COMPARATIVE PERFORMANCE OF HONEYBEES (*APIS MELLIFERA* L.) AND BLOW FLIES (*PHORMIA TERRONOVAE*) IN ONION (*ALLIUM CEPA* L.) SEED SETTING

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ABSTRACT

Effect of honeybee and blowfly pollination on onion (*Allium cepa* L.) seed production was studied at National Agricultural Research Centre, Islamabad. Pakistan during 2005-06. The experiment was laid out in a randomized complete block design with three treatments (caged plants with honeybee, caged plants with blow flies and caged plants without pollinators-control) and four replications each. Number of seed sets from 10 umbels, one from each replication were counted and weighed. The number of seed sets in caged plants with honeybees was maximum as compared to plants caged with blow flies and control. The same treatment also produced maximum seed weight as compared to other treatments. The results revealed that onion seed setting is dependent on insect pollination. The percentage of seed set for first treatment i.e. the plants caged with honeybees ranged from 62-93 with mean number of 80.7±0.93 (mean ± SE), followed by caged plants with blow flies 51-91%, 72.16 + 1.31 (mean ± SE)] and control [7-26%, 16.4 ± 4.09 (mean ± SE)]. The mean weight of seed produced from the plants caged with honeybees was higher (1.90 ± 0.11 g) as compared to blow flies caged plants (1.55 ± 0.89) and control (0.33 ± 0.22). The weight analyses were significantly different in all treatments. It is concluded that honeybees visitation to the flowers is important for pollination but blow flies can be used as an alternate pollinator when honeybees are not available. However, blow flies are not feasible in commercial seed production due to high temperature during peak flowering season in seed production area whereas honeybees are feasible as they can thrive temperature over 40°C. Blow flies are equally good candidates for experimental purposes for pollination.

KEYWORDS: ***Allium cepa; Apis mellifera;*** **Calliphoridae; cross pollination; open pollination; Pakistan.**

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INTRODUCTION

Onion (*Allium cepa* L) is an important vegetable crop and is a major ingredient of cooked food. It can be used in salads, as raw and as a condiment. It is estimated that about 55 million tons of onion are produced annually all over the world (www.fao.org). In Pakistan onion is grown almost throughout the country with the annual production of 1,657,900 tons.

Insect pollination is necessary for many cross pollinated crops especially in case of hybrid seed production e.g. onion (17). The role of honeybees in onion production has been documented by number of authors (1, 17, 22). Managed bee pollination is not possible in all environments thus conserving other pollinators can be a good option in areas which are hot or very cold.

Most of the available literature on onion pollination includes the caged experiments using different flies and bees e.g. *Lucilia* (Diptera: Calliphoridae), *Ersitalis* sp. (Diptera: Syrphidae) and *Osmia rufa* (Hymenoptera: Megachillidae) (4, 7, 13). Onion flowers are protandrous and pollen is shed within 2-3 days before the stigma reach receptivity (14). Self pollination is not possible in onion, therefore pollen must reach from another flower of the same or different plant (25). Higher yield and better control over bulb size could also be obtained if plants are grown at optimum density (11). Onion does not produce quality seed if insects do not visit the flowers (25).

The honeybee, *Apis mellifera* L., is of greatly economic importance in terms of increased yield and quality of commercially grown insect pollinated crops. It also assists self pollinated crops in the world (7). In Pakistan use of bees, except honeybees in few cases, for pollination is still missing dimension in crop production. Honeybee is the only most abundant ecologically important introduced pollinator and is mostly managed for honey production. Onion seed yields, particularly hybrid seed, are heavily dependent on bee pollinator activity for pollination, seed set and adequate yields. In commercial production of seed, the industry depends on the honeybee for pollination (17).

Pollination deficit has been pointed as one of the causes of low onion seed production. The most common insect pollinator in onion fields is the honeybee (18) and according to Woyke (24), the presence of honeybees and other pollinating insects is needed for a good setting and high seed yield.

Apart from honeybees, onion flowers are visited by bumblebees, dipterans and butterflies (10). It was also reported from India that *Apis dorsata* and *Apis florae* are the main pollinators of onion but syrphids also play an important role in pollination. Lesley and Ockendon (15) mentioned that when flowering was not completely synchronous between onion cultivars, honeybees were more selective than blow flies, but where flowering was synchronous; both types of pollinator visited the two cultivars at random.

The present study was conducted to determine the effect of honeybees and blow flies on onion seed production and also to create awareness about pollination services among the onion growers and income generation of beekeepers as rental value of bees.

MATERIALS AND METHODS

This study was conducted at National Agricultural Research Centre, Islamabad, Pakistan during 2005-2006 in a randomized complete block design with three treatments and four replications each. The plot size of 4 x 2 x 1 meter for each treatment with row to row distance of 75 cm and plant to plant distance of 30 cm was maintained. Sowing was done (cv. Phulkara) on 15.10.2005 in 12 plots having four rows each. There was poor sprouting of bulbs in some rows which were filled in by transplanting bulbs from non-experimental area of uniform population. Agronomic practices like hoeing, weeding, application of fertilizer (NPK) and farmyard manure were applied equally in all the treatments.

Seed stems started developing (bolting) in third week of February, while flowering commenced by second week of March 2006. Treatments applied were plants in plots caged with honeybees (T_1), plants caged with blow flies (T_2) and plants caged with no pollinators inside (T_3). Approximately 500 worker honeybees were introduced in locally designed transporting hives in the cages on wooden boards nailed with strong pegs two feet above the ground level to save the hives form rain water and termites attack. Some wooden pieces were placed in plastic bowls for easy access of bees to water source. It eliminated the chance of dipping of bees while drinking/sucking water. Water bowls were replaced twice a week to avoid water contamination with fungus, etc. As some weeds also attract bees so complete eradication of weeds was done in experimental plots for maximizing exposure of onion flowers to honeybees.

To save time and avoid sophisticated equipments blow flies were reared by using a simple technique. In the plots covered with cages, fish heads and cow lungs were placed and cages were left open for an hour in the early morning when honeybees and other inseets except blow flies were not active. Thousands of blow flies were trapped in the cages. About half of flies were removed and remaining were left in the cages. The blow flies survived for two weeks time and whole process was repeated again till the end of flowering which lasted for 30 days. The seeds matured within 45-50 days in different replicates. From every replication 10 matured umbels were selected randomly and number of seeds was counted and weighed for further analysis. SPSS statistical programme version 14 was used to analyze the data.

RESULTS AND DISCUSSION

Maximum seed sets percentage (62-93%) was noted in the plants caged with honey bees with mean number of seeds of 80.7 + 0.93 (mean + SE) (Fig.1). It was followed by the plants caged with blow flies (51-91%) with mean number of seeds of 72.16 + 1.31 (mean + SE). In control treatment seed sets percentage ranged from 7-26 with mean number of 16.4 + 4.09 (mean + SE) (Fig. 1).

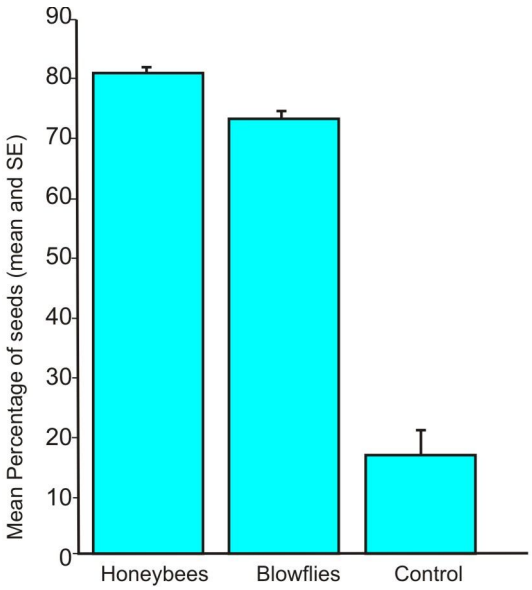

Fig. 1 Mean percentage of seed set in different treatments.

These results do not agree to findings of Alamgir and Alam (2). On the basis of their 17 days observation, a honeybee visited ca 407 onion flowers during its visiting hours in a day and spent 5.5 second per flower. A blowfly on the other hand visited ca 300 flowers and stayed 7.6 seconds per flower. Significantly higher percent of filled ovaries were harvested in blowfly pollinated plots (61.0%) compared to open pollinated (49.5%), honeybee pollinated (49.0%) and control plots (42.2%).

The results obtained were also not confirmed by Lesley and Ockendon (16), who investigated the effect of pollination by blowflies and honeybees and seed yield of onion in breeders cage. They found no consistent difference between pollinators as in two experiments blowflies pollination gave significantly higher yield but in third experiment bee pollination produced significantly more seed.

The percentage of seed set was arcsine square root transformed before analyzing the data. The treatments were found to have significant effect on the number of seeds produced (two way ANOVA, $F_{(2,108)} = 1127.49$, $P < 0.001$). The effect of replications on the number of seed setting did not show any significant effect (two way ANOVA, $F_{(2,108)} = 0.027$, $P > 0.001$). After performing the post hoc tests, all three treatments were found to be significantly different from each other.

In another study (12) blowflies were used in cages and sleeves as crop pollinators for nearly 50 years. The higher seed yields obtained with blow flies may be the result of their continuous presence on or near the flowers and in fact in sleeves the honeybees pollinated in an irregular manner because they attempted to escape and need feeding which puts them at a disadvantage as compared with blow flies.

Farmers often pay beekeepers for placing their colonies by blooming onion fields to attain higher bee foraging populations. Low bee activity in onion has had a deleterious effect on onion seed production leading to reduced or differential seed yields among individual onion cultivars (3). Waller (23) found that bee foraging was inversely proportional to the potassium content. They determined that onion nectar is high in potassium content and concluded that these high levels are the primary factor limiting successful bee pollination of onions. To overcome this problem a number of methods were used to attract the honeybees in onion fields (feeding honeybee colonies onion syrup, stripping colonies of nectar and pollen) but none of the

experiments effectively increased number of honeybees with no desirable improvement in onion seed yield (17). But in this experiment we forced the bees for pollination, hence they produced better seed yield, the reason might be the sugar composition of onion which showed that onion had variable but adequate sugar concentrations that attracted and maintained foraging activity by pollinators (8).

The mean weight of seeds produced from the plants caged with honey bees was 1.90 + 0.11 g (range: 0.44-2.69) and from control it was 0.33 + 0.22g (range: 0.01-0.33g). For seed weight significant difference was observed for all treatments (two way ANOVA, $F_{(2,108)}$ = 100.27, < 0.001). Similar results have also been reported earlier (2) where seed weights per umbel were 3.2, 2.2, 1.59 and 1.1g in blowfly pollinated, honeybee pollinated, open pollinated and untreated control flowers, respectively.

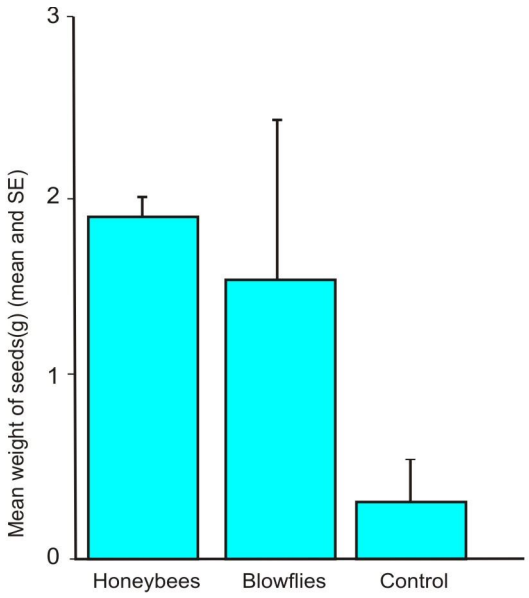

Fig. 2 Mean weight of seeds in different treatments.

Some species of blowflies regularly visit certain plants for sugars and cause cross pollination, but it is not known how to compare their abilities with those of bees. Some plants in the Northern Hemisphere, such as ivy (*Hedera helix)* may be completely dependent on flies for pollination (5).

The blowflies were found to be easier to use and more efficient than hand pollination (17). In the wild they may pollinate a wide variety of flowers as large quantities of pollen have been noted on their bodies (9). They may

have been the main pollination insects before honey bees and bumble bees were introduced in 1839 and 1885, respectively (21).

The study concludes that onion seed yields, particularly hybrid seed, are heavily dependent on pollinator activity for pollination, seed set and adequate yields. Moreover, the insect to be used for pollination, should be easily handled and readily available in large number. Apart from honeybees only blowflies have fulfilled this criterion.

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