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Effect of plant and animal origin products on growth parameters of Honey Bee, *Apis Mellifera* (L.) At Pantnagar, Uttarakhand- An eco-friendly and novel approach

Brijesh Bisht and Ruchira Tiwari

Abstract

The preliminary studies were conducted in G.B. Pant University of Agriculture and Technology, Pantnagar to find out the effect of plant and animal origin products on growth parameters of honey bee, *A. mellifera*, reared in old and newly drawn wax combs for six generations during the year 2016 and 2017. The maximum larval weight (128.63mg) and (131.78mg) was observed in desi cow urine treated old bee frames and neem leaf powder treated new bee frames, respectively. The maximum weight of newly emerged adults (112.66 mg) and (118.77mg) was recorded from buffalo urine treated old bee frame and desi cow urine treated new bee frames, respectively. The maximum mean sealed worker brood areas were calculated in old bee frames (304.24cm²) and newly drawn combs (311.63cm²) treated with desi cow urine. Thus, the results showed positive effect of pure desi cow urine, buffalo urine, powders of neem leaves and ajwain seeds on growth parameters of honey bees, whereas, the goat urine and cow urine based plant extracts showed adverse effect on the growth parameters of honey bees.

Keywords: Ajwain, cow urine, eco-friendly, growth parameters, honey bee, neem

1. Introduction

Honey bees play a key role in agriculture and environmental preservation as efficient pollinators of plant flora and thus carrying the work of conservation and maintaining the plant biodiversity [1]. Honey bees along with other pollinators present in the ecosystem provide free service in the ecosystem to pollinate the crops and around 70% pollination is carried out by bees alone and farmers throughout the world depend on animal pollinators to produce an estimated 35% of the global food supply [2].

Besides, pollinating the crop, the honey bees have to face the danger of exposure to toxic chemicals and that result in their mortality or contaminating the bee hive with toxic residues of chemicals on crop [3]. The larvae of the honey bee workers treated with pyriproxyfen at different periods retarded both the larval and pupal developments and declined the adult emergence rate [4]. The adverse effect of juvenile hormones on the growth and developmental parameters of honey bees [5].

Thus, it becomes a matter of concern for us to protect the bees from the toxic effect of chemicals and must find suitable alternatives to chemicals. The residues of NeemAzal granules (1% azadirachtin) did not adversely affect bee mortality, foraging activity or brood development. So, as a remedial measure, plant and animal origin products such as neem can be utilized as neem have got many potential ingredients such as azadirachtin and limonene which not only provide protection against diseases but also ward of insect pest by acting as ovipositional and feeding deterrent [6-7]. The extensive use of synthetic pesticides in agriculture system proved failure and has compelled the scientific community to go back to the traditional and indigenous products for tackling the pest problems. Beside urine of different animals and their decoction, plant based products such as ajwain and neem has got the important component to be a basis for bee protection [8].

According to the research work on the efficacy of cow urine, powders of neem leaf and ajwain seeds for honey bee disease management, it was found to be a potential alternative to the toxic pesticides, as a results it opens a novel area of research by using these animal and plant origin products [8]. As far as the effect of eco-friendly formulations on honey bees is considered, the use of cow urine has been considered as Sanjivani for honey bee disease management with no

adverse effect on bees [9]. The authoress depicted the successful stories of beekeepers of Uttarakhand and Uttar Pradesh utilizing the simple and innovative cow urine based disease management technique in beekeeping and reaping the benefits from it and even regarded cow urine as Panacea for honey bees.

The usage of animal origin products in beekeeping is a novel approach all over the world. The animal urine collected from cow breeds (desi, holstein and jersey), buffalo and goat used in bee protection is inspired from the notion that, cow is a mobile dispensary and cow urine is remedy for all ailments [10].

Though, very few scientists have studied about rate of growth of honey bees and the effect of insecticides on the growth and developmental parameters of worker honey bees but we can surely say that research work on the effect of animal and plant origin products on growth and developmental parameters of honey bees are untouched. As the use of animal urine, neem powder and ajwain seed powder in beekeeping is believed to create a congenial environment in bee hive by increasing their grooming habit and they tend to become more active, hence are able to ward off insect pest and diseases [11].

Therefore, with this prelude, a novel approach was followed under field conditions to evaluate the efficacy of plant and animal origin products also on the growth parameters of worker honey bees to find out there positive or adverse effect on different stages i.e. larvae, pupae and adults along with sealed worker brood areas.

2. Materials and Methods

2.1 Collection of animal and plant origin products and preparation of desired formulations

The tested animal origin products i.e. urine from desi, jersey, holstein cow breed, desi breed murrah buffalo and local breed goat were collected from houses of local farmers and stored in adequate amount for experimental purpose. The test plants, leaves of neem (*Azadirachta indica*, L.) were collected from the University campus Pantnagar and ajwain seeds (*Trachyspermum ammi*) were purchased from Pantnagar Market. Subsequently, the plant extracts of neem leaves and ajwain seed powder @1%, were prepared by taking 10g of dried leaf powder of neem and ajwain seeds and weighed separately by using a top balance, macerated in the electrical grinder and dipped in 1000 ml of cow urine in containers and were kept for fermentation for 24h and then filtered by using muslin cloth.

2.2 Field experiments on efficacy of plant and animal origin products on growth parameters of honey bee, *A. mellifera* reared in old and new wax bee combs for six generations during 2016-17 at Pantnagar

The field experiments on the effect of plant and animal origin products on growth parameters of worker honey bee reared for 1st to 6th generations in old as well as newly drawn beeswax combs (Frames) were carried out in year 2016 and 2017 on the following parameters such as

1. Per cent eggs hatched
2. Egg hatching period (days)
3. Mean weight of larvae, pupae and adult
4. Mean sealed worker brood area (cm²)

Thus, the main aim of study was concentrated around whether there is any change in any of these and up to what extent in comparison to growth parameters of workers in untreated control.

To compare the growth parameters of larvae of worker honey bee, experiments were conducted in one year old bee combs and newly drawn bee combs, separately in Langstroth beehives with 8-9 bee frames. An area of 10x10cm=100cm² (with approx. 400 cells) of newly laid eggs was selected/marked in each bee colony in three replications. The dusting of powders and sprays of urine of cow, buffalo, goat and formulations prepared i.e. Neem Leaf Cow Urine Extract (NLCUE) @ 1% and Ajwain Seed Cow Urine Extract (ASCUE) @1 % were done separately on the marked areas containing newly laid eggs of worker bees. The second dusting/spraying were done after 15 days on the marked areas in the bee colonies. The regular monitoring of the treated bee frames was done and the readings were taken after the dusting/spraying of the formulations on mean number of eggs hatched and mean days for egg hatching was taken 3 days after spray to find out that if the hatching period is prolonged or remain unchanged. The mean weight of 4th, 6th and 8th day's old (sealed) larvae was also calculated by taking out 10 larvae/replication and average weight was noted down. Similarly, weight of pupae and adult bees was also taken and compared with the weight of the larvae, pupae and adult bees developed in the bee colonies without treatments (untreated control). The mean sealed worker brood areas (SWBA) and nectar and pollen stores in both old and newly drawn bee frames were also noted under all treated and untreated bee colonies to find out the effect of plant and animal origin products on the brood growth and development in honey bee colonies.

2.2 Brood measurement

Sealed worker brood areas (SWBA) were recorded after one month of application of the treatments using a plastic sheet divided into square inches and converted into cm² after multiplied by 2.54 [12].

2.3 Statistical Analysis

Data was subjected to Complete Randomized Design (CRD) after suitable transformations. The per cent data was subjected to Square root transformations with 0.5 as adding factor.

3. Results

3.1 Effect of eco-friendly plant and animal origin products on growth parameters of honey bee reared for six generations in old Frames (wax combs) during March to September 2016 at Pantnagar, Uttarakhand

The data given in Tables 1 and 2 showed that the egg hatching was taken 3-4 days in all treatments except 4-5 days was recorded in bee colonies treated with Goat urine, NLCUE and ASCUE with comparatively less per cent egg hatching in one year old bee frames as well as newly drawn frames as mentioned below.

The compiled data given in Table-1 on overall per cent egg hatching, mean weight of larvae, pupae, newly emerged bees and sealed worker brood areas in treated bee colonies after six generations of worker honey bees reared in one year old bee frames during March to September 2016 at Pantnagar, Uttarakhand clearly showed the highest egg hatching (94.06%) in Ajwain seed powder treated bee colonies followed by Desi cow urine (91.72%) while in other treatment the egg hatching ranged from Ajwain Seed CowUrine Extract (ASCUE) (80.00%) to Neem leaf powder (91.33%) whereas minimum egg hatching (77.17%) was observed in Neem Leaf Cow urine Extract (NLCUE) treated bee colonies followed by Goat urine (78.17%) with 86.94%

egg hatching was observed in untreated bee colonies. The studies conducted on worker honey bee of *A. mellifera* for six generations using eco-friendly plant and animal products clearly suggested positive effect on the overall weight of 4 days old larvae of worker honey bees, as highest weight was observed in Buffalo urine (34.15 mg) which was at par with Desi cow urine (34.01 mg), whereas the least larval weight was recorded in Goat urine treated bee colonies (26.65 mg) followed by ASCUE (28.54mg) and NLCUE (29.54mg). While among the other treatments the larval weight was ranged from (30.55mg to 32.98mg) in Holstein cow urine and Ajwain seed powder treated bee colonies, respectively with least larval weight (27.18 mg) was recorded in untreated bee colonies. Similarly, the maximum weight (101.00 mg) of 6 days old larvae of worker honey bees was observed in bee colonies treated with Desi cow urine followed by Buffalo urine (100.93 mg), neem leaf powder (98.37mg) and ajwain seed powder (94.92 mg). The least weight of 6 days old worker larvae was observed in NLCUE (79.29 mg) followed by goat urine (84.13 mg) and ASCUE (84.80mg) with (87.04 mg) in untreated bee colonies. The weight of 8 day old sealed larvae of worker bees reared in one year old frames was recorded the highest in Desi cow urine treated bee colonies (128.63 mg) followed by Buffalo urine (127.07 mg), Ajwain seed powder (126.36 mg) and Neem leaf powder (125.62 mg), while the least weight was observed in NLCUE (93.12 mg), ASCUE (96.83 mg) and Goat urine (109.66 mg) with (121.18 mg)

weight of sealed larvae was recorded in untreated bee colonies. The overall mean pupal weight of worker honey bees recorded the highest in bee colonies treated with Ajwain seed powder (121.92 mg) followed by Desi cow urine (120.11 mg) which was at par with Jersey cow urine (120.08 mg) and Buffalo urine (119.02 mg). The least pupal weight was observed in bee colonies treated with Goat urine (101.47 mg) followed by ASCUE (105.64 mg) and untreated control (108.01 mg). The overall mean weight of newly emerged adults of worker honey bees calculated for six generations reared on old bee frames was found highest in bee colonies treated with Buffalo urine (112.66 mg) followed by Desi cow urine (108.69 mg) and Neem leaf powder (105.91 mg), whereas the least adult weight was observed in Goat urine (87.61 mg), NLCUE (89.34 mg) and ASCUE (91.33 mg) treated bee colonies with (102.09 mg) adult weight was recorded in untreated bee colonies. The overall mean Sealed Worker Brood Areas (SWBA) calculated for one year old bee frames for all the treatments after one month of the experiment till six generations was found highest in Desi cow urine (304.24 cm²) followed by Neem leaf powder (303.04 cm²), Buffalo urine (298.69 cm²), Ajwain powder (296.27 cm²), with again the least SWBA measured in bee colonies treated with Goat Urine (188.97 cm²) followed by ASCUE (203.90 cm²) and NLCUE (209.23 cm²) with SWBA (187.25 cm²) in untreated bee colonies

Table 1: Effect of plant and animal origin products on growth parameters of honey bee, *Apis mellifera* reared for six generations in one year old bee combs during March to September 2016 at Pantnagar, Uttarakhand (Overall average values calculated from 1st to 6th generations of worker honey bees)

S. No.	Treatments	Conc.	Egg hatching (%)	Egg hatching duration (days)	Mean weight (mg)					Mean Sealed worker brood area (cm ²)
					Larva			Pupa	Newly emerged worker bee	
					4 days old	6 days old	8 days old (Sealed larvae)			
1	Desi cow urine	100%	91.72 (73.29)*	3-4	34.01 (5.87)**	101.00 (10.07)	128.63 (11.36)	120.11 (10.98)	108.69 (10.45)	304.24 (17.46)
2	Jersey cow urine	100%	90.66 (72.20)	3-4	31.41 (5.65)	89.48 (9.48)	115.74 (10.78)	120.08 (10.98)	105.15 (10.29)	286.12 (16.93)
3	Holstein cow urine	100%	88.00 (69.74)	3-4	30.55 (5.57)	89.46 (9.48)	120.88 (11.02)	115.07 (10.75)	102.76 (10.16)	261.89 (16.19)
4	Buffalo urine	100%	90.55 (72.11)	3-4	34.15 (5.89)	100.93 (10.07)	127.07 (11.29)	119.02 (10.93)	112.66 (10.64)	298.69 (17.29)
5	Goat urine	100%	78.67 (62.49)	4-5	26.65 (5.21)	84.13 (9.19)	109.66 (10.49)	101.47 (10.09)	87.61 (9.39)	188.97 (13.76)
6	NLCUE	1.0%	77.17 (61.46)	4-5	29.54 (5.48)	79.29 (8.93)	93.12 (9.67)	110.20 (10.52)	89.34 (9.48)	209.23 (14.48)
7	ASCUE	1.0%	80.00 (63.44)	4-5	28.54 (5.39)	84.80 (9.24)	96.83 (9.86)	105.64 (10.30)	91.33 (9.58)	203.90 (14.29)
8	Neem leaf powder	5g/hive	91.33 (72.86)	3-4	30.78 (5.59)	98.37 (9.94)	125.62 (11.23)	117.93 (10.88)	105.91 (10.31)	303.04 (17.42)
9	Ajwain Seed powder	5g/hive	94.06 (75.88)	3-4	32.98 (5.78)	94.92 (9.77)	126.36 (11.26)	121.92 (11.06)	104.77 (10.26)	296.27 (17.23)
10	Untreated Control	-	86.94 (68.81)	3-4	27.18 (5.26)	87.04 (9.35)	121.18 (11.03)	108.01 (10.42)	102.09 (10.13)	187.25 (13.70)
	Sem±		0.009 (0.019)		0.014 (0.002)	0.024 (0.003)	0.029 (0.003)	0.012 (0.021)	0.016 (0.002)	0.038 (0.032)
	CD 5%		0.029 (0.058)		0.042 (0.005)	0.071 (0.009)	0.088 (0.085)	0.037 (0.004)	0.041 (0.005)	0.110 (0.075)
	Cv		0.019 (0.049)		0.080 (0.052)	0.046 (0.005)	0.044 (0.005)	0.074 (0.005)	0.023 (0.028)	0.025 (0.003)

NLCUE- Neem Leaf Cow Urine Extract ASCUE- Ajwain Seed Cow Urine Extract

*Figures in the parentheses are angular transformed values ** Figures in the parenthesis are square root transformed values with adding factor 0.5

3.2 Effect of eco-friendly plant and animal origin products on growth parameters of honey bee reared for six generations in newly drawn frames (wax combs) during July 2016 to January 2017 at Pantnagar, Uttarakhand

The data presented in Table-2 clearly showed the highest egg hatching (93.55%) in Desi cow urine treated bee colonies followed by Ajwain seed powder (92.28%), Holstein cow urine (92.22%), Neem leaf powder (91.39%), Buffalo urine (91.28%) and Jersey cow urine (90.78%) whereas significantly less egg hatching was observed in bee colonies treated with NLCUE (73.61%), Goat urine (75.55%), ASCUE (78.89%) and untreated control (87.22%).

The compiled data for all six generations of worker honey bees reared in newly drawn frames (wax combs) showed the affirmative effect of eco-friendly animal and plant products on overall weight of 4 days old larvae of worker honey bees showing highest larval weight in colonies treated with Buffalo urine (72.51 mg) and Ajwain seed powder (68.73 mg). Whereas the least larval weight was recorded in Goat urine treated bee colonies (55.83 mg), Desi cow urine (60.08 mg) and NLCUE (60.44mg) with (64.33 mg) larval weight in untreated bee colonies.

The overall weight of 6 days old larvae of worker honey bees was recorded the highest in Desi cow urine (119.88 mg) treated bee colonies followed by Buffalo urine (117.54 mg), Holstein cow urine (116.91 mg) which was at par with Jersey cow urine (116.23 mg) followed by Neem leaf powder (114.73 mg) and Ajwain seed powder (108.02 mg). On the other hand, the least larval weight was observed in Goat urine treated bee colonies (85.05 mg) followed by ASCUE (89.11 mg) and NLCUE (90.74 mg) with (107.76 mg) in untreated bee colonies.

The overall mean weight of 8 day old (sealed larvae) of

worker honey bees reared in newly drawn frames showed the highest weight in Neem leaf powder treated bee colonies (131.78mg) followed by Desi cow urine (130.12 mg), Buffalo urine (129.29 mg) whereas the least larval weight was recorded in bee colonies treated with Goat urine (103.11mg) which was at par with NLCUE (103.98 mg) and ASCUE (106.19 mg) with comparatively more larval weight (122.21 mg) was observed in untreated bee colonies.

Similarly, the overall mean pupal weight of worker honey bees was recorded highest in bee colonies treated with Jersey cow urine (122.01 mg) followed by Buffalo urine (120.72 mg), Ajwain seed powder (119.81 mg) which comparable with untreated be colonies (118.58 mg). The least pupal weight was observed in bee colonies treated with NLCUE (96.73 mg) and Goat urine (100.79 mg).

The overall weight of newly emerged adults of worker honey bees was calculated till six generations and found the highest adult weight in bee colonies treated with Desi cow urine (118.77 mg) followed by Buffalo urine (117.03 mg), Neem leaf powder (115.56 mg), Ajwain seed powder (114.05 mg), Holstein cow urine (110.64 mg), untreated control (110.02 mg). Whereas, the least adult weight was observed in Goat urine (92.48 mg), ASCUE (97.23 mg), NLCUE (99.75 mg) and Jersey cow urine (108.94 mg) treated bee colonies.

The compiled overall mean SWBA were calculated for all the treatments after one month of the experiment till six generations and found the highest in Desi cow urine (311.63 cm²) followed by Neem leaf powder (308.79 cm²), Jersey cow urine (298.32 cm²), Buffalo urine (297.77 cm²), Ajwain powder (297.54 cm²), Holstein cow urine (284.68 cm²) and NLCUE (215.95 cm²) with the least SWBA measured in bee colonies treated with ASCUE (192.31cm²) followed by Goat urine (211.95 cm²) and untreated (213.28 cm²).

Table 2: Effect of plant and animal origin products on growth parameters of honey bee, *Apis mellifera* reared for six generations in newly drawn frames during July 2016 to January 2017 at Pantnagar, Uttarakhand (Overall average values calculated from 1st to 6th generations of worker honey bees)

S. No.	Treatments	Conc.	Egg hatching (%)	Egg hatching duration(days)	Mean weight					Mean Sealed worker brood area (cm ²)
					Larva (mg)			Pupa (mg)	Newly emerged bee(mg)	
					4 days old	6 days old	8 days old Sealed larvae			
1	Desi cow urine	100%	93.55 (75.29)*	3-4	60.08 (7.78)**	119.88 (10.97)	130.12 (11.43)	109.81 (10.48)	118.77 (10.89)	311.63 (17.65)
2	Jersey cow urine	100%	90.78 (72.31)	3-4	62.89 (7.96)	116.23 (10.80)	122.86 (11.11)	122.01 (11.05)	108.94 (10.44)	298.32 (17.27)
3	Holstein cow urine	100%	92.22 (73.81)	3-4	63.07 (7.97)	116.91 (10.84)	125.30 (11.23)	116.61 (10.79)	110.64 (10.52)	284.68 (16.87)
4	Buffalo urine	100%	91.28 (72.81)	3-4	72.51 (8.54)	117.54 (10.86)	129.29 (11.39)	120.72 (10.99)	117.03 (10.82)	297.77 (17.25)
5	Goat urine	100%	75.55 (60.36)	3-4	55.83 (7.50)	85.05 (9.25)	103.11 (10.18)	100.79 (10.04)	92.48 (9.62)	211.95 (14.56)
6	NLCUE	1.0%	73.61 (59.09)	4-5	60.44 (7.81)	90.74 (9.55)	103.98 (10.22)	96.73 (9.83)	99.75 (9.99)	215.95 (14.69)
7	ASCUE	1.0%	78.89 (63.11)	3-4	62.73 (7.95)	89.11 (9.47)	106.19 (10.33)	115.68 (10.75)	97.23 (9.86)	192.31 (13.87)
8	Neem leaf powder	5g/hive	91.39 (72.93)	3-4	62.91 (7.96)	114.73 (10.73)	131.78 (11.50)	112.98 (10.63)	115.56 (10.75)	308.79 (17.57)
9	Ajwain Seed powder	5g/hive	92.28 (73.86)	3-4	68.73 (8.32)	108.02 (10.42)	127.44 (11.31)	119.81 (10.95)	114.05 (10.68)	297.54 (17.25)
10	Untreated Control	-	87.22 (69.06)	3-4	64.33 (8.05)	107.76 (10.40)	122.21 (11.08)	118.58 (10.89)	110.02 (10.49)	213.28 (14.60)
	Sem±		0.109 (0.074)		0.018 (0.002)	0.032 (0.002)	0.052 (0.007)	0.031 (0.003)	0.043 (0.003)	0.043 (0.003)
	CD 5%		0.325 (0.221)		0.054 (0.007)	0.096 (0.006)	0.038 (0.032)	0.092 (0.008)	0.029 (0.008)	0.008 (0.015)
	CV		0.218 (0.186)		0.039 (0.049)	0.052 (0.036)	0.042 (0.028)	0.047 (0.043)	0.069 (0.043)	0.048 (0.054)

NLCUE- Neem Leaf Cow Urine Extract ASCUE- Ajwain Seed Cow Urine Extract

*Figures in the parentheses are angular transformed values ** Figures in the parenthesis are square root transformed values with adding factor 0.5

4. Discussion

It has been searched in literature that nothing or a little research work was done concerning rate of growth of honey bee larvae. But it is peculiar that no studies have been made on the efficacy of eco-friendly plant and animal origin products for their effect on honey bee growth parameters and the present studies conducted were the novel and preliminary approach in field of beekeeping throughout the world.

It has been determined that the mean weight of newly emerged bees from old comb in which 68 generations had emerged was about 19% smaller and bees reared in new comb weighed about 8.3% more than those reared in old comb^[13]. Similarly, worker bees reared in old combs may weigh up to 19% less than bees reared in new combs^[14]. The present investigations on the effect of animal and plant products on the growth parameters of worker honey bees were conducted in one year old and newly drawn bee frames (wax combs) to find out the change in growth parameters in brood and adults of treated honey bees, as it has been described^[15] that old aged combs used for brood rearing becomes darker, almost black, and more brittle because of accumulated faecal material, propolis and pollen. The darker colour may also be a result of numerous undefined contaminants that are collected and absorbed in the wax over time suggested that smaller cell diameters result in smaller bees in old comb because of the lack of space and a relative shortage of food.

The age of bee comb affected the growth of honey bee colony and brood survivorship as over three years of field study concluded that honey bee colonies housed on new comb had a greater area of total brood, a greater area of sealed brood, and higher weight of individual young bees^[16]. The researcher^[17] conducted first important work on the rate of growth of honey bee larvae in bees wax combs in *A. mellifera* colonies.

It has been evaluated that the topical application of 0.5 µl azadirachtin at between 100 and 500 ppm concentrations to fourth instar larvae did not affect adult bee's lifespan^[18]. The laboratory bioassay studies showed the toxicity of neem oil (35 EC) at different concentrations (0.075–0.03%) to cells containing eggs and young larvae of honey bees as the contents of most of the treated cells were removed by workers, and many of the remaining larvae were neglected and died by starvation and the survived were small and deformed^[19].

It has been investigated that worker larvae were more sensitive to azadirachtin than adult worker bees, exhibiting an LC₅₀ of 180.92 ng/ml to purified azadirachtin and 100.13 ng/ml to formulated azadirachtin. More than 90% of treated, normal-appearing, white prepupae and pupae showed precocious and abnormal pigmentation on their mouthparts and other appendages^[20]. The sub-lethal effects of pesticide residues in brood comb, on worker honey bee development and longevity were studied in bee colonies of *Apis mellifera* and results showed the reduced adult longevity, increased brood mortality, higher fecundity of *Varroa* mites due to delayed development and emergence of adult bees^[21].

Therefore, it is clearly proved from the above references that no any research work has been conducted on the effect of animal and plant products on the growth parameters of honey bees, *A. mellifera* worldwide and the present investigations are the preliminary as well as a novel approach in the field of beekeeping.

5. Conclusion

The present studies clearly showed the positive effects of Desi, Jersey and Holstein cow urine, Buffalo urine, along with

Ajwain seed and Neem leaf powders on honey bees growth parameters as they have no negative impact on egg hatching and also increased the larval, pupal and adult weights of worker honey bees with increase in sealed worker brood areas which is the essential requirement of any healthy bee colony. On the other hand, Goat urine and Cow urine based neem leaf and ajwain seed extracts (NLCUE and ASCUE) were found harmful for honey bee brood. Thus, it may be concluded that cow urine, buffalo urine, powders of neem leaves and ajwain seeds were found safe with no lethal effects on brood and the bees but the deeper and detailed studies regarding the activity of these plant and animal origin products on honey bees are essentially required for better use of these products in the field of honey bee management.

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