Field Performance of Honey Bee on Yield Attributes of Mustard

M.E. Reza[1]*, S. Mandal[2], M.A. Rahman[1], T. Ahmed[1], M.N.A. Siddiquee[1] and M.A. Hossain[3]

[1]Entomology Division, [2]Farm Division, [3]Director General
Bangladesh Sugarcrop Research Institute, Ishurdi, Pabna, Bangladesh

ABSTRACT

The experiment was carried out at BSRI farm, Ishurdi, Pabna during the cropping season 2016-2017. A total of 33 decimal mustard field was selected and variety BARI sarisha 14 was planted in late November, 2016. Two *A. mellifera* honeybee hives were placed adjacent to field. There are three 8m X 8m plot were selected and covered with net where pollination was stopped by honeybee. Data were collected at harvest in treated (netted) and untreated plot (open). Data showed that the open untreated plot where pollination was done by honeybee perform better in all parameters in comparison to netted plots. The plant height (cm), plant weight (g), no. of branch/plant, no. of siliqua/plant, no. of seeds/siliqua was increased 3.84%, 8.99%, 15.32%, 19.86% and 2.08% over treated plot respectively. Also 1000 seed weight (gm) and yield (kg/ha^{-1}) was increased 22.94% and 26.23% over treated plot respectively which is significantly different between the treatments.

Key words: Honeybee, pollination, mustard, yield attributes, *Apis mellifera*

INTRODUCTION

Mustard (*Brassica* spp.), family cruciferae are the major oilseed crop grow throughout Bangladesh for edible oil with average productivity of 1143 kg/ha in 2017-18 (BBS, 2018). It is an open pollinated crop and honeybees are effective pollinators for open pollinated crops because of a lot of nectar and pollens are available on the flowers of mustard. Cross pollination of entomophilous crops by honeybees is considered as one of the effective and cheapest method for triggering the crop yield both qualitatively and quantitatively. Being the pollination service provider bees contribute handsomely in enhancing the productivity and production of cross pollinated crops through efficient pollination in an inconspicuous and silent manner (Singh *et al.*, 2005 and Mohapatra *et al.*, 2010).

*Corresponding author: M.E. Reza, Scientific Officer
e-mail: elmureza@gmail.com

Honeybees are very important social insect known as the most economically valuable insect because of its honey production and pollinating activities (Lawal and Banjo, 2010). Honeybee produces honey, bee wax, royal jelly, pollen, propolis and bee venom. Honey is one of the most nutritive foods containing various kinds of sugars, proteins, free amino acid, minerals, trace element, enzymes and vitamins with a fairly high caloric value (303 calories per 100g honey). It has been used as a component of many commercially manufactured pharmaceutical products. Honeybee venom is produced in several countries and is used for the treatment of rheumatoid arthritis and several other diseases. It is also used for desensitizing hypersensitive individuals (Muzaffar, 1990).The principal role of honeybee in Agriculture is pollination. Due to pollination, done by honeybee crop yield increases, quality of seed and fruit improves and heterosis can be exploited. Beekeeping can play a vital role in sustainable agricultural development as it increases economy without changing environmental balance. Beekeeping is one of the important components of Integrated Rural Development programs (Verma, 1990). Honeybees are the main pollinators responsible for over 98% of visits to flowers of apple. They are among the most important pollinating insects found within orchards and modern agricultural systems (Williams, 1994; Morse and Calderone, 2000). There are many species of honeybee, but four species are common these are *Apis fbrae*, *Apis dorsata*, *Apis cerana* and *Apis mellifera* Due to domestic nature, *Apis mellifera* is the most popular worldwide and can be easily reared, and safely migrated from one place to other for pollination and honey production. *A. mellifera* carried heavier pollen, less aggressive, and produce more honey than the native bee *A. cerana*. It is less prone to swarming for beekeepers who naturally hope to lose their colonies as rarely as possible (FAO, 1986). Like other honeybee species *A. mellifera* has a high flight range for foraging. A worker of this species may fly maximum 2-3 km away from its colony (Abrol, 1997). Therefore, numbers of studies are being carried out to find effective and efficient ways of bee pollination in Brassica as well as other crops throughout the world. The present study is directed towards to assess the role of honeybees, in enhancing the yield of mustard in an inconspicuous and silent manner in increase number of siliqua per plant and number of seeds per siliqua.

MATERIALS AND METHODS

Experiments on field validation of *Apis mellifera* and its effect on yield of mustard crop were set up in BSRI farm, Ishurdi, Pabna. The studies were carried out from November 2016 to April 2017. The mustard variety "BARI Sarisha-14" was sowing during the month of mid November in a 33 decimal area. All recommended agronomic practices were done. The plots were kept unsprayed throughout the crop season. Into the plots, there are three 8m x 8m has been randomly selected which is covered with aerated net. There are two honeybee hives was set up into the field so that honeybee can easily collect pollen and nectar from mustard. The following data were collected from the experiment plot: Plant height (cm); Plant weight (gm); No. of Branch/Plant; No. of Siliqua/Plant; No. of Seeds/siliqua; 1000 Seed Weight (g) and Yield (kg/ha^{-1}). Data analysis was done with statistical software STAR.

RESULTS AND DISCUSSION

Effects of honeybee on yield of mustard

In this study, There are three randomly selected 8m x 8m plot was covered with net and other field was open. So that, into the netted area the honeybee cannot enter and pollinate but the open plot was easily pollinates with honeybees. During harvest same size plot that is 8m x 8m plot was selected for pollinated mustard data collection. From each plot 10 plants were selected randomly and data were collected about mentioned earlier. Table 1 shows that field performance of Honey bee on yield attributes of mustard during 2016-2017.

The mean plant height of mustard was higher (156.00 cm) in untreated open plot in comparison to netted plot which was 150.23 cm and not significantly different There is a little difference among the group of data The mean plant weight of mustard was higher (25.71 gm) in open plot than the netted plot with no significant difference between plots. As P value is greater than F value that means there is no variation among open and netted plot. The mean number of branch per plant of mustard was higher (7.00) in open plot than netted plot. The number of branch per plant was not significantly different between treatments F value (2.40) indicates that there are little effects of treatments. The mean number of siliqua per plant of mustard was also higher in open plot compared to netted plot which is 19.86% increase over netted plot (157.33). The F value is 3.32 and P value is 0.070 indicates that there was difference between the treatments but not significant. Thapa (2006) found in Indian mustard about 11 per cent increased in pod setting.

The mean number of seeds per siliqua of mustard was higher (11.30) in open plot than the netted plot with no significant difference between plots. As P value is greater than F value that means there is no variation among open and netted plot. Many researchers reported similar results, Verma and Joshi (1983) reported that on mustard bloom, honeybee pollination increased the number of seeds by 4.07 per pod. Sanas *et al.* (2014) also found that *A. mellifera* increased the number of seed per pod (23.27%) in mustard under control condition in Maharastra. Significant difference was found on 1000 seed weight of mustard. Open plot showed higher (2.09 g) weight where netted plot showed 1.70 gm and 22.94% weight was increased over control plot. The F value (159.39) indicates there was a wide variation between the treatments.

The yield performance of mustard has a significant difference between open plot (pollinated by honey bee) and netted plot. Higher (1.54 t ha^{-1}) yield was found in open plot and it was 26.23% over netted plot. The F value (139.89) indicates that there was a wide variation between treatments. There are many studies showing the pollinator's role and findings are confirmative with Prasad *et al.* (1989) they reported in *B. juncea*, open pollination gave the maximum yield (1340 kg ha^{-1}) followed by plots caged with one *A. cerana* honeybee colony (1130 kg ha^{-1}), where plots caged without bees (exclusion of pollinators) gave the lowest seed yield (1000 kg ha^{-1}). Sanas *et al.* (2014), also reported that mustard plot gave maximum seed yield (963.45 Kg ha^{-1}) pollinated by free access to all pollinators and lowest yield (602.52 Kg ha^{-1}) in pollination without insect.

Table 1. Field performance of honey bee as pollinator on yield attributes of mustard, 2016-2017

Parameters	Treated plot (Net)	Untreated plot (Open)	% increase over treated	F Value	CV (%)	Sig. (P Value)
Plant Height (cm)	150.23	156.00	3.84	1.98	10.36	0.160
Plant weight (gm)	23.59	25.71	8.99	0.01	74.69	0.978
No. of Branch/Plant	6.07	7.00	15.32	2.40	35.71	0.122
No. of Siliqua/Plant	157.33	188.57	19.86	3.32	38.37	0.070
No. of Seeds/siliqua	11.07	11.30	2.08	0.27	15.56	0.621
1000 Seed Weight (gm)	1.70a	2.09b	22.94	159.39	6.38	0.000
Yield (kg ha^{-1})	1.22a	1.54b	26.23	139.89	7.59	0.000

Relationship among the parameters

Table 2 shows that correlation among different parameters of mustard. There are some statistically positive and negative correlation has been found. Plant height and plant weight, plant height and branch/plant, plant height and seeds/siliqua, plant weight and branch/plant, plant weight and 1000 seed weight, plant weight and yield, branch/plant and siliqua/branch, branch/plant and seeds/siliqua & seeds/siliqua and 1000 seed weight shows negative relations.

All the parameters except plant weight showed positive relation against yield. Also other parameters like plant height and siliqua/branch, plant height and 1000 seed weight, plant weight and siliqua/branch, plant weight and seeds/siliqua, branch/plant and 1000 seed weight, siliqua/branch and 1000 seed weight & siliqua/branch and seeds/siliqua showed positive relation.

Table 2. Field performance of honey bee as pollinator on yield attributes of mustard, 2016-2017

Parameters	Plant Height	Plant Weight	Branch/ Plant	Siliqua/ Branch	Seeds/ Siliqua	100 Seed Weight	Yield (t/ha^{-1})
Plant Height	1	-0.0896	-0.0371	0.1267	-0.1577	0.1922	0.2185
Plant Weight	-0.0896	1	-0.2019	0.0229	0.0846	-0.0299	-0.0031
Branch/ Plant	-0.0371	-0.2019	1	-0.0427	-0.0758	0.1677	0.2253
Siliqua/ Branch	0.1267	0.0229	-0.0427	1	0.0076	0.0959	0.1566
Seeds/ Siliqua	-0.1577	0.0846	-0.0758	0.0076	1	-0.0349	0.0719
1000 Seed Weight	0.1922	-0.0299	0.1677	0.0959	-0.0349	1	0.7638
Yield (t/ha^{-1})	0.2185	-0.0031	0.2253	0.1566	0.0719	0.7638	1

REFERENCES

Abrol, D.P. 1997. Bees and bee-keeping in India. *Indian Bee Journal*, p.1.

FAO, 1986.The tropical and Subtropical Agriculture. FAO Agriculture services bulletin 68, Food and agricultural Organization of the United Nations, Rome. p.283.

Lawal, O.A. and Banjo, A.D. 2010. Appraising the beekeeping knowledge and perception of pests problem in beekeeping business at different ecological zones in South-Western Nigeria. *World Journal of Zoology*, **5**: 137-142.

Mohapatra, L.N.; Sontakke, B.K. and Rana, S.N. 2010. Enhancement of crop production through bee pollination. Orissa review, September, 2010. pp.44-47.

Morse, R.A. and Calderone, N.W. 2000.The value of honeybees as pollinators of U.S. crops. *Journal of Bee Culture*, **3**: 128.

Muzaffar, N. 1990. Beekeeping-An Income-generating cottage Industry for Rural women in Pakistan. In: Honeybees in mountain agriculture, L. R. Verma. Westview Press, Boulder, San Francisco, Oxford. pp. 113-118.

Prasad, D.; Hameed, S.F.; Singh, R.; Yazdani, S.S. and Singh, B. 1989. Effect of bee pollination on the quantity and quality of rai crop (*Brassica juncea* Coss.). *Indian Bee Journal*, **51** (2): 45-47.

Sanas, A.P.; Narangalkar, A.L.; Godase, S.K. and Dalvi, V.V. 2014. Effect of honeybee pollination on quantitative yield parameters of mustard (*B. juncea*) under control condition in Maharastra. *Green Farming*, **5** (2): 241-243.

Singh, R.; Chaudhary, B.K.; Bhowmick. and Singh, R.P. 2005. Honeybee flora of Bihar, Uttar Pradesh and Madhy Pradesh. International Beekeeping Congress, Nov. 13^{th}-18^{th} 2005, Bangalore, India. p.53.

Thapa, R.B. 2006. Honeybees and other insect pollinators of cultivated plants: *A review. J. Inst. Agric. Anim. Sci.*, **27**: 1- 23.

Verma, L.R. 1990. Apiculture in Bhutan: Problems and prospects. In: Honeybee in mountain agriculture, L. R. Verma. West view press, Boulder, San Francisco, Oxford. pp. 163-169.

Verma, S.K. and Joshi, N.K. 1983. Studies on honeybees in the pollination of cauliflower (*Brassica olercea* L. var. Botryitis). *Indian Bee Journal,* **45**(3): 45-55.

Williams, I.H. 1994. The dependence of crop production within the European Union on pollination by honeybees. *Agricultural Zoology Reviews*, **6**: 229-257.