the three years of trials, patches of natural vegetation near the rapeseed plots (less than 200 m away) were marked, and no treatments or tillage were applied. Brassicaceae species present in the spontaneous patches were identified, and the flowering period of both the spontaneous patches and the crop was recorded. The phenological stage scale proposed by the Centre Technique Interprofessionnel des Oléagineux Métropolitains (CETIOM) was used, which is widely adopted in Argentina and Europe (Aguirre Wibmer and Uriarte Puppo, 2010).

2.2 Flower visitors

The diversity and abundance of flower visitors were simultaneously evaluated in the rapeseed crop and in patches of spontaneous vegetation composed mainly of Brassicaceae species. During the flowering period, white water traps, commonly adopted in entomological studies, were used to capture a wide variety of flower visitors (Toler *et al.*, 2005; LeBuhn *et al.*, 2012; FAO, 2016; Buffington *et al.*, 2021).

Fig. 1. White water traps for capturing flower visitors in patches of spontaneous vegetation at the Chacra Experimental Integrada Barrow.

The traps consisted of 180 ml plastic cups randomly placed: six in the rapeseed sampling area and six in the spontaneous patches at flower level (Fig. 1). The cups were attached to 8 mm twisted iron rods with an *ad hoc* adapter that allowed height adjustment. Approximately 90 ml of water with white soap flakes (to break surface tension) was added to each container. During the period when the flowering of the rapeseed and the spontaneous patches overlapped, the traps were activated weekly at 11:00 AM (-3 GMT) and collected at the same time the next day (24-hour sampling). The insect samples were labeled and preserved in 70% ethanol.

Specimens corresponding to the orders Coleoptera, Hymenoptera, Diptera, and Lepidoptera, mentioned in the literature as the most relevant orders of flower visitors, were counted (Proctor and Yeo, 1973; Barth, 1991; Kevan, 2008). Statistical analyses were performed using the Infostat software (Di Rienzo *et al.*, 2018). Insect count data were transformed to their natural logarithm (ln) and analyzed using analysis of variance (ANOVA) and Fisher's LSD test for mean comparisons.

2.3 Rapeseed yield components

To determine the effect of pollinators on yield and its components in rapeseed cultivars, two treatments were applied: free pollination (FP) and restricted pollination (RP). Prior to the onset of flowering, part of the crop was covered with insect pollinator exclusion cages (Fig. 2) to obtain the RP treatment. The cages, with a surface area of 2 m² and a height of 1.6 m, were constructed with plastic pipes and high-density polyethylene (HDPE) aphid-proof netting. The cages were removed once flowering was completed to minimize their impact on the crop.

The crop was harvested at physiological maturity. To determine this moment, the technique described by the Canola Council of Canada (2013) was used, which considers the color of seeds. For sampling, a 0.25 m² quadrat was randomly thrown within each plot. The number of plants and the number of racemes were registered, and then all the material was manually harvested. From each sample, 20 racemes were randomly selected, and the number of siliques with seeds, the siliques that did not produce seeds, and the number of flowers that did not produce siliques were determined. From each raceme, one silique was randomly selected, and the number of seeds was determined. Thousand seed weight (TSW) was determined using an automatic seed counter. The fat content on a dry matter basis was determined by nuclear magnetic resonance (NMR) at the Laboratorio de calidad industrial de granos of the Chacra Experimental Integrada Barrow. In this work, the terms “fat content” and “oil” are used synonymously.

The yield of each treatment was established by weighing the seeds harvested in the sampling area (0.25 m²) and expressing the value in kilograms per hectare. The fruit set percentage was established using the formula:

Fig. 2. Insect pollinator exclusion cages in the rapeseed crop at the Chacra Experimental Integrada Barrow.

$$\textbf{Fruit set percentage} = \left(\frac{\textbf{Total number of siliques /}}{\textbf{Number of siliques with seeds}} \right) \times 100$$

i.e., the proportion of siliques that produced seeds relative to the plant's potential was determined. Yield component data were also subjected to analysis of variance (ANOVA), and if differences were detected, means were compared using Fisher's LSD test. Statistical analyses were performed using Infostat software (Di Rienzo *et al.*, 2018).

3 Results

3.1 Spontaneous patches

The flowering of rapeseed (F1-G1 on the CETIOM scale) occurred between October and November and lasted approximately 30 days in all trials described. In the study area, spontaneous populations of adventitious Brassicaceae widely distributed in the country were identified, predominantly spontaneous radish (*Raphanus sativus* L.) and mustard species [*Rapistrum rugosum* L. (All.), *Sisymbrium irio* L., and *Hirschfeldia incana* (L.) Lagr.-Foss.] (Fig. 3).

The flowering period of spontaneous species started, in all three years of trials, before the crop flowering. Once the crop flowering ended, flower visitors continued visiting the spontaneous patches, as their flowering extended for at least 30 more days (until the end of December). The flowering period of spontaneous Brassicaceae exceeded 90 days (three times longer than rapeseed crop).

3.2 Flower visitors

In all years, a large number of insect specimens were captured in the spontaneous Brassicaceae patches. In two out of the three years, the number of insects in spontaneous patches was even higher than those visiting the crop ($p < 0.05$) (Tab. 1). This work determined that the same species of flower visitors were captured in both the crop and the spontaneous patches (Tab. 2) implying that insect species present in the study area use the flower resources of both sampling sites. In both the rapeseed and the spontaneous Brassicaceae patches, the most abundant individuals belonged to the order Hymenoptera, with *Campsomeris bistrimaculata* Lepeletier, *Apis mellifera* L., and the Halictidae morphospecies being the most represented groups. These results confirmed the relevance of these plants as food supply for flower visitors.

3.3 Rapeseed yield components

Due to aphid attacks on the Macacha variety plots during 2019, the data were not representative, and the corresponding statistical analyses were not performed. In the remaining five cultivars (Fig. 4), the free pollination treatment (FP) produced significantly more seeds per silique than the restricted pollination treatment (RP) ($p < 0.05$). The fruit set percentage differed significantly in three of the five cultivars ($p < 0.05$), with Bioaureo and Hyola 830 being the cultivars that did not show differences with insect visits ($p > 0.05$). No statistical differences were found for any of the analyzed cultivars in TSW and fat content percentage ($p > 0.05$). In all cultivars analyzed, the yield was significantly higher when insects had access to the flowers ($p < 0.05$).

Fig. 3. Patches of vegetation with spontaneous Brassicaceae near the rapeseed crop plots.

Table 1. Number of flower visitors captured in white water traps in 2017, 2018, and 2019, during the period when the flowering of the rapeseed and the spontaneous Brassicaceae patches overlapped. Identical letters within the same row indicate no significant differences ($p > 0.05$).

Year	Rapeseed	Spontaneous Brassicaceae
2017	149 a	329 b
2018	167 a	348 b
2019	104 a	156 a

4 Discussion

4.1 Importance of spontaneous brassicaceae patches

The flowering of rapeseed is relatively long (approximately one month under the conditions of this study); however, pollinators require other food sources to complete their life cycles. Most entomophilous crops bloom massively and provide valuable resources for pollinators. However, these abundant resources are only available for short periods, so their contribution to maintaining pollinator populations might be of limited importance (Rosado Gordón *et al.*, 2002; Westphal *et al.*, 2003; Garibaldi, 2013; Rader *et al.*, 2016).

This study demonstrated that flower visitors of rapeseed in the south-central region of Buenos Aires use resources provided by both crop and spontaneous species. These results highlight the importance of nearby spontaneous Brassicaceae as food resources, enabling pollinators to complete their life cycle, thus their importance in sustaining pollinator diversity within the agroecosystem. The availability of food resources for pollinators over extended periods in cultivated areas depends on the presence of wild species, whose flowering periods tend to be more irregular and extended than those of crops (Mandelik *et al.*, 2012; Miñarro and Prida, 2013; Morandin and Kremen, 2013; O'Brien and Arathi, 2018). The adverse effects of wild species are often emphasized, while their positive contribution to supporting pollinator populations and other beneficial insects in the crop is overlooked, as noted by Altieri and Nicholls (2004). Other authors have reported that when such plants are removed or their abundance is significantly reduced, both pollinator populations and the yield of some crops are negatively affected (Kearns and Inouye, 1997).

4.2 Flower visitors

The fact that the flower visitors captured in the water traps belonged to several orders is encouraging, as pollinator diversity can enhance crop pollination due to the differences in the functional traits of species (Blüthgen and Klein, 2011; Garibaldi *et al.*, 2013). The Hymenoptera sampled were not only the most abundant but also exhibited intense foraging activity on rapeseed flowers (personal observation). These flower visitors, as reported in a previous study, also carry thousands of rapeseed pollen grains on their bodies (Marinozzi *et al.*, 2023), highlighting their potential as effective pollinators of the crop. Collectively, these results align with other studies that have reported the contribution of honeybees and other hymenopterans to rapeseed pollination

Table 2. Captures in the crop and the spontaneous Brassicaceae patches near the crop in 2017, 2018, and 2019, expressed as percentages for the different groups of flower visitors. C: Rapeseed and S: Spontaneous Patches.

Order	Species	2017		2018		2019	
		C%	S%	C%	S%	C%	S%
Hymenoptera	*Apis mellifera, Xylocopa augusti, Halictidae, Colletes sp., Bombus bellicosus,* unidentified bees. *Campsomeris bistrimaculata, Polybia scutellaris,* unidentified wasps.	67.1	59.3	47.3	43.7	57.7	47.4
Coleoptera	*Astylus quadrilineatus,* unidentified Coleoptera.	3.4	36.8	22.2	46.3	24	41
Diptera	*Eristalinus taeniops, Allograpta sp., Toxomerus sp.,* unidentified Diptera.	22.1	4.0	21	8.3	15.4	10.3
Lepidoptera	*Plutella sp.,* unidentified Lepidoptera.	7.4	0.0	9.6	1.7	2.9	1.3

(Manning and Wallis, 2005; Sabbahi *et al.*, 2006; Araneda *et al.*, 2010; Chambó, 2014; Aldemir and Unay, 2020).

Insects visiting a crop can engage in one or more beneficial interactions (pollination, pest control, etc.), harmful interactions (pollen consumption, herbivory, etc.), or both (Médiène *et al.*, 2011). The latter would be the case for *Astylus quadralineatus*, a pollen-consuming species. Despite their feeding habit, some studies suggest that they could be efficient pollinators when present in large numbers, as they fly between flowers, and their body hairs are covered with pollen (Medan, 1991; Ledford, 2007; Faoro and Orth, 2014). In this study, *Astylus* was found in a higher percentage on spontaneous species than on the crop. One aspect of the spontaneous patches that was not addressed in this study but could be undesirable is their potential role as refuge for the hibernation of these beetles. In France, studies on another pollen-consuming beetle species, *Meligethes aeneus*, have shown that local habitat variables influence the abundance of adults emerging in spring (Rusch *et al.*, 2012).

Many dipterans, such as those from the genera *Allograpta, Toxomerus*, and *Eristalis*, are known to be effective biological control agents of aphids, in addition to performing pollination services (Díaz *et al.*, 2020; Torretta *et al.*, 2021). The dipterans, especially the previously *mentioned genera*, were more abundant in rapeseed than in spontaneous patches. Landscape structure influences the abundance of syrphid flies, and their presence is considered a sign of a healthy agroecosystem (Sarthou *et al.*, 2005; Alignier *et al.*, 2014; Herrault *et al.*, 2016).

Another positive observation is that, in all the years of sampling, the abundance of honeybees was higher in the rapeseed crop than in the spontaneous patches. This is significant because, given the simultaneous availability of both resources, the crop was more extensively visited by bees. Regarding halictids, in 2017 and 2018, they presented a similar proportion in both the crop and spontaneous patches, while in 2019, they were more abundant in the spontaneous patches. According to Kremen *et al.* (2002), pollinator diversity is necessary to buffer the natural population variations that occur between years. Spontaneous species that are relatively unimportant in one year can become the most abundant the following year, thus altering their relative importance in the pollination role.

Most of the bees captured in the trials were solitary species that nest in the ground (Michener, 2007). Steffan-Dewenter *et al.* (2002) concluded that in agricultural environments, the diversity and abundance of solitary bees were strongly correlated with the amount of nearby semi-natural land. Captive insects from the taxa *Bombus* sp. (queens), *Campsomeris* sp., and Halictidae seeked refuge by digging into the soil in laboratory trials. These observations add further evidence to confirm that uncultivated areas not only provide food resources for pollinators but are also suitable sites for the reproduction of many bee species (Ricketts *et al.*, 2008; Garibaldi *et al.*, 2011). Literature indicates that several families, including the pollinators mentioned above, nest in the ground (Kearns and Inouye, 1997; Villemant, 2005; Michener, 2007; Roig-Juñent *et al.*, 2014). Our observations, along with reports on nesting and food sources, corroborate that undisturbed areas benefit these insect populations.

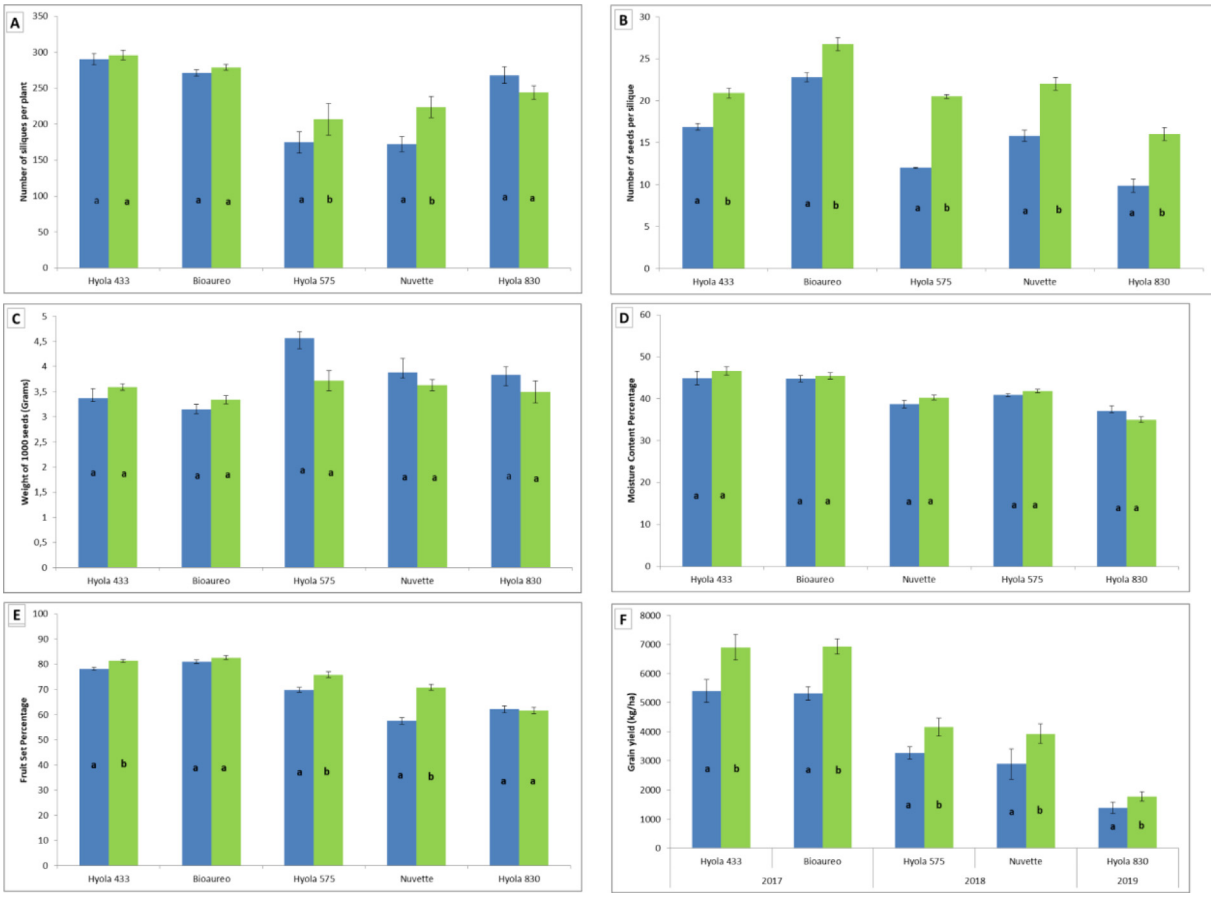

Fig. 4. Yield components of the rapeseed crop, in free pollination (green bars) and restricted pollination (blue bars) treatments for the different cultivars. A = Number of siliques per plant. B = Number of seeds per silique. C = Thousand seed weight. D = Fat content percentage. E = Fruit set percentage. F = Yield expressed in kilograms per hectare. Identical letters indicate no significant differences ($p > 0.05$) between treatments within each cultivar.

4.3 Yield components of rapeseed

Rapeseed exhibits a strong compensatory capacity among yield components, and, on the other hand, its cultivars differ in terms of self-compatibility (Diepenbrock, 2000). Therefore, cultivation conditions, genotype, and the presence of pollinating insects influence the contribution of each component to grain yield. In this study, within the pollinator exclusion cages (PR), flower setting occurred through wind and self-pollination. When insects had access to the crop, the yield was significantly higher for all tested rapeseed cultivars, with an average increase ranging between 27% and 35%. Consistent with our results, several authors have reported improvements in rapeseed yield due to the presence of pollinating insects, particularly honeybees (Manning and Wallis, 2005; Sabbahi *et al.*, 2006; Araneda *et al.*, 2010; Chambó, 2014; Aldemir and Unay, 2020). While they all agree on an increase in yield, the degree of improvement due to pollinating insects varies significantly among these authors. These differences may be due to the variability in environmental conditions under which the trials were conducted and the different cultivars used.

As shown in the results, all cultivars produced a greater number of seeds when the flowers were visited by pollinators (FP), and the improvements in yield components differed among cultivars (Fig. 4). Unlike other studies where only the effect of pollinators on yield components was evaluated (Sabbahi *et al.*, 2005; Bommarco *et al.*, 2012; Mazzei *et al.*, 2021), in this study, yield was determined by weighing the harvested seeds in the sampling plot area (0.25 m²) and expressing the value in kilograms per hectare. According to Ouvrard and Jacquemart (2018), this is the most convenient way to estimate yield for rapeseed, as it is a plastic species with a number of flowers, fruits, and seeds that vary significantly among cultivars. The percentage of fruit set, defined as the ratio between the number of full fruits and the total reproductive organs (Cantagallo, 2000), was also studied.

This concept has been used to study the efficiency of yield generation (seeds or fruits) from the total number of flowers developed in an inflorescence, individual plant, or crop. For this parameter, the free pollination treatment (FP) was significantly higher in three of the five cultivars: Hyola 433, Hyola 575, and Nuvette ($p < 0.05$) (Fig. 4D). These results were comparable to those obtained by Sabbahi *et al.* (2005), who found 61% fruit set in the self-pollination treatment, 73% in the treatment with a density of 1.5 hives ha^{-1}, and 77% with 3 hives ha^{-1}. In the Bioaureo and Hyola 830 cultivars, no significant differences were found ($p > 0.05$), and the fruit set percentage was similar in both treatments.

When analyzing the number of siliques per plant, Nuvette and Hyola 575 showed significant differences ($p < 0.05$), while Hyola 433, Hyola 830, and Bioaureo did not show statistically significant differences ($p > 0.05$) (Fig. 4A). For the number of seeds per silique, all FP treatments produced significantly more seeds per silique ($p < 0.05$) (Fig. 4B). There is heterogeneity among researchers regarding which yield components of rapeseed are most influenced by the environment and by bees. Some authors argue that the number of siliques per plant is more important (Thurling, 1974; Diepenbrock, 2000; Angadi *et al.*, 2003). Others, like Diepenbrock (2000), indicate that yield depends on several factors since rapeseed has a high compensatory capacity. Regarding the TSW, no statistical differences were found for any of the cultivars analyzed ($p > 0.05$). Although several authors (Sabbahi *et al.*, 2005; Manning and Wallis 2005; Araneda, 2010) concluded that the TSW. component is greater in treatments without pollinators, this increase in weight could be attributed to a greater availability of photosynthates for a smaller number of seeds. However, Bommarco *et al.* (2012) found a higher individual seed weight in treatments with entomophilous pollination. In conclusion, the cultivars studied showed different compensation strategies to manifest an increase in productivity per unit area in the presence of pollinating insects.

The oil content is an important variable for the commercialization of rapeseed. These results showed a trend towards a slightly higher oil content with entomophilous pollination (FP), but no significant differences were found between treatments ($p > 0.05$) (Fig. 4D). Langridge and Goodman (1982), also obtained higher average oil content in seeds with free pollination compared to restricted pollination treatments, although this increase was not significant. Since significant differences were found in seed yield but not in oil content, the presence of pollinators influenced the oil yield per hectare through the former variable.

5. Conclusions

Although the region exhibits a high degree of anthropogenic modification due to agricultural activities, numerous insect species forage on the flowers of cultivated and spontaneous Brassicaceae species.

The same species of flower visitors were found in both rapeseed and the nearby patches of spontaneous Brassicaceae. These insects belong to various orders and a wide range of species, including several Hymenoptera, Coleoptera, Diptera, and Lepidoptera, such as *Apis mellifera*, Halictidae, *Campsomeris bistrimaculata*, *Astylus quadrilineatus*, *Allograpta*, *Toxomerus*, *Eristalis*, and *Plutella* sp.

Pollinating insect visits to rapeseed improved seed production and did not alter the oil content percentage, thereby increasing the oil yield per hectare due to its positive impact on grain yield.

This study can be the starting point for adopting crop management practices that consider the preservation of pollinators in the central-southern region of Buenos Aires. To address this, it is essential to understand the existing resources.

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Author contribution statement

All authors contributed to the conception and design of the study. Marinozzi Luciano conducted the experiments, analyzed the results, and drafted the manuscript. Villamil Soledad assisted with the implementation of the research, the analysis of the results, and the manuscript writing. Gallez Liliana made substantial contributions by revising the manuscript and provided critical revisions for intellectual content.

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