COMPARATIVE ASSESSMENT OF HONEY BEES AND OTHER INSECTS WITH SELF-POLLINATION OF SARSON IN PESHAWAR

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Abstract

Self-pollinated Sarson plants (covered with muslin netting) produced 26.46 to 34.34 (mean 28.68) grams of seed per plant while honey bee pollinated and non-apis insect polliant-ed plants yielded 67.2 to 90.02 (mean 74.37) grams and 41.72 to 56.35(mean 48.42) grams per plant, respectively. The increase in seed yield due to insect pollination was 159.31% in case of honey bee pollinated plants and 68.83% in non-apis insect pollinated plants. Besides pro-ducing increase yield insect pollination caused formation of well-shapped, larger grains and more viable seed than the self pollinated plants.

Introduction

Pollination is a mechanical transference of pollen grains from anthers to stigmas of the same or different flowers. It is a vital link in fertilization complex process resulting in the production of fruits and seeds of flowering crops. Pollination is an important component of one of the essential inputs (equally seed, fertilizer and irrigation) for better and higher produc-tion but it is indispensible in oil seed, fruit and vegetable seed production. According to Howard et al (1915), the flowers of mustard open between 9 a.m. and noon, and continues for 3 days. Mohammad (1935) reported that only 37 percent of bagged flowers were able to form pods themselves as against 100 percent in cross pollinated toria. Rahman (1940) has found 105 insect species belonging to 55 families pollinating *Brassica napus* and *B, compestris* of which honey bees, *Apis indica* were predominating. According to Kremer (1945) most of grain pro-ducing crops require the service of insect for cross pollination, out of which honey bees are the most satisfactory natural pollinators. Mustard is an excellent source of nectar and pollen for honey bees (Pellett 1947). Sneep (1952) mentioned that better seed yield of brassica crops can be obtained from honey bees pollination in green houses. Priestley (1954) tried successfully the use of bees as pollinators in green houses and obtained better results. Sampson (1957) showed that compatibility varies with species, cultivar, and even the age of the plant. Eckert (1959) reported that heavy pollen are carried by insects, mostly honey bees while light ones by wind. Latif *et al* (1960) reported that *Apis indica* (*cerana*) were able to increase the yield of brassica crops by about 100% Olsson (1952) obtained a setting of 64.7% of the flowers, with 2.46 seeds per pod, and 1.75g per pod with bees excluded, but with bees present these values were increased to 95.3, 4.08, and 2.69, respectively, more than doubling the total production. Koutensky (1959) also showed that the seed yield of white mustard were increased by 66%

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with honey-bees pollination. Varieties of the polish rape are almost completely cross pollinated (Anonymous 1961). Wind can carry pollen grains from one plant to another but insect pollinators principally honey-bees ensure complete pollination. Free and Spencer-Booth (1963) found that bees more than doubled seed production of *Brassica alba*. Pritsch (1965) also obtained significantly better yields of white mustard in cages with bees than in cages where bees were excluded. Free and Nuttal (1968) stated that Brassica plants caged with honey-bees produced 13% more seed than those without bees. According to Cook (1972) legumes, brassica and sunflower are greatly benefited from the honey-bees visitation. Free and Williams (1973) reported that cross pollination required for setting of fruit and seed crops is accomplished through honey bees. Shahid and Mohammad (1976) obtained the lowest yield from the raya plants (*Brassica* sp.) covered with polythene bags than the plants left open under natural conditions. McGregar (1976) has listed fifty three crops dependent upon or greatly benefited by insect pollination in USA. Kauffeld and Nelson (1982) obtained higher yield of cucumber foraged by *Apis mellifera* and the cucumber fruits were well-shaped and larger in size. Parker (1983) stated that there are about ninety five crop species grown in USA which are dependent upon or greatly benefiting from insect pollination. Tanda (1984) reported that honey bee pollination increased the bell retention by 25–51% and improved the quality of cotton. William (1985 (a) reported that honey-bee pollination played a vital role in the production of over US $ 95 million worth of horticultural crops in North Carolina in 1983. William (1985 b) reported that honey-bee pollination is indispensible in cucumber production. Khan *et al* (1986) stated that Honey-bees are physically well suited and "Flower Constant" that is visiting only one kind of flower at a time either for nectar or pollen collections.

Keeping in view the paramount economic importance of honey-bees in crop pollination, experiments were carried out at Peshawar to evaluate the role of honey-bees in pollination of sarson, (*Brassica compestris* L.) which occupied 41,995 hectares and yielded 21,749 tonnes of sarson seed during 1981-82 (Siddiq *et al* 1981-82).

Material and Method

The experiment was conducted at Badaber Mera, at a distance of 26 Km from the NWFP Agricultural University, Peshawar in order to avoid honey-bees routine visitation during 1986-87 with the following parameters:

T_1 = Pollination by honey-bees.

T_2 = Pollination by non-Apis insects.

T_3 = Self Pollination without insect pollinators.

The crop was sown on 25-10-1986 in an area of half a hectare. Two meter wide border line was discarded on all four sides of the field and the central areas was divided into four replications. From each replication three plants were taken at random and tagged as T_1, T_2 and T_3 for observations. The T_3 plant in each replication was covered with muslin cloth

supported by four sticks fixed in soil around the plant in order to avoid pollinators. T_2 plants were left uncovered for non-apis pollinators in each replication. T_1 plants were covered with muslin cloth supported by four sticks fixed in soil around the plant for introduction of honey bees in each replication. When the crop started blooming (5%) ten honey bee foragers of *Apis mellifera* were used to release in each T_1 enclosure in the morning and were recollected at dusk for putting in the respective hive. The process was repeated till the shedding of petals. The total number of pods formed and grain weight per plant were recorded at maturity.

Results and Discussion

The observations on the pollination and pod formation in Sarson, *Brassica compestris* L. were compiled for each treatment and replication. The data so collected were analysed and are presented in Table-1.

Table 1. Comparative effect of insect pollination and self-pollination on pod formation of sarson.

Treatment	Average seed bearing pods per plant in				Mean pods per plant
	R_1	R_2	R_3	R_4	
Honey bees pollinated	760	664	940	1086	862.50
Other insect pollinated	540	496	626	705	591.75
Self-pollinated	442	428	450	512	458.00

ANOVA

	DF	SS	MS	F-Value	Prob
Total	11	475600.92			
Variable-1	3	99190.92	33063.639	5.41*	.038
Variable-2	2	339753.17	169876.583	27.81**	.000
Error	6	36656.83	6109.472		
Non-additivity:	1	36626.36	35626.357	172.86	.000
Residual:	5	1030.48	206.095		

Grand Mean = 637.417 Grand Sum = 7649.00 Total Count = 12
Co-efficient of variation = 12.26%.

As seen from the table the average seed bearing pods per plant were 664 to 1086 (mean 862.5) in the honey bee pollinated plants, 496 to 705 (591.75 mean) in non-apis insect pollinated plants and 428 to 512 (458 mean) in self pollinated plants. As seen from the analysis of varience the difference of seed bearing pods is significant among the replications but the difference among treatments is highly significant. The pod formation is maximum (862.5) in honey bee pollinated plants followed by non-apis pollinated plants (591.75) and the least number of pods (458) in self-pollinated plants. It is quite evident that insects helped in pollination and formation of pods in Sarson, *Brassica compestris* L.

The observations on seed weight per plant in each treatment and replication were compiled. The data were analysed and are presented in Table-2.

Table 2. Comparative effect of insect pollination and self-pollination on seed setting and yield of sarson.

Treatments	Average seed weight per plant per replication (grams)				Mean seed weight per plant (g)	% increase over self-pollinated
	R_1	R_2	R_3	R_4		
Honey bee pollinated.	67.20	60.48	79.80	90.02	74.37	159.31
Other insect pollinated.	44.80	41.72	50.82	56.35	48.42	68.83
Self-pollinated.	27.44	26.46	28.49	34.34	28.68	—

ANOVA

	DF	SS	MS	F-Value	Prob
Total	11	4797.68			
Variable-1	3	525.77	175.258	6.69*	.024
Variable-2	2	4114.76	2057.381	78.56**	.000
Error	6	157.14	26.190		
Non-additivity	1	147.81	147.807	79.18	.000
Residual	5	9.33	11.867		

Grand Mean = 50.660 Grand Sum = 607.920 Total Count = 12
Co-efficient of Variation = 10.10%.

The comparison of data revealed that mean seed weight per plant was 74.37, 48.42 and 28.68 grams in honey bee pollinated plants, non-apis insects pollinated plants and self-pollinat-

ed plants, respectively. As shown in analysis of varience the difference in seed yield among the treatments is highly significant (Table-2).

The increase in yield of Sarson seed due to insect pollination over self-pollination was recorded to be 159.31% and 68.33% respectively, in honey pollinated and non-apis insects pollinated plants.

The honey bee pollinated brassica plants have shown 159.31% increase in seed yield as compared to 100% increase shown by Latif et al (1960), 66% reported by Koutensky (1959) and 13% by Free and Nuttal (1968).

It has been established that insects help in pollination of Sarson plants and increase seed yield. The non-apis pollinators also showed significantly more pod formation and seed yield but their number being not enough to cover the entire plant population the maximum effect is not realized. The contention has been proved by releasing honey yield by 159.31%. It is therefore, desirable that honey bees may be employed for pollination of brassica crops for realizing maximum seed yield.

Optimum number of bee colonies required for maximum pollination of brassica crop has not been worked out. Yakovleva (1975) recommends the introduction of 0.5-1 hive/ha in USSR while McGregor (1976) has indicated that provision of one to two colonies per acre should be encouraged.

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