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Influence of Attractants on Bees Pollination and Enhancing the Yield of Mustard

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ABSTRACT: However, numerous factors such as pests and diseases, pesticides, hazards, poor nutrition, poor management and changes in environmental conditions reduce the number of bee colonies, all of which directly or indirectly show an effect on the pollination of agricultural crops, for better pollination and increasing pollination efficiency, we use various types of bee attractants. Among the bee attractants used in mustard crop to evaluated the effect on qualitative and quantitative parameters *viz.*, number of siliquae (pod/plant), siliquae length, number of seeds (seeds/siliquae and seeds/plant), test weight (g/1000 seeds) and total seed yield; treatment Bee-Q @ 1.25 per cent with open pollination was found superior in above parameters. The differences in pollination without insect and open pollination along with bee attractants were significant about almost all aspect. Spraying of bee attractants especially Bee-Q, Jaggery gave higher yield of mustard seed in terms of both quality and quantity when compare to crop caged without bees and open pollination without spraying.

Keywords: Attractants, siliquae, pollination, honeybee, Bee-Q, Jaggery, mustard, qualitative and quantitative.

INTRODUCTION

The mustard crop belonging to *Brassicaceae* or *Cruciferae* family of plant. The name Cruciferae or crucifer is derived from the shape of the flowers. Rapeseed or mustard oil is the most important edible oil in North India which is difficult to be replaced by any other oil. The oil content of most of the types ranges between 30-48 per cent, however, in white mustard it is hardly 25 to 33 per cent. The seed and oil are used as condiment in preparation of pickles and for flavoring curries and vegetables. The oil is utilized for human consumption throughout the northern India in cooking and frying. It is cultivated throughout the India especially in Rajasthan (10.60 lakh ha.) followed by Madhya Pradesh (3.99 lakh ha.) Haryana (1.46 lakh ha.), Gujarat (1.02 lakh ha.), Telangana (0.69 lakh ha.), Uttar Pradesh (0.58 lakh ha.) and so on. Madhya Pradesh is the second largest producers of Rapeseed and Mustard crop; the production of mustard crop is 10.38 lakh tones in the area about 6.75 lakh ha. and the productivity of mustard crop is 1538 kg/ ha (DAC and FW 2020). Most of oilseed crops are cross pollinated. Adequate pollination is vital for any significant increase in seed production. About 90 per cent cross pollination is carried out by the insects, 85 per cent of which comprises bees. Honey bees are efficient and primary pollinators of entomophilous crops. Pollination is one of the important natural factors enhancing crop yield. Mustard is an often-cross-pollinated crop, adequate pollination is vital for significant increase in seed production. Utilization of pollinators especially honey bees is considered as one of the cheapest and ecofriendly inputs in maximizing the yield of cross-pollinated crops. Many experiments have consistently confirmed that the yield levels can be increased to the extent of 50 to 60 per cent in fruits and plantation crops, 45 to 60 per cent in sunflower, sesamum and Niger and 100 to 150 per cent in cucurbitaceous crops through good management of pollinators (Melnichenko and Khalifman 1960). Therefore, bee keeping can play a vital role in improving crop yields besides an additional source of income through honey, bee wax and many other bee products. The present study is directed to assess influence of attractants on the role of honeybees in pollination and enhancing the yield of mustard crop in an inconspicuous and silent manner in both qualitative and quantitative manner.

MATERIALS AND METHODS

The experiment was conducted at Krishi Vigyan Kendra Morena under the Department of Entomology, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, Madhya Pradesh. The study was conducted during two rabi season of 2020-21 and 2021-22 on mustard crop. The various type of indigenousbee attractants *viz.*, T_1-Open pollination

with Sugar solution @ 10%, T_2-Open pollination with Coriander @ 1.25 %, T_3-Open pollination with Jaggery @ 10%, T_4-Open pollination with Cacambe @ (10%), T_5-Open pollination with Onion Solution @ 10%, T_6-Open pollination with Sugarcane juice @ 10%, T_7-Open pollination with Bee-Q @ 1.25 %, T_8-Open pollination without Treatment (Control), T_9-Crop caged with bees and T_{10}- Crop caged without bees were used for the comparison. Crop without any spray served as check. The two treatments were caged before the start of flowering during night to eliminate natural pollinators. Later, remaining treatments were imposed at 10 per cent flowering of the crop. Spraying of attractants was done trice at 10 days interval starting from 10 per cent flowering of the crop. Bee hive with back and front entrance was kept open in one boundary of cage to facilitate the bees to move in and out of the cage. The cage was removed after completion of flowering in order to study the effect of bee pollination in enhancing the productivity and quality of mustard crop. Observations was recorded on five randomly selected plants for six different characters *viz.* number of siliquae/plants, siliqua length (cm), number of seeds/siliquae, total number of seeds/ plants, total seed yield per plant (g), 1000 seeds weight (g) in each replication and required transformation was applied for statistical analysis. The experimental data were subjected to statistical analysis as per the method of randomized block design suggested by Panse and Sukhatme (1954). The significance of treatment was assessed on the basis of determining critical difference (CD) at 5% level of significance results are discussed in this manuscript.

RESULTS AND DISCUSSION

The recorded data and results of two *rabi* seasons 2020-21 and 2021-22 (pooled data also) clearly indicated that, application of attractants has positive effect in increasing the yield and yield related parameters of mustard crop.

***Rabi* 2020-21 Season:** The maximum number of siliquae per plant, siliqua length (cm), total seeds per plant, total seed yield per plant and test weight of seeds (283.33, 6.06 cm,4157.33, 18.89gm and 4.54gm respectively) was recorded in treatment of Open pollination with Bee-Q @ 1.25 % but the maximum number of seeds per siliquae was recorded in the Open pollination with Jaggery @ 10% (15.00) and the minimum number of siliquae per plant, siliqua length (cm), total seed yield per plant and test weight of seeds (241.00, 4.98cm, 8.94gm and 2.93gm respectively) was recorded in treatment Crop caged without bees but the minimum number of seeds per siliqua and total seeds per plant (12.33 and 3025.67 respectively) was recorded in treatment Open pollination Without Treatment (Control). Padamshali *et al.* (2018); Tara and Sharma (2010); Rajashri *et al.* (2012); Shakeel and Inayatulla (2013); Bhowmik *et al.* (2014); Mahadik *et al.* (2019), are also support this finding.

***Rabi* 2021-22 Season:** The maximum number of siliquae per plant, siliqua length (cm), number of seeds per siliqua, total seeds per plant, total seed yield per plant and test weight of seeds (276.33, 6.07cm, 15.67, 4333.67, 19.98gm and 4.61gm respectively) was recorded in treatment of Open pollination with Bee-Q @ 1.25 % and the minimum number of Siliqua length (cm), Number of seeds/siliquae, Total no. of seeds/plant, Total seed yield per plant (gm), 1000 seed weight (g) (5.03, 12.67cm, 3158.33, 9.47gm and 3.00gm respectively) was recorded in treatment Crop caged without bees but the minimum number of number of Siliqua/plant (249.33) was recorded in treatment Open pollination with Coriander @ 1.25 %. These findings corroborated with the results of Pudasaini *et al.* (2014); Choudhary *et al.* (2016); Padamshali *et al.* (2018); Nagi and Mohammed (2016); Yankit *et al.* (2018); Mahadik *et al.* (2019).

Two *Rabi* Season Pooled data: The maximum number of siliquae per plant, siliqua length (cm), number of seeds per siliqua, total seeds per plant, total seed yield per plant and test weight of seeds (279.83, 6.07cm, 15.17, 4247.25, 19.44gm and 4.58gm respectively) was recorded in treatment of Open pollination with Bee-Q @ 1.25 % and the minimum number of No. of Siliqua/plant, Siliqua length (cm), Number of seeds/siliquae, Total no. of seeds/plant, Total seed yield per plant (gm) and 1000 seed weight (g) (245.25, 5.01, 12.67, 3105.17, 9.20 and 2.97 respectively) was recorded in treatment Crop caged without bees. The results are in agreement with the findings of Mishra *et al.* (1990) observed that per cent pod setting, seeds per pod and proportion of healthy seeds were significantly higher in open-pollinated flowers than in net caged and muslin-bagged ones. While, Khan and Chaudhary (1991), reported that insect pollination led to higher yield and formation of well-shaped larger grain and more viable seeds than self-pollination. Goyal (1993), estimated 20 % increase in the yield of sesamum, sunflower and mustard rape due to pollination by honey bees. Padamshali *et al.* (2018); Panigrahi and Maiti (1996); Vaidya (1998); Mahadik *et al.* (2019), Rajasri *et al.* (2012); Nagpal *et al.* (2017); Padamshali *et al.* (2018) both concluded that the effect of pollination on the quality and quantity of rapeseed (*B. campestris* var. *sarson*) under was high open pollinated conditions.

Table 1: Effect of bee pollination on Qualitative and quantitative parameters of mustard in 2020-21.

Treatment	No. of Siliqua/plant	Siliqua length (cm)	Number of seeds/siliqua	Total no. of seeds/plant	Total seed yield per plant (gm)	1000 seed weight (g)
Open pollination with Sugar solution @ 10%	273.67	5.80	14.67	4011.33	15.16	3.78
Open pollination with Coriander @ 1.25 %	252.67	5.50	13.67	3453.00	11.66	3.38
Open pollination with Jaggery @ 10%	276.67	5.78	15.00	4152.33	18.34	4.42
Open pollination with Cacambe @ (10%).	261.00	5.92	13.33	3478.67	12.65	3.64
Open pollination with Onion Solution @ 10%	255.33	5.58	13.33	3406.33	11.97	3.51
Open pollination with Sugarcane juice @ 10%	268.00	5.82	14.33	3843.33	14.29	3.72
Open pollination with Bee-Q @ 1.25 %	283.33	6.06	14.67	4157.33	18.89	4.54
Crop caged with bees.	248.00	5.21	13.33	3307.67	10.86	3.28
Crop caged without bees.	241.00	4.98	12.67	3052.00	8.94	2.93
Open pollination Without Treatment (Control).	245.33	5.10	12.33	3025.67	9.56	3.16
S Em.	3.21	0.05	0.38	116.32	0.51	0.03
CD	9.29	0.14	1.09	336.45	1.47	0.10

() Figures in parenthesis are square root transformed value; NS=Non-Significant

Table 2: Effect of bee pollination on Qualitative and quantitative parameters of mustard in 2021-22.

Treatment	No. of Siliqua/plant	Siliqua length (cm)	Number of seeds/siliquae	Total no. of seeds/plant	Total seed yield per plant (gm)	1000 seed weight (g)
Open pollination with Sugar solution @ 10%	268.00	5.78	14.33	3843.00	16.39	4.26
Open pollination with Coriander @ 1.25 %	249.33	5.52	13.67	3405.33	11.81	3.47
Open pollination with Jaggery @ 10%	271.67	5.77	14.67	3985.00	17.71	4.44
Open pollination with Cacambe @ (10%).	263.00	5.90	14.33	3769.67	14.40	3.82
Open pollination with Onion Solution @ 10%	260.67	5.61	14.00	3653.00	12.88	3.52
Open pollination with Sugarcane juice @ 10%	265.33	5.82	14.67	3893.33	15.89	4.08
Open pollination with Bee-Q @ 1.25 %	276.33	6.07	15.67	4333.67	19.98	4.61
Crop caged with bees.	255.67	5.11	14.00	3581.67	11.78	3.29
Crop caged without bees.	249.50	5.03	12.67	3158.33	9.47	3.00
Open pollination Without Treatment (Control).	251.67	5.15	13.67	3437.33	10.87	3.16
S Em.	3.48	0.06	0.41	130.86	0.78	0.15
CD	10.05	0.17	1.17	378.5	2.26	0.43

( ) Figures in parenthesis are square root transformed value; NS=Non-Significant.

Table 3: Pooled effect of bees pollination on Qualitative and quantitative parameters of mustard (2020-21 and 2021-22).

Treatment	No. of Siliqua/plant	Siliqua length (cm)	Number of seeds/siliqua	Total no. of seeds/plant	Total seed yield per plant (gm)	1000 seed weight (g)
Open pollination with Sugar solution @ 10%	270.83	5.79	14.50	3927.08	15.79	4.02
Open pollination with Coriander @ 1.25 %	251.00	5.51	13.67	3429.17	11.74	3.42
Open pollination with Jaggery @ 10%	274.17	5.78	14.83	4067.42	18.02	4.43
Open pollination with Cacambe @ (10%).	262.00	5.91	13.83	3624.50	13.51	3.73
Open pollination with Onion Solution @ 10%	258.00	5.60	13.67	3528.00	12.42	3.52
Open pollination with Sugarcane juice @ 10%	266.67	5.82	14.50	3868.67	15.08	3.90
Open pollination with Bee-Q @ 1.25 %	279.83	6.07	15.17	4247.25	19.44	4.58
Crop caged with bees.	251.83	5.16	13.67	3442.83	11.31	3.29
Crop caged without bees.	245.25	5.01	12.67	3105.17	9.20	2.97
Open pollination Without Treatment (Control).	248.50	5.12	13.00	3230.08	10.21	3.16
S Em.	2.58	0.05	0.30	99.08	0.49	0.08
CD	7.47	0.15	0.88	286.57	1.42	0.23

( ) Figures in parenthesis are square root transformed value; NS=Non-Significant

CONCLUSIONS

Among the all the indigenous food attractants Bee-Q @ 1.25% solution attracted maximum number of bees followed by Jaggery @ 10% and Sugar solution @ 10%. Honey bee species showed better activity during 1st day after spraying at 10 and 50 per cent flowering but the better results in case of number of siliquae (pod/plant), siliquae length, number of seeds (seeds/siliquae and seeds/plant), test weight (g/1000 seeds) and total seed yield were observed in Bee-Q @ 1.25 per cent treated open pollinated crop plot. The differences in pollination without insect and open pollination along with bee attractants were significant with regard to almost all aspect. Spraying of bee attractants especially Bee-Q, Jaggery Coriander and Sugar solution gave higher yield of mustard seed in terms of both quality and quantity when compare to crop caged without bees and also open pollination without spraying.

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Conflict of Interest. None.

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