Entomology

Winter packings in honey bees (*Apis cerana*) to reduce winter mortality in Kashmir Himalayas

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Abstract

Bees provide a range of ecosystem services that contribute to the wellbeing of people whilst maintaining the planet's life support systems by pollination services. It is very important to save this creature by caring its health. A colony of honey bees (*Apis cerana*) does not hibernate in winter. The bees form cluster, clinging tightly together on the combs of hive. They employ fairly sophisticated thermal management strategies to prepare the nest and protect the colony from freezing. However, the precise nature of the cluster, its response to external temperature and ability to survive extreme cold for extended periods in chilly winter in Kashmir was studied in this programme. the activity of honey bees in harsh winter in Kashmir valley especially the 40 days which starts from 20th December to January 30th which cause winter mortality in bees. Colony winter mortality varied considerably in different regions of the state. Survey conducted during2015-2020 revealed that 72.55 percent farmers used gunny bags as packing material while as 26.93 percent use rice straw. Our study shows highest 80.00percent survivability of bees with using packing combination of Paper Rice straw gunny bags. The economics of migratory and non-migratory honey bees were worked out in our study programme.

Keywords: health, honey bees, *Apis cerana*, winter packings

Introduction

Honey bees settle in wide range of climate from the tropics to cool temperature zones. as winter approaches, honey bees employ fairly sophisticated thermal management strategies to prepare the nest and protect the colony from freezing. An individual worker bee can sense changes in temperature to within 0.25^{0}c using temperature receptors located on its antennae. Foraging activities generally stop around 10^{0}c (50^0 F) and honey bees have been known to survive the winter without door temperature as low as -29^{0}C(-20^{0}F). Lower ambient temperatures and diminishing floral resources prompt workers to drastically reduce brood rearing. Simultaneously, food (pollen and honey) is stored for the winter, creating a thermal mass to help regulate internal hive temperature. As the external temperature drops and colony reduces the size of its brood nest, the bees reduce their core nest temperature from 34^{0}c (93^{0}F) to approximately 18^{0}c (64^{0}F). Honey bees can retain heat in two ways, first they can retain heat over the long term by selecting a good nest site that is tightly sealed and enclosed. Larger entrances or those located at the top of the cavity, will significantly increase heat loss for the colony during winter. Sealing the cavity also plays a role in temperature management. While colonies seal up un wanted cracks and gaps in hive components. This sealing also helps with the overall defense of the hive by limiting possible openings for intruders as well as reduce the likelihood of unwanted air flow in winter. Secondly, they retain heat over the short term by "Clustering" where adult members of the colony huddle close together to reduce the volume of air needing thermal management (fig-1). This has a twofold effect of reducing the surface area of bee bodies exposed to cold air as well as creating a thermal mass of bees protecting the temperature of the remaining brood in the brood nest (usually right in the center of this mass of huddled bees). Thus, clustering has a profound effect on heat retention by drastically decreasing the surface area and subsequent heat loss. As the ambient temperature drops below-10^0 C(14$^{0C)}$, heat retention is in sufficient to keep cluster warm. At this point the adult bees begin to generate their own heat by consuming carbohydrate (In the form of honey) and exercising their powerful flight muscles while remaining clustered inside the hive. As such, the bees are their own central heating system. The rate of heat generation is proportional to the temperature difference between inside the hive and out over the cause of winter, as bees die and the cluster size shrinks, younger bees take up the heat generation task, consuming honey, flexing their flight muscles, generating heat and waiting for spring.

Material and methods

The Present studies were under taken at SKUAST-Kashmir at an apiary of Division of Entomology during 2015-2020.In the first week of October colonies were grouped into six lines with three colonies in each line. Each colon was treated as one replication. The colonies of each line/yard were given different packing material. The Colonies were made of equal strength with seven frames each in order to keep space available for packing material. Sufficient stores (honey) were left for feed during winter. The Entrance of all colonies were minimized with mud. All colonies were checked for the presence of healthy queen, store and bee strength before given winter packings. The treatments described here include (1) the

colony in the unprotected hive without packings referred to as check colony (2) the colony in the hive wrapped with insulation/packing material referred as packed colony. The swarming, absconding, disease incidence and the Cost benefit of each treatment was studied.

Fig 1: Hives under snow and Bee cluster in Kashmir during winter

Results

The survey results that in district Ganderbal both the species of honey bees were found in the apiaries of farmers. Results depicted that 63.48 percent farmers are using bags as winter packing materials and 34.99 percent farmers used rice straw as packing material. The strength of the colonies was found exceptionally good. While in district Srinagar 73.56 percent farmers use Gunny bags as winter packing for their honey bee live stock and 26.43 percent farmers use rice straw as winter material. In district Ananthnag 80.62 percent farmers use gunny bags while 19.39 percent use rice straw as packing material. Overall 72.55 percent farmers use Gunny bags as wintering material while 26.93 percent of farmers use rice straw as wintering material (table-1). We conduct an experiment in which we use different packings in combination as a packing material for *Apis cerana* at our apiary in SKUAST-Kashmir Shalimar, also the cost benefit was worked out at the conclusion of experiment. The results show highest expenditure 305.40 Rupees were found in treatment-1 (Paper + Rice straw + Gunny Bags) and 3.5 Kg of honey is harvested from per colonies with 1:2.48 C:B ratio. On the other side lowest 283.40 Rupees expenditure were found in treatment having Gunny bags + Rice straw + Thermocole only the packing material with cost benefit ratio 1:1.16. Highest (1:3.08) c:B ratio was found in treatment having Thermocole + Dry leaves + Gunny bags as packing material while in control having no packings the cost benefit ratio (1:0.5) was recorded (Table-3).

The survey conducted on Managed bee colonies in Kashmir revealed that colony winter mortality varied considerably in different regions of the Mountain state over the study and was variable within regions of this state. Table-2 depicts over all mean mortality varies from 12.00 to 12.66. The results further show highest mean percent winter mortality (12.66%) recorded in Srinagar and Anantnag while as Ganderbal recorded (12.00%) mean winter mortality of honey bees (Table-2).

Table 1: Winter management practices of honey bee hives adopted by beekeepers and its Status in Kashmir

District	Type of packing	Type of bees	% Farmers adopting		Mean (%)	Position of colony
			2015	2020		
Ganderbal	Gunny bags	1 &2	66.66	60.30	63.48	+++
	Rice straw	1 &2	33.33	36.66	34.99	+++
	No packing		----	---	---	
Srinagar	Gunny bags	1 &2	71.42	75.71	73.56	+++
	Rice Straw	1 &2	28.59	24.27	26.43	+++
	No packing		-----	-----	-----	
Anantnag	Gunny bags	1 &2	87.50	73.75	80.62	+++
	Rice Straw	1 &2	12.52	26.26	19.39	+++
	No packing		----	----	-----	
Mean	Gunny bags				72.55	
	Rice Straw				26.93	
	No Packing				0.00	

1&2= *Apis mellifera & Apis cerana*, +++ = Strong condition

Table 2: Winter mortality loss of Managed honey bees in Kashmir due to haresh winter Chilling

District	Percent Loss of Honey Bee Colonies due to Winter Chilling					
	2015	2016	2017	2018	2019	2020
Ganderbal	14.00	12.00	8.00	14.00	10.00	14.00
Srinagar	12.00	14.00	12.00	14.00	8.00	16.00
Ananthnag	14.00	8.00	16.00	12.00	14.00	12.00
Pooled (winter mortality % loss)						12.44

Table 3: Pooled effect of various winter packaging materials used for packing of bee hives during 2015-20 (Non migrated colonies)

Colony No	No. of Bee Frames during autumn (Before Packing)	Treatment	Observations recorded (after opening winter packing)						
			% Survival of Bee frames in spring	Swarming/ Absconding	Incidence/ Disease/insects	Robbing	Expenditure on feeding, packing, treatment (Rs)	Yield	C:B Ratio
1	5.0	Paper+ Rice straw+ Gunny Bags	80.0	S+	-	-	305.40	3.5	1:2.52
2	5.5	Paper+ thermocole+Rice straw	72.72	S+			300.40	2.5	1:1.79
3	6.0	Gunny bags + Rice straw + Thermocole	50.00	S+	D+,I+	-	283.40	1.5	1:1.16
4	5.5	Paper + Gunny Bags	54.54	S+	_	R+	285.00	3.0	1:2.27
5	6.5	Thermocole + Dry Leaves + Gunny Bags	69.23	S+	_	_	285.40	4.0	1:3.08
6	6.5	Control	10.00	-tive	+tive	+tive	300.0	0.5	1:0.5

Rate of Honey= Rs 220/kg, S+ =Swarming, D+=Disease, I+ =Mite and R+= Robbing

Conclusion

Winter Packings in Kashmir is a necessary management practice as for *Apis mellifera* bees are concerned, in our study we find considerable bee losses occur during whole season in which winter chill is one of the threat to apiculture industry in this region which affects the health of the managed bees. The Impact of different packing materials on winter chill coma or mortality in Kashmir Himalayas were mercury dips up to Minus 15^0c in Plains during winter months. Secondly the economic information generated is of great value to beekeepers and of great value to beekeepers and of the interest to bee scientists and other insect behaviorists.

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