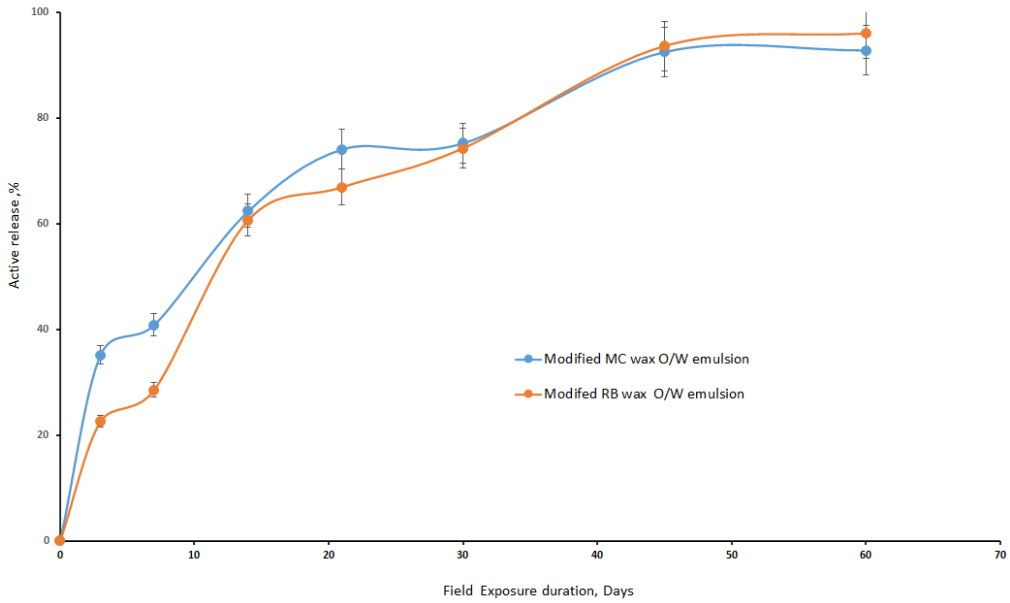

Figure 1

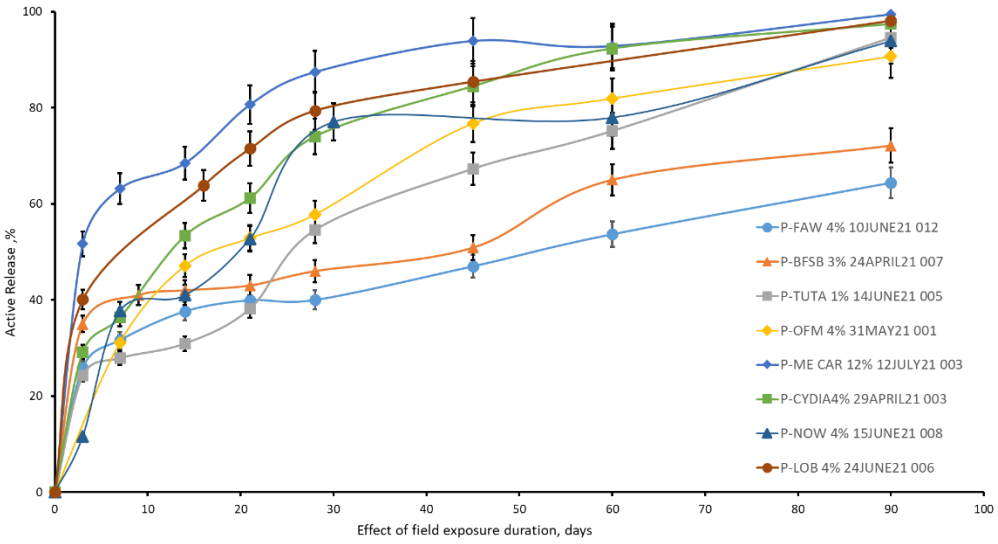

Figure 2

R. SAKTHIYA DAKSHI (IN/PA-2533)
(Agent for the Applicant)

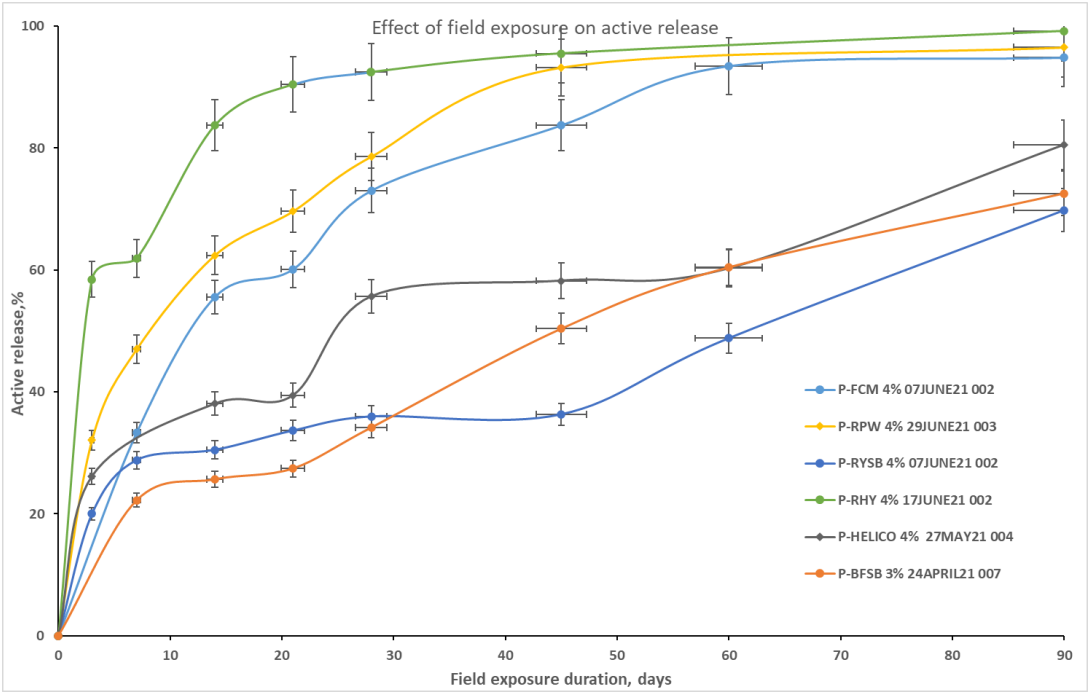

Figure 3

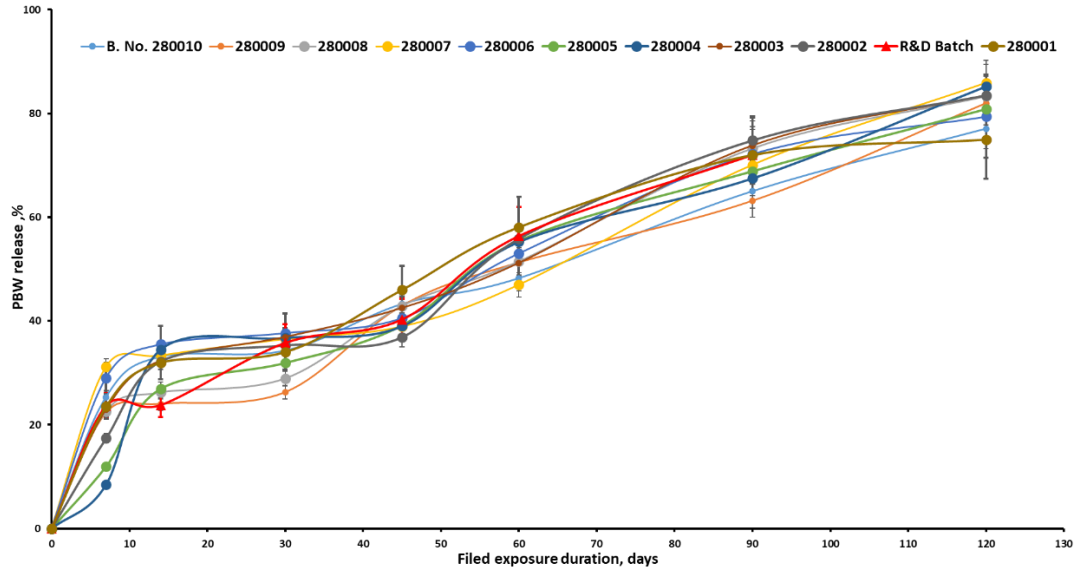

Figure 4

R. SAKTHIYA DAKSHI (IN/PA-2533)
(Agent for the Applicant)

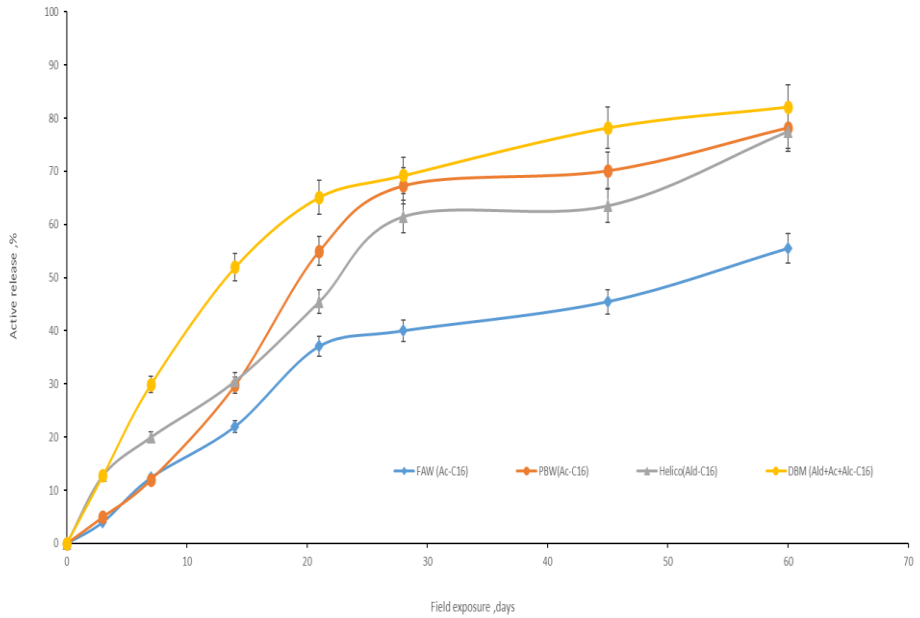

Figure 5

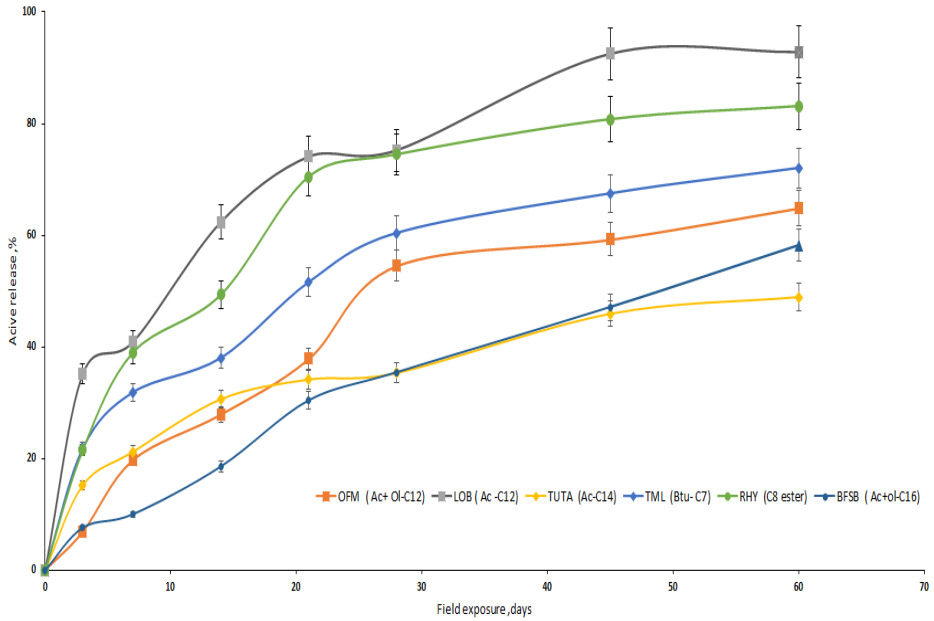

Figure 6

R. SAKTHIYA DAKSHI (IN/PA-2533)
(Agent for the Applicant)

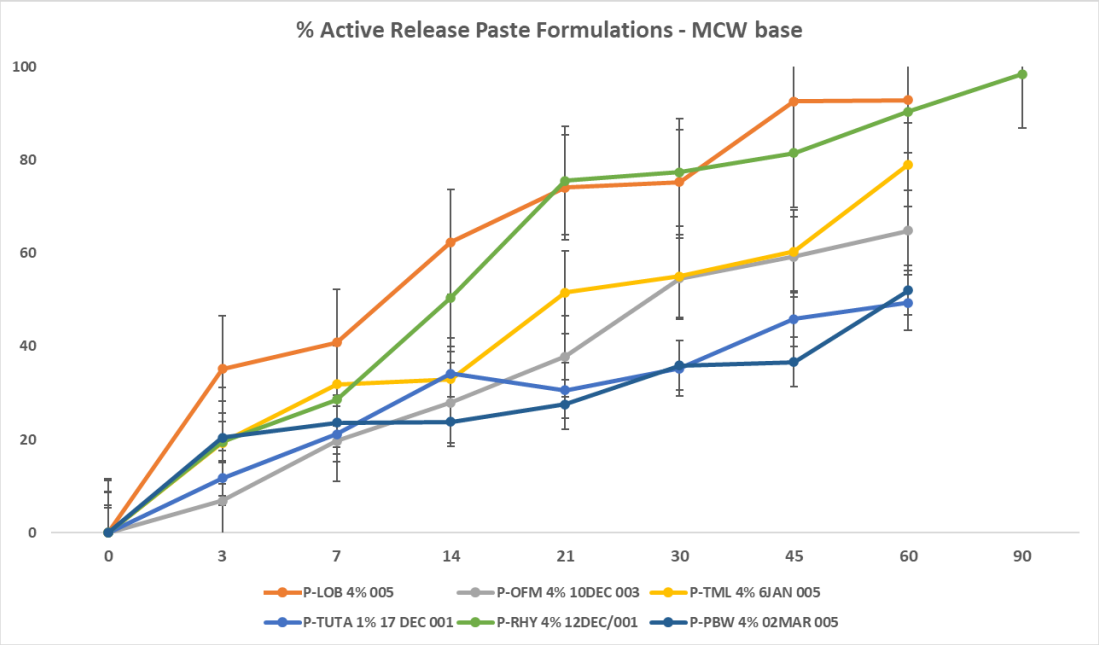

Figure 7

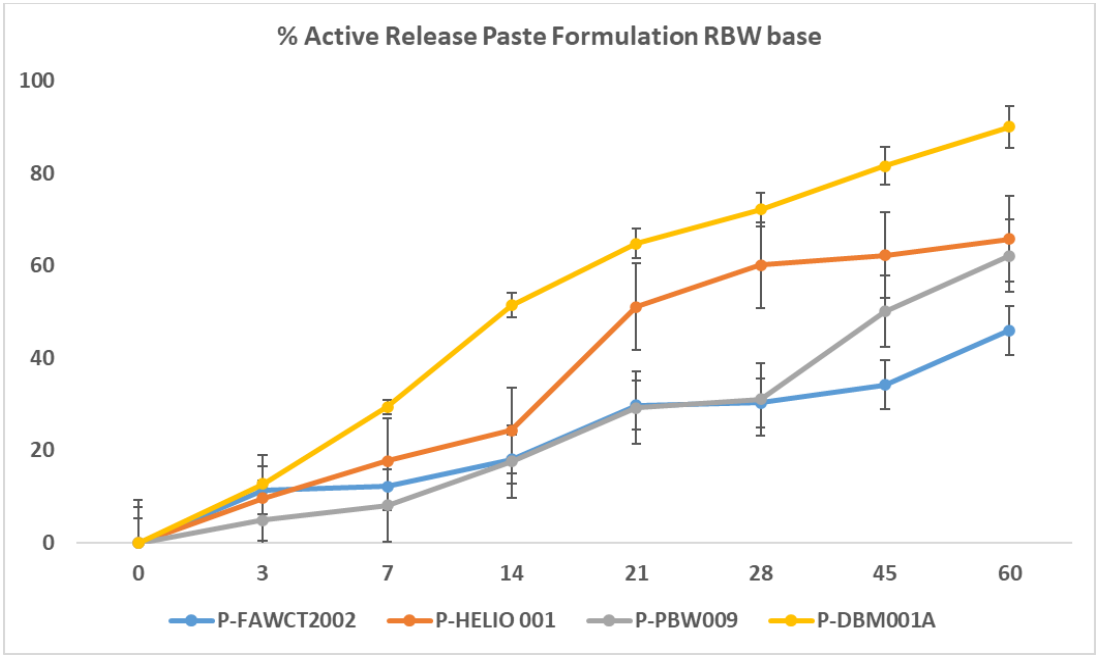

Figure 8

R. SAKTHIYA DAKSHI (IN/PA-2533)
(Agent for the Applicant)

FORM 2

THE PATENTS ACT, 1970

(39 of 1970)

AND

The Patents Rules, 2003

COMPLETE SPECIFICATION (*DRAFT*)

(See Section 10; Rule 13)

1. TITLE OF THE INVENTION:

"CONTROLLED RELEASE SEMI-SOLID EMULSION FORMULATIONS OF SEMIOCHEMICALS"

2. APPLICANT:

(a) NAME: **Pheromone Biotech LLP**

(b) NATIONALITY: **An Indian firm**

(c) ADDRESS: **Plot No-1, Mahalakshmi Residency, Kompally, Hyderabad - 500014, Telangana, India.**

4. PREAMBLE TO THE DESCRIPTION:

The following specification particularly describes the invention and the manner in which it is to be performed.

CONTROLLED RELEASE SEMI-SOLID EMULSION FORMULATIONS OF SEMIOCHEMICALS

FIELD OF THE INVENTION

The present disclosure relates to a controlled release semi-solid water dispersible emulsion formulation comprising semiochemical/s, in particular, relates to a formulation of semiochemical/s in the form of cream or gel or paste with variable viscosity. The formulation is amenable to manual or mechanical applications in agriculture and which is compatible with or without insecticides. Further, the present disclosure relates to a semiochemical/s delivery vehicle / diffuser, in a natural environment to trigger insect chemical behavioural modification for season long insect control.

BACKGROUND OF THE INVENTION

The global population is projected to increase around 9.7 billion by 2050, which will result in a tremendous demand for food. With the increase in the global population, there will be a corresponding increase in the demand for food to feed the growing population. Various strategies are being used to increase the supply of food including better irrigation for soil based agriculture, aeroponics, hydroponics, and pest management by use of chemicals (such as insecticides, pesticides), genetic modification of plants / organisms, integrated pest management.

Insecticides have a wide application in the field of agriculture and industry. They are being used for a number of years to increase the crop yield by controlling insects that harm crops/ food. However, there are many drawbacks associated with the use of insecticides, such as harmful to non-target organisms, to beneficial insects, building up of resistance by the insects, and environment. They have the potential to alter biodiversity and ecosystem components majorly and are toxic to animals as well as humans. Some insecticides become concentrated as they spread in the food chain. Traditional pest control methods relies on indiscriminate use of insecticides being sprayed at regular intervals from sowing to harvest has induced insecticide resistance.

With the growing insecticide resistance, failing genetic modification of plants / organisms and scant environmentally friendly new chemical pest control molecules in pipeline, there is a need to develop pest control technologies by way of new mechanism of action by use of nontoxic chemicals.

Insect Pheromones which are species specific have proven useful in pest control and have become essential components of crop protection as part of Integrated Pest management. The eco-friendly semiochemical based pest control strategies developed are by way of using sex pheromones for mating disruption & mass trapping, host-plant volatiles are used for attract & Kill, Push Pull techniques that have largely replacing conventional insecticides. Though very effective these semiochemical compounds are used in very high amounts and so far formulated in polymer based protective matrices. Another drawback is that they have been inefficiently deployed in field in the form of plastic dispensers (Ex: hand-applied ropes, tapes, and sachets) all of which have limited the adoption of the technology.

Semiochemical/s (AI) intended to create semiochemical plumes or cloud or atmospheric saturation of the crop field to modify insect behaviour to control the target pest require very low amounts of pheromone . However, due to inefficient diffusers a very high doses of expensive semiochemicals per treated area currently ranging from 80 grams to 250 grams per hectare, have inconsistent performances, generate plastic waste and are very expensive limiting the adoption of use of the technology. The dose presently in use and registered globally for the purpose of mating disruption use exorbitantly very high dose of pheromone than actually required. Based on existing reports on the amount of pheromone females release in environment it's obvious that we can disrupt mating with even 1/10thth of the A.I quantity presently registered and commercially in use. Thus for the technology to be adopted a diffuser which can release semiochemicals close to zero or 1st order and the one which is not effected by environmental variations like rain, wind, UV rays and temperature and last season long in the field will help adopt the technology replacing conventional insecticides.

Various compositions related to agrochemicals for controlling insects and methods for preparing the same are known in the art and are elucidated hereinafter. Method for the preparation of micro capsular formulations of agrochemicals comprises preparing the paste or suspension of the conventional active agrochemical ingredient in vegetable oil and dispersing the resultant paste/solution in water. Compositions to attract and kill insect pests comprising

an organic biodegradable matrix component from natural sources; an organic biodegradable ultraviolet light absorbent matrix component from natural sources; a biodegradable insecticidal or acaricidal compound; and a pheromonal or kairomonal attractant and procedures to prepare it are known.

Stabilized insect mating disruption pheromone composition comprising an insect pheromone and 2,2′-Methylenebis(6-t-butyl-p-cresol) and methods of use and microcapsules containing these compositions are also known.

Fre´De´Rique M. De Lame et.al [Development and Evaluation of an Emulsified Paraffin Wax Dispenser for Season-Long Mating Disruption of Grapholita molesta in Commercial Peach Orchards. J. Econ. Entomol. 100(4): 1316Ð1327 (2007)] describes a sprayable composition with paraffin wax after emulsification with water in combination of pheromones for mating disruption of Grapholita molesta in peach orchard. The major drawback of this composition is that, the method of preparation is not disclosed, dollops were applied with the spatula or as sprayable and only focused towards application side in the agricultural field.

P. Gonzalez-Audino et al. [Development of natural waxes dispensers for pheromones and use in mating disruption of the ambrosia beetle Megaplatypus mutatus in poplar (Populus spp) plantations; Agroforestry Systems · May 2016], Monolithic solid dispensers for mating disruption of ambrosia beetle using Lanolin wax and bee wax in combination with pheromones. The system was thoroughly mixed in molten state and poured into a mold with half sphere shaped. The major drawback of this product is that, it is solid in nature and require some hanging or tying support on the plant or in agricultural field. The release rates exhibits shorter release of not more than six weeks.

US6001346 discloses a sprayable or solid formulation which uses biodegradable wax carrier for insect pheromones and a method for constant release rate of the pheromone from the biodegradable wax. A composition comprising a pheromone and paraffin wax formulated as an aqueous emulsion or in a solid form. suitable for application to a surface of a tree or crop for mating disruption of insect pests. Pheromone is released by diffusion or by partitioning from the biodegradable wax carrier or by pheromone exposure due to the biodegradable wax carrier degradation. The major drawback of this patent is that, method of preparation of formulation and composition is not clearly disclosed, type or nature of aqueous emulsion or a

solid is not described, release duration is very short up to three weeks and only focused towards application side in agricultural field. Additionally, other disadvantages of this formulation is that, it is not water dispersible, uses very low concentration of surfactant which leads to physicochemical instability. The formulation does not describe the use of any adhesion promoter so majority of applied dollop may fall down from the plant surface.

Thus, there exists an unmet need for a semiochemical controlled release formulation for insect behaviour modification either by confusion or disorientation and mating disruption, or an attraction and kill to achieve insect control and prevent crop damage. These formulations will be an effective integrated pest management tool and will serve as a replacement to use of harmful broad-spectrum insecticides. We need cost effective, water dispersable and efficient semiochemical/s diffuser which lasts for season long in agriculture field conditions. which also exhibits physicochemical stability under long term storage conditions and rainfastness in field after application on crop. **OBJECTIVES OF THE INVENTION**

Objective of the present invention is to provide a water dispersible controlled release semi solid formulation containing semiochemical/s resistant to environmental temperature, humidity, and rainy condition, for control of insect pests which are harmful to agrarian crops by means of attract and kill technique, confusion and disorientation or mating disruption (MD) or male annihilation technique (MAT).

Another objective of the present disclosure is to provide a semisolid composition which adheres to wet / dry plant surface or any solid substrate.

Another objective of the present disclosure is to use natural mesoporous materials to regulate release of semiochemical/s as a controlled release material.

Another objective of the present disclosure is to use high surface area carbon for adsorption of semiochemical/s for controlled release.

Another objective of the present disclosure is to use minimum amount of semiochemical/s to achieve season long insect behaviour modification lasting at least a minimum of 2 months and up to 5 months.

Still another objective of the present disclosure is to provide a composition which is amenable to various forms of application systems, to deliver required amount of formualtion in the field. Yet another objective of the present disclosure is to provide a process for the preparation of controlled release semi solid composition.

Still another objective of the present disclosure is to provide water dispersible property to aid addition of insecticide, which can be used for attract and kill strategy with compatible chemical insecticides.

Another objective of the present disclosure is to provide an eco-friendly, stable, non-phytotoxic, cost-effective, biodegradable and insect specific semiochemical/s controlled release system, which is alternative to existing chemical / bio pesticide systems. The formulation can be prepared with variable viscosity to suit various crops, geographies and equipment used for application. The formulation can be packed and stored in a laminated tubes and applied on the plant foliage or tree surface or any other surface in agricultural field.

Other objectives and advantages of the present disclosure will be more apparent from the following description, which is not intended to limit the scope of the present disclosure.

SUMMARY OF THE INVENTION

The present disclosure relates to controlled release, semi-solid composition comprising semiochemical/s specifically pheromones incorporated in waxy matrix. The composition provides a crop specific semi-solid, water dispersible wax emulsion for controlled release of semiochemical/s. The paste delivery system is designed to release pheromones for the entire crop season for protection against insect pests by modifying the insect behaviour. The composition in the form of cream or gel or paste when dispensed in field in the form of tiny to large source points to create consistent semiochemical/s plumes that are competitively attractive against a targeted insect pest for a given treated area. Specifically, plumes of semiochemical/s are released under challenging environmental conditions.

The present invention relates to controlled release semiochemical/s, a water dispersible semi solid, and oil in water emulsion composition comprising wax-based composition that comprises semiochemical/s to control insect pests by attraction and kill technique, confusion

and disorientation or mating disruption and provides semiochemical/s release duration up to twelve weeks or more in agricultural field and is stable for minimum of 2years at room temperature.

DESCRIPTION OF THE ACCOMPANYING DRAWING

The present disclosure will now be described with the help of the accompanying drawing, in which:

Figure 1: illustrates the Comparative Release data graph of controlled release paste in modified synthetic microcrystalline wax (MC) and a natural rice bran (RB) wax with Lobesia AI;

Figure 2: illustrates the Comparative Release data graph of controlled release of semi-solid paste formulation in open field with selected AI, FAW, BFSB, TUTA, OFM, ME, Lobesia, NOW, CYDIA;

Figure 3: illustrates the Comparative Release data graph of controlled release of semi-solid paste in open field with selected AI, FCM,RPW,RYSB,RHY,HELICO, BFSB;

Figure 4: illustrates the Comparative Release data graph of controlled release of semi-solid paste of PBW in open field for 120 days;

Figure 5: illustrates the Comparative Release data graph of controlled release of semi-solid paste in open field of actives with different carbon chain length;

Figure 6: illustrate the Comparative Release data graph of controlled release of semi-solid paste in open field using modified MC wax; and

Figure 7: illustrates the Comparative Release data graph of controlled release of semi-solid paste in open field using modified Rice Bran wax.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiments are provided to convey the scope of the present disclosure thoroughly and fully to the person skilled in the art. Numerous details, are set forth, relating to specific components, and methods, to provide a complete understanding of embodiments of the present disclosure. It will be apparent to the person skilled in the art that the details provided in the embodiments should not be construed to limit the scope of the present disclosure. In some embodiments, well-known processes, well-known apparatus structures, and well-known techniques are not described in detail.

The terminology used, in the present disclosure, is only for the purpose of explaining a particular embodiment and such terminology shall not be considered to limit the scope of the present disclosure. As used in the present disclosure, the forms "a", "an", and "the" may be intended to include the plural forms as well, unless the context clearly suggests otherwise. The terms "comprise", "comprising", "including" and "having" are open ended transitional phrases and therefore specify the presence of stated features, integers, steps, operations, elements, modules, units and/or components, but do not forbid the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof. The particular order of steps disclosed in the method and process of the present disclosure is not to be construed as necessarily requiring their performance as described or illustrated. It is also to be understood that additional or alternative steps may be employed.

As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed elements.

Throughout this specification the word "comprise of", or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated element, integer or step, or group of elements, integers, or steps, but not the exclusion of any other element, integer or step, or group of elements, integers, or steps.

The use of the expression "at least" or "at least one" suggests the use of one or more elements or ingredients or quantities, as the use may be in the embodiment of the invention to achieve one or more of the desired objects or results. While certain embodiments of the inventions have been described, these embodiments have been presented by way of experiment only and are not intended to limit the scope of the inventions. Variations or modifications to the formulation of this invention, within the scope of the invention, may occur to those skilled in the art upon

reviewing the disclosure herein. Such variations or modifications are well within the spirit of this invention.

The numerical values given for various physical parameters, dimensions, and quantities are only approximate values and it is envisaged that the values higher than the numerical value assigned to the physical parameters, dimensions and quantities fall within the scope of the invention unless there is a statement in the specification to the contrary.

While considerable emphasis has been placed herein on the specific features of the preferred embodiment, it will be appreciated that many additional features can be added and that many changes can be made in the preferred embodiment without departing from the principles of the disclosure. These and other changes in the preferred embodiment of the disclosure will be apparent to those skilled in the art from the disclosure herein, whereby it is to be distinctly understood that the foregoing descriptive matter is to be interpreted merely as illustrative of the disclosure and not as a limitation.

The abbreviations used in the present disclosure have the meaning as specified below unless mentioned otherwise:

Abbreviations:

Tween 60: Polyoxyethylene Sorbitan Monolaurate
Span 60: Sorbitan Monostearate
PVA: Poly vinyl alcohol
PVP: Poly vinyl pyrrolidone
BHT: Butylated hydroxytoluene
BHA : Butylated hydroxyl anisole
Neusilin US2: Magnesium Alumino metasilicate,
SBA15/Syloid 244P/Syloid XPP: Mesoporous silica,
UV screeners: Charcoal & titanium dioxide
Brij: Polyoxyethylene Lauryl Ether, Polyoxyethylene glycol octadecyl ether
MCW: Microcrystalline wax
TML: Trimedlure
RHY: Rhinoceros
AI- Semiochemical/s

ME – Methyl eugenol

CL – Cuelure

Carbon HBET- carbon derived from organic source having surface area >2000m^2/g

Tween 20: Polyoxyethylene Sorbitan Monolaurate

Tween 80: polyoxyethylene sorbitan monooleate

Table-1 as provided below provides a list of pheromones and its abbreviated forms as used in the current specification.

Brand Name	**Active Blend**
PBW	(Z, Z)-7, 11- hexadecadien-1-yl acetate
	(Z, E)-7, 11- hexadecadien-1-yl acetate
FAW	Z9- Tetradecenyl acetate
	Z7- Dodecenyl acetate
	Z11- Hexadecenyl acetate
BFSB	E-11-hexadecen-1-yl acetate
	(E)-11-hexadecen-1-ol
TUTA	3*E*,8*Z*,11*Z*-Tetradecatrienyl acetate
	3*E*,8*Z*-Tetradecadienyl acetate
CLM	(Z,Z,E)-7,11,13-Hexadeca trien-1-al
DBM	Z-11-Hexadecenal
	Z-11-Hexadecenyl-1-acetate
	Z-11-Hexadecenol
RYSB	Z-11-Hexadecenal
	Z-9-Hexadecenal
Helico	Z-11-Hexadecenal
	Z-9-Hexadecenal
Spodo	(Z,E)-9,11-Tetradecadienyl acetate
	Z9,E-12-Tetradecadienyl acetate
TMB	Cis-3-Hexenyl acetate
	2E- Hexen-1-ol
PSB	Z-11-Hexadecenyl-1-acetate
	Z-11-Hexadecenol

ESB	Z-11-Hexadecenol
EC	(7*Z*,9*E*)-Dodeca-7,9,11-trien-1-yl formate (Carob moth)
NOW	11Z,13Z-Hexadeca dienal
RPW	4 methyl 5 nonanol
	4 methyl 5 nonanone
Rhino/RHY	Ethyl-4-Methyl octanoate
ME	Methyl eugenol
CL	Cuelure
CM	(E,E) -8,10-Dodecadien-1-ol
OFM	(Z)-8-Dodecen-1-yl acetate
	(E)-8-Dodecen-1-yl-acetate
	(Z)-8-Dodecen-1-ol
PB	(1R)-cis-4,6,6-Trimethylbicyclo [3.1.1] hept-3-en-2-one
WFT	Methyl Isonicotinate
Profuze	trans-3,7-Dimethyl-2,6-octadien-1-ol cis-3,7-Dimethyl-2,6-octadien-1-ol
Terpenes	Mono terpenes Terpene alcohols
ISB	Z-13-Octadecynyl acetate
	Z-13-Octadecenol
LPB	(E,E)-10,12-hexadecadienal
	(E, E)-10,12-hexadecadienol
	E-10-hexadecenal
SE	Z, E-9,12-Tetradecadien-1-yl-Acetate
	Z-9 Tetradecenol
FCM	(Z)-8-Dodecen-1-yl acetate
	(E)-8-Dodecen-1-yl-acetate
Lobesia	7E, 9Z Dodecadienyl acetate
-	Beta Ionone, Alpha Ionone
-	ethyl tiglate,

-	γ-octalactone
-	1- octen-3-ol
-	3-careneγ-octalactone
-	1- octen-3-ol
-	acetoin, methionol
-	3-carene

Table-I

The present invention discloses a water dispersible semisolid formulation is the combination of formulation ingredients which confer the delivery vehicle the desired properties

1. Rice Bran wax as a base including natural and synthetic oils and waxes;
2. Combination of Surfactants from the group of cetostearyl alcohol, Lecithin, cetyl alcohol, stearyl alcohol, stearic acid, montanic acid, oleic acid, polyhydroxy alcohol, phospholipid, along with Brij's, span's and tween's;
3. Magnesium stearate, Zinc stearate as water repelling / texture modifying agents ;
4. Controlled release mesoporous materials and Carbon HBET ;
5. Polymer as rheology modifier and adhesion promoter ;
6. Humectant /stabiliser; and
7. Preservatives.

The present disclosure uses rice bran as base wax for semiochemical/s pheromone-based insect pest control paste formulation due to the easy availability of rice, its contents such as oils and wax.

The present disclosure also describes all natural and synthetic oils and waxes, and polymers for semiochemical/s-based insect pest control system.

The semi-solid emulsion composition comprises:

(a) Dispersed phase in an amount in the range of 0.1 to 50 w/w% of the total amount of the composition;

(b) Dispersion medium component in an amount in the range of 0.1 to 50w/w% of the total amount of the composition; and

(c) Additives in an amount in the range of 0.01 to 15% of the total amount of the dispersion medium.

Typically, the additives are selected from the group comprising stabilizer, pH modifier, humectant, preservative, lubricant / texture modifier, diluent, and antioxidant.

The semi-solid composition of the present disclosure has a strong hydrophobic component, an emulsion component and additives and/or auxiliaries, encapsulating agent, stabilizer(s)or emulsion stabilizer(s), film forming agents, preservative(s), an antioxidant, UV Screeners, a diluent, lubricating agents and provides rain fastness, protection from photo degradation on application. In accordance with the embodiments of the present disclosure, the semi-solid composition of semiochemical/s is capable of controlling the pest either through mating disruption or mass trapping by using mechanical devices or can be used to attract & kill strategies in combination with insecticides.

In an embodiment of the present disclosure, the dispersed phase component comprises:

(a) wax as a carrier in an amount in the range of 1 w/w% to 50 w/w% of the total amount of the composition;
(b) oil in an amount in the range of 0.01 w/w% to 15 w/w% of the total amount of the composition;
(c) semiochemical/s in an amount in the range of 0.01 w/w% to 20 w/w% of the total amount of the composition; and
(d) antioxidant in an amount in the range of 0.01 w/w% to 10 w/w% of the total amount of the composition;

Wherein the semiochemical/s is entrapped within the wax carrier, along with an emulsifier, and additive components that are homogeneously dispersed in the system dispersion media.

The semiochemical/s is at least one selected from the group consisting of pheromone/s, allomone/s, kairomone/s, synomone including comprising sex semiochemical/s and/or attractant and combinations thereof. These semiochemical may be used alone or as premixed in combinations.

In accordance with an embodiment of the present disclosure, the premix matrix is used in combination with carbon in an amount in the range of 1 to 99 w/w% of the total formulation for prolonged release of semiochemical/s.

The nano-structured materials are selected from the group consisting of activated charcoal, carbon, graphite sourced carbon and carbon particles derived from natural organic substrate. The mesoporous material nano-structured materials preferably silica or amorphous uniform monodisperse spherical carbon particles derived from natural organic substrate have BET surface area of about > 2500 m^2/g when measured using nitrogen adsorption method.

The ratio of active component to the mesoporous material or nano-structured material in the premix matrix is in the ratio of 1:10 to 10:1.

In accordance with the embodiments of the present disclosure, the insect semiochemical/s are selected from the group consisting of the active blend of (Z, Z)-7, 11- hexadecadien-1-yl acetate and (Z, E)-7, 11- hexadecadien-1-yl acetate; the active blend of Z 9- Tetradecenyl acetate, Z7- Dodecenyl acetate and Z11- Hexadecenyl acetate; the active blend of E-11-hexadecen-1-yl acetate and (E)-11-hexadecen-1-ol; the active blend of 3E,8Z,11Z-Tetradecatrienyl acetate and 3E,8Z-Tetradecadienyl acetate; the active, (Z,Z,E)-7,11,13-Hexadeca trien-1-al; the active blend of Z-11-Hexadecenal, Z-11-Hexadecenyl-1-acetate and Z-11-Hexadecenol; the active blend of Z-11-Hexadecenal and Z-9- Hexadecenal; the active blend of Z-11-Hexadecenal and Z-9-Hexadecenal; the active blend of (Z,E)-9,11-Tetradecadienyl acetate and Z9,E-12-Tetradecadienyl acetate; the active blend of Cis-3-Hexenyl acetate and 2E- Hexen-1-ol; the active blend of Z-11-Hexadecenyl-1-acetate and Z-11-Hexadecenol; the active of Z-11-Hexadecenol; the active of (7Z,9E)-Dodeca-7,9,11-trien-1-yl formate; 11Z,13Z-Hexadeca dienal; the active blend of 4 methyl 5 nonanol and 4 methyl 5 nonanone; the active of Ethyl-4-Methyl octanoate; the active of Methyl eugenol; the active blend of Methyl eugenol and Cuelure; the active of (E,E) -8,10-Dodecadien-1-ol; the active blend of (Z)-8-Dodecen-1-yl acetate, (E)-8-Dodecen-1-yl-acetate and (Z)-8-Dodecen-1-ol; the active, (1R)-cis-4,6,6-Trimethylbicyclo [3.1.1]hept-3-en-2-one; the active trans-3,7-Dimethyl-2,6-octadien-1-ol & cis-3,7-Dimethyl-2,6-octadien-1-ol; the blend of Z-13-Octadecynyl acetate and Z-13-Octadecenol; the blend of (E,E)-10,12-hexadecadienal, (E,E)-10,12-hexadecadienol and E-10-hexadecenal; the blend of Z,E-9,12-Tetradecadien-1-yl-Acetate and Z-9 Tetradecenol; the blend of (Z)-8-Dodecen-1-yl acetate and (E)-8-Dodecen-1-yl-acetate;

the active, (7E,9Z) dodeca- 7,9-dien-1-yl acetate, and the active 4-vinyl Anisole; Methyl Isonicotinate; Mono terpenes and Terpene alcohols. We have also used semiochemical/s described in Table no 1 for semisolid formulation preparation.

Other pheromones that may be used as semiochemical/s in the present disclosure include the following -

(Z,Z,E)-3,6,8-Dodecatrien-1-ol
(E, E)-10, 14-Hexadecadienal
(Z,Z)-9, 2-Tetradecadien- 1 -ol
(Z,Z)-9, 12-Tetradecadienyl acetate
(Z,Z)-9, 11-Tetradecadienyl acetate
(Z,Z)-8, 0-Tetradecadienai l
(Z,Z)-8, 0-Dodecadienyi acetate
(Z,Z)-11 , 13-Hexadecadienyl acetate
(Z,Z)-8, 10-Dodecadien- -ol ;
(Z,Z)-11 ,13-Hexadecadien-1-ol
(Z,Z)-7,9-Dodecadienyl acetate ;
(Z,Z)-10, 12-Hexadecadienal
(Z,Z)-7,9-Dodecadien-1-ol
(Z,E)- 10,12-Hexadecadienai
(Z,Z)-7, 11-Tridecadienyl acetate
(Z)-11-Heptadecenyl acetate
(Z,Z)-5,9-Tridecadieny acetate
(Z)-11-Heptadecen-1-ol
(Z,Z)-5,8-Tetradecadienyl acetate
(Z,Z)-5,8-Tetradecadien-1-ol
(Z,Z,Z)-9, 12, 15-Octadecatrienal
(Z,Z)-5,8~Tetradecadienal
(Z,Z)-5,7-Dodecadienal
(E, E)~ 10, 12-Hexadecadien-1 -ol
(Z,Z)-4,7-Tridecadienyl acetate
(Z)-8-Heptadecen-1-ol
(Z,Z)-4,7-Tridecadien-1-ol
(E)-8-Heptadecenyl acetate
(Z,Z)-4,7-Decadienyl acetate
(Z,Z)-9,1 1-Pentadecadienal
(Z,Z)-4,7~Decadien~1-ol
(E,Z)-9, 1 1-Pentadecadienal
(Z,Z)-3,8-Dodecadien-1-ol
(Z,E)-7,1 1 -Hexadecadienal
(Z,Z)-2,4-Decadienal
(E,Z)-8,10-Pentadecadienyl acetate
(Z,Z)~9, -Tetradecadienal
(Z,Z)~9, 11-Tetradeeadien-1-ol
(Z,Z)~5,7~Dodecadienyl acetate
(Z,Z)-9,1 1-Hexadecadienal
(Z,E,E)-3,6,8-Dodecatrien-1-ol
(Z,Z)-11 ,13-Hexadecadienal
(Z,E)-9,1 1-Teiradecadienyl acetate
(Z,E)-8, 10-Dodecadienyl acetate
(Z,E)-11 ,13-Hexadecadienyl acetate
(Z,E)-7,9-Dodecadienyl acetate
(Z, E)-10, 12-Hexadecadienyl acetate
(Z,E)-7,9-Dodecadien-1-ol
(E,Z)-10, 2-Hexadecadienal
(Z,E)-5,7-Dodecadienyl acetate
(E,Z)-9, 1 1-Hexadecadienal
(Z,E)-5,7-Dodecadienal
(Z,E)-9,1 -Hexadecadienal
(Z,E)-3,5-Tetradecadienyl acetate
(Z,Z)-9, 12-Octadecadienal
(Z,E)-3,5-Dodecadienyi acetate

(Z,E)-7,1 1 -Hexadecadienyl acetate
(Z,E)-3,5-Decadienyl acetate
(Z,Z)-8, 10-Pentadecadienyl acetate
(Z,E)~5,9-Tridecadienyl acetate
(E)-10-Heptadecenyl acetate
(Z, E)-9, 12-Tetradecadienyl acetate
(Z, E)-9, 12-Tetradecadienal
(Z, E)-9, 12-Tetradecadien- 1 -ol
(Z, E)-9, 11 -Tetradecadienal
(Z, E)-9, 11 -Tetradecadien-1 -ol
(Z, E)-8, 10-Tetradecadienyl acetate
(Z, E)-8, 10-Dodecadienal
(Z, E)- 1 , 13-Hexadecadienal
(Z, E)-8, 10-Dodecadien-1-ol
(Z,E)-11 ,13-Hexadecadien-1-ol
(Z, E)-5,7-Dodecadien-1 -ol
(E,Z)-9, 1 -Hexadecadienyl acetate
(Z, E)~8, 10-Tetradecadien-1 -ol
(Z)-S-Tetradecenyi acetate
(Z)-13-Octadecen-1-ol
(Z)-10-Tridecenyl acetate
(E, E,Z,Z)-4,6, 1 1 , 13-Hexadecatetraenal
(Z)-10-Tetradecenyl acetate
(Z,Z)-2, 13-Octadecadien-1-ol
(Z)-10-Dodecenyi acetate
(Z,Z)-7, 0-Hexadecadienyl acetate
(Z)-9-Undecenyl acetate
(E)-6-Hexadecenyl acetate
(Z)-9-Tridecenyl acetate
(E,E,Z)-10, 12,14-Hexadecatrienal
(Z)-9-Tetradecenyl acetate
(E,Z)-2, 13-Octadecadienyi acetate
(Z)-9-Tetradecenal
(E,Z)-2, 13-Qctadecadienai
(Z)-9-Tetradecen-1-ol
(E,Z)-2, 13-Octadecadien-1-ol
(Z)-9-Dodecenyl acetate
(E,Z)-4,6-Hexadecadien-1-ol
(Z)-9-Dodecenal
(E,Z)-4,6-Hexadecadienyl acetate
(Z)-9-Dodecen-1-ol
(E,E)-1 ,3-Hexadecadien-1-ol
(Z)-8-Undecenyl acetate
(Z)-5-Hexadecenyl acetate
(Z)-8-Trideceny! acetate
(E,E,E)-10,12, 14-Hexadecatrienai
(Z)-8-Tetradecenal
(Z)- 3-Octadecenyl acetate
(Z)-8-Tetradecen-1-ol
(E)-13-Octadecenai
(Z)-8-Dodecenyl acetate
(Z)-9-Hexadecenyl acetate
(Z)-8-Dodecenyl acetate
(Z)-12-Hexadecenyl acetate
(Z)-8-Dodecen-1-ol
(Z)-1 1-Hexadecenal
(Z)-7-Tridecenyl acetate
(Z,Z, E)-7, 11 , 13-Hexadecatrienal
(Z)-7-Tetradecenyl acetate
(Z)-11-Octadecenyl acetate
(Z)-7-Tetradecenai
(Z)-1 1-Octadecenal
(Z)-7-Tetradecen-1-ol
(Z)- 1 -Octadecen- -ol
(Z)-7-Dodecenyl acetate
(E)-1 1-Hexadecen-1-ol
(Z)-7-Dodecenal
(E)-1 1-Hexadecenyl acetate

(Z)-7-Dodecen-1-ol
(Z)-10-Hexadecenal
(Z)-7-Decenyl acetate
(Z,Z)-6,9-Pentadecadienyi acetate
(Z)-6-Tetradecenyl acetate
(Z)-9-Octadecenal
(Z)-5-Undecenyl acetate
(E)-5-Hexadecenyl acetate
(Z)-5-Tetradecenyl acetate
(E)-9-Octadecenal
(Z)-5-Tetradecenai
(Z)-9-Octadecen-1-ol
(Z)-5-Tetradecen-1-ol
(E)-9-Octadecenyl acetate
(Z)-5-Dodecenyl acetate
(E)-9-Hexadecenyl acetate
(Z)-5-Dodecenal
(E)-9~Hexadecenal
(Z)-5-Dodecen-1-ol
(E)-9-Hexadeceno1-ol
(Z)-5-Decenyl acetate
(E)-12-Pentadecenyl acetate
(Z)-5-Decen-1-ol
(Z)-10-Pentadecenal
(Z)-4-Tridecenyl acetate
(E,Z,Z)-4,6, 10-Hexadecatrienyl acetate
(Z)-4-Tridecenal
(E, E,Z)-4,6, 1 -Hexadecatrienyl acetate
(Z)-4-Decenyl acetate
(Z)-8-Pentadecenyl acetate
(Z)-4-Decenai
(Z)-9-Pentadecenyl acetate
(Z)-3-Tetradecenyl acetate
(E)-2-0ctadecenal
(Z)-3-Tetradecen-1-ol
(E)-2-0ctadecenyl acetate
(Z)-3-Dodecenyl acetate
(Z)-7-Hexadecen-1-ol
(Z)-3-Dodecen-1-ol
(E)-7-Hexadecenyl acetate
(Z)-2-Tridecenyl acetate
(E, E,Z)-4,6, 0-Hexadecatrien-ol
(Z)-12-Tetradecenyl acetate
(E,E)-5,9-Octadecadien-1-ol
(Z)-11-Tridecenyl acetate
(Z)-2-Heptadecenal
(Z)-11-Tetradecenyl acetate
(Z, E)-3, 13-Octadecadienyl acetate
(Z)-11-Tetradecenai
(Z,Z)-3, 13-Octadecadienyl acetate
(Z)-10-Dodecen-1-ol
(Z,Z)-7, 0-Hexadecadien-1-ol
(Z)~7~Undecenyl acetate
(Z)-5-Hexadecen-1-ol
(Z)~5-Decenal
(Z)-12-Pentadecenyl acetate
(Z)- 11 -Tetradecen-1 -ol
(E,Z)-3, 13-Octadecadienal l
(E,Z,Z)-4,7, 10-Tridecatrienyl acetate
(E, E)-4,8-Heptadecadienyi acetate
(E,Z)-9,1 1-Tetradecadienyl acetate
(E,Z)-8, 10-Tetradecadienyl acetate
(E,Z)-8, 10-Tetradecadienal
(E,Z)-8, 10-Dodecadienyl acetate
(E,Z)-1 1 , 13-Hexadecadienyl acetate
(E,Z)-8, 10-Dodecadienal
(E,Z)-11 , 3-Hexadecadienai
(E,Z)-8, 10-Dodecadien-1-ol

(E,Z)-11 , 3-Hexadecadien-l-ol

(E,Z)-7,9-Dodecadienyl acetate

(E,Z)-10, 12-Hexadecadien-1-ol

(E,Z)-7,9-Dodecadienal

(E,Z)-10, 12-Hexadecadienyl acetate

(E,Z)-5,9-Tridecadienyl acetate

(Z)-9-Heptadecenal

(E,Z)-5,7-Dodecadienyl acetate

(E,Z)-8, 1 1-Hexadecadienal

(E,Z)-5,7-Dodecadienal

(E, E)-9, 11-Hexadecadienal

(E,Z)-4,9-Tetradecadienyi acetate

(Z,Z)-13, 15-Octadecadienal

(E,Z)-4,9-Tetradecadienal

(Z,Z,Z)-3,6,9-Octadecatrienyl acetate

(E,Z)-4,7-Tridecadienyl acetate

(E)-8-Heptadecen-1-ol

(E,Z)-4, 10-Tetradecadienyl acetate

(E, E, E)-9, 2, 5-Octadecatrien-1 -ol

(E,Z)-3,8-Tetradecadienyl acetate

(E, E)-11 , 14-Octadecadienal

(E,Z)-3,5-Tetradecadienyl acetate

(Z,Z)-9, 12-Octadecadienyl acetate

(E,Z)-3,5-Dodecadienyi acetate

(Z,E)-7, 1 1-Hexadecadien-1-ol

(E,Z)-2,4-Decadienal

(E,Z)-8, 10-Pentadecadien-1-ol

(E,Z)~7,9-Dodecadien-1-ol

(E, E)-10, 12-Hexadecadienai l

(E,Z)~5,7-Dodecadien-1-ol

(Z, Z)-8 , 10- H exadecad ieny I acetate

(E,Z)~3,7-Tetradecadienyl acetate

(Z,Z)-1 1 , 13-Octadecadienal

(E,E,E)-10,12, 14-Hexadecatrienyl

(E,E)-9,11-Tetradecadienyl acetate

(E,E)-8, 10-Dodecadienyl acetate

(E,E)-1 ,13~Hexadecadienyl acetate

(E,E)-7,9-Dodecadienyl acetate

(E, E)-10, 12-Hexadecadienyl acetate

(E,E)-5,8-Tetradecadienal

(Z,Z,Z)-9, 12, 15-Octadecatrienyi acetate

(E,E)-5,7-Dodecadienyl acetate

(Z,Z)-7,1 1-Hexadecadienal

(E,E)-5,7-Dodecadien-1-ol

(Z,Z)-7, 1 -Hexadecadienyl acetate

(E,E)-4, 10-Dodecadienyi acetate

(Z,Z)-7, 1-Hexadecadien-1-ol

(E,E)-3,5-Tetradecadienyl acetate

(E,E)-9,12-Octadecadien-1-ol

(E,E)-3,5-Decadienyl acetate

(Z,E)-8,10-Pentadecadienyl acetate

(E, E,Z)- 10, 12, 14-Hexadecatrienyl

(E, E)-9, 2-Tetradecadienyl acetate

(E, E)-8, 10-Tetradecadienyi acetate

(E, E)-8, 10-Tetradecadienal

(E, E)-8, 1 Q-Dodeeadien-1 -ol

(E,E)-11 ,13-Hexadecadien-1-ol

(E, E)-8, 0-Dodecadienal

(E,E)-1 1 ,13-Hexadecadienal

(E, E)-2,4-Tetradecadienal

(E,E)-5,9-Octadecadienyl acetate

(E, E)-2,4-Decadienal

(E, E)-8, 10-Pentadecadienyl acetate

(E)-S-Tridecenyl acetate

(E.E.Z)-4,6. 10-Hexadecatrienyl acetate

(E)-S-Tetradecenal

(E)-9-Octadecen-1-ol l

(E)-S-Tetradecen- 1 -ol

(Z)-2-0ctadecenyl acetate
(E)-S-Dodecenyl acetate
(E)-S-Hexadecenyl acetate
(E)-S-Decenyl acetate
(Z)-10-Pentadecenyl acetate
(E)-I O-Tetradecenyl acetate
(Z, E)-2, 13-Octadecadienyl acetate
(E)-I O-Dodecenyl acetate
(E,Z)-6, 11 -Hexadecadienyl acetate
(E)-I O-Dodecenal
(E,Z)-6, 1 1 -Hexadecadienal
(E)-9-Tridecenyl acetate acetate
(E)-9-Tetradecen- 1 -ol
(Z)-13-Octadecenal
(E)-9-Dodecenai
(Z)-14-Hexadecenyl acetate
(E)-9-Dodecen~1-ol
(Z)-12-Hexadecenal
(E)-9-Tetradecenyl acetate
(E)-14-Octadecenal
(E)-9~Dodecenyl acetate
(E)-14-Hexadecenal l
(E)-8-Tridecenyl acetate acetate
(E)-8-Tetradecenyl acetate
(E)-13-Octadecenyl acetate
(E)-8-Dodecenyl acetate
(Z)-1 1-Hexadecen-1-ol
(E)-8-Dodecenal
(Z)-1 1-Hexadecenyl acetate
(E)-8-Dodecen-1-ol
(E)-1 1-Hexadecenal
(E)-8-Decen-1-ol
(Z,Z)-6,9-Pentadecadienal
(E)-7-Tetradecenyl acetate
(E)-11-Octadecenal
(E)-7-Tetradecen- 1 -ol
(E)-1 1-Octadecen-1-ol
(E)-7-Dodecenyl acetate
(E)-10-Hexadecenal
(E)-7-Dodecenal
(Z)-10-Hexadecenyl acetate
(E)-7-Dodecen-1-ol
(E)-10-Hexadecen-1-ol
(E)-7~Decenyl acetate
(Z,Z)-8,9-Pentadecadien-1-ol
(E)-6-Tridecenyi acetate
(E, E,Z)~4,8, 1 -Hexadecatriena!
(E)-6-Tetradecenyl acetate
(Z)-9-Octadeceny! acetate
(E)-6-Dodecenal
(Z)-9-Hexadecenal
(E)-6-Dodecen-1-ol
(Z)-9-Hexadecen-1-ol
(E)-5-Dodecen-1-ol
(Z)-7-Hexadecenal
(E)-5-Decen-1-ol
(E)-9-Pentadecenyl acetate
(E)-5~Tetradecenyl acetate
(Z)-2-0ctadecenal
(E)-4-Tridecenyl acetate
(E,Z,Z)-4,6, 10-Hexadecatrien-1 -ol
(E)-4-Dodecenyl acetate
(Z)-7-Hexadecenyi acetate
(E)-4-Decenyl acetate
(Z)-8-Pentadecen-1-ol
(E)-3-Tetradecenyl acetate
(Z,Z)-8, 11 -Heptadecadienyi acetate
(E)-3-Tetradecen-1-ol

(Z,Z)-8, 0-Heptadecadien-1-ol	(Z,Z)-3, 13-Octadecadienai
(E)-3-Dodecenyl acetate	(E)-11-Tetradecenyl acetate
(E)-7-Hexadecenal	(E, E)-3, 13-Octadecadienyl acetate
(E)-2-Undecenyi acetate	(E)-10-Dodecen-1-ol
(Z)-3-Hexadecenyi acetate	(E,Z)-4,6-Hexadecadienal
(E)-2-Undecenal	(E)-1 -Tetradecen-1-ol
(E)-5-Hexadecen-1-ol	(Z,Z)-2, 13-Octadecadienyl acetate
(E)-2-Tridecenyl acetate	(E)-1 1-Tridecenyl acetate
(Z, E)- 1 ,14-Hexadecadienyl acetate	(E)-2-Heptadecenal
(E)-2~Dodecenal	(E)-1 1-Tetradecenal
(E)-7-Hexadecen-1~ol l	(E,Z)-3, 13-Octadecadienyl acetate
(E)-12-Tetradecenyl acetate	(E , E)-8, 10-Tetradecadien- 1 -ol

In an embodiment of the present disclosure, the emulsion is an oil-in-water emulsion system which can be easily dispersible in water.

In accordance with the embodiments of the present disclosure, the wax carrier is selected from the group consisting of natural wax, synthetic wax and combinations thereof. The synthetic wax is selected from the group consisting of microcrystalline wax, ozokerite, ceresin, Montan wax, paraffin and combinations thereof. The natural wax is selected from the group consisting of rice bran wax, sunflower wax, bees wax, candelilla wax, carnauba wax, Chinese insect wax, esparto wax, Japan wax, spermaceti wax, lanolin wax and combinations thereof.

The emulsifier is selected from the group consisting of group consisting of cetostearyl alcohol, Lecithin, cetyl alcohol, stearyl alcohol, stearic acid, montanic acid, oleic acid, polyhydroxy alcohol, phospholipid, Brij50, Brij 52, Brij 30, Brij 35, Brij 90, Brij 92, Span 20, Span 40, Span 60, Span 80, tween 20, tween 40, tween 60 or tween 80, and combinations thereof.

The diluent is selected from either paraffin oil, soyabean oil, cotton seed oil, olive oil, jojoba oil, sunflower oil, corn oil, peanut oil, sesame oil, castor oil, medium chain triglycerides, Isopropyl palmitate.

The film forming / adhesion promoter and rheology modifying agent is selected from poly vinyl pyrrolidone, and PVA solution. In the embodiment of the present disclosure, the film forming agent is used alone.

The preservative in accordance with the embodiments of the present disclosure is selected from methyl paraben, propyl paraben, sodium benzoate and potassium sorbate.

The antioxidant is selected from BHT, BHA, tocopherol; and texture modifier is selected from magnesium stearate, zinc stearate, and blend of esters of behenic acid with glycerol. Typically, the texture modifier, Magnesium stearate and zinc stearate acts as water repellent. Carbon HBET and mesoporous silica is used for control release matrix material by adsorbing active on its surface for prolonged release and efficient moth catch as compared to conventionally used charcoal. Metallic stearates are used as texture modifier as well as emulsion stabilizers, along with other emulsion stabilizers such as Tween 60/Polysorbate 60, Comprittol 888. Propylene glycol acts as humectants and Span 60, Span 60 acts as the composition stabilizers.

In a preferred embodiment of the present disclosure, the semi-solid composition comprises a dispersed phase and dispersion medium which can be better described as given below:

(a) Dispersed phase comprising a semiochemical/s and/or attractant in an amount in the range of 0.5 to 20 w/w% ; the wax carrier is in an amount in the range of 0.5 to 60 w/w% ;diluent in the range of about 0.5 to 20 w/w%; antioxidant in the range of about 0.01 to 6 w/w%; lubricant/ texture modifier in the range of about 0.5 to 10 w/w% of the total composition;

(b) Dispersion medium comprising emulsifier in an amount in the range of 0.1 w/w% to 50 w/w% by of the total amount of the composition along with additive ; and.

(c) Additives comprising

I. stabilizer in an amount in the range of 0.5 w/w% to 10 w/w% of the total amount of the composition;

II. preservative in an amount in the range of about 0.01 to 0.5 w/w% of the total amount of the composition ; and

III. film forming agent in an amount in the range of about 0.1to 7.5 w/w% of the total amount of the composition

IV. Carbon HBET and mesoporous silica in 0.1 to 10 w/w% of the total amount of the composition

In an embodiment of the present disclosure, the formulation is applied as Controlled Release Enhanced Mating Interruption Technology application. The controlled release paste which is a base matrix formulation of biologically inert materials used to control the release of semio-chemicals and/or odours with or without pesticides. Controlled release paste/emulsion can be used with a variety of lures and demonstrates that the matrix emits semiochemicals at effective pest suppression levels for a time interval ranging from 8 to 12 weeks. Having a wide range of viscosities and application methods, (e.g., applicator sprays, aerial applicator sprays, caulking gun type tubes, etc.). This controlled release paste/emulsion technology increases productivity by mechanizing the application of semiochemical/s dispensing points. The low viscosity quality of this highly adaptable product allows for an easy transition from small-scale manual applications to large-scale mechanical applications.

The semi-solid formulation of the present disclosure includes semiochemical/s entrapped within wax carrier which displays steady, controlled, and sustained release for a longer period of time. Wax carrier helps the delivery of the semiochemical/s and is advantageous for camouflaging the treated area with Semio-chemicals to attracting adult insects or modify insect natural behaviour thus to achieve mating disruption. Semi-solid formulation is eco-friendly, cost effective, physiochemically stable, exhibits rain-fastness, for pest management delivery system, and is used by direct application on plant surfaces and also stored at room temperature with caped tube for longer time without any compromise in quality.

The semi-solid formulation of the present disclosure may comprise customary auxiliary agrochemicals depending upon particular application form and active semiochemical/s substance respectively. Auxiliaries include water or solvent, solid carriers, dispersant, emulsifiers, solubilizers, thickeners, protective colloids, surfactants, adhesion promoting agents, anti-freezing agents, anti-foaming agents, colorants, bactericides, antimicrobial agent, and the like.

In another aspect there is provided a method for preparing a semi-solid emulsion composition. The method comprises the following steps:

(a) Preparation of dispersed phase:

i. wax and diluent oil were mixed together at melting temperature of wax – oil blend to obtain molten waxy liquid

ii. Semiochemical/s alone or adsorbed on mesoporous silica and carbon HBET, diluent, antioxidant, and texture modifier were dispersed in the molten waxy liquid under stirring.

(b) Preparation of dispersion medium :

Separate aqueous phase prepared by mixing aqueous polymer solution and a surfactant blend under stirring at same temperature to the melting temperature of wax – oil blend.

(c) The aqueous phase obtained in step (b) added to the mixture obtained in (a) and mixed at about 3000 rpm using bottom homogeniser; and

(d) Finally humectant/ stabiliser was added along with preservative at a temperature in the range of 60°C to 65°C to obtain the semi-solid emulsion composition.

In another embodiment, the present disclosure provides a microcapsule in wax-based semiochemical/s composition comprising microcapsules made of aminoplast resins, poly urea and ethyl cellulose as controlled release matrix polymers.

The semi-solid composition of the present disclosure has a pH in the range of 5 to 6.5 and is dispersible in water.

The semi-solid compositions of the present disclosure exhibit rain-fastness and adhere on the plant surface for longer time even during rain, as determined by ASTM STP 1268 procedure. In an embodiment of the present disclosure, the semi-solid composition exhibits chemical and physical stability at 0°C to 54°C temperature with controlled release of semiochemical/s over an extended period of at least four weeks.

In another embodiment of the present disclosure, semiochemical/s present in the semi-solid composition exhibits controlled release and trigger behavioural response in insect species. Typically, the release rate of semiochemical/s from wax semisolid formulation is in the range of 1 to 20 milligrams per gram per day and can be modulated with change of formulation excipients concentration.

The semi-solid composition of the present disclosure can be used to control undesired insect infestation, such as Lepidoptera, Hemiptera, Coleoptera, Diptera, Thysanoptera, Hymenoptera

(for example codling moth), which are responsible for substantial losses of crops. The insects are controlled by means of attraction and kill technique, confusion and disorientation or mating disruption. The semiochemical/s substance may be targeted for a single kind of pest or may be targeted for at least two kinds of insect pests. The semiochemical/s substance may be present in pre-mix solution of wax-based paste composition either in dissolved, dispersed, or solid form.

Propylene glycol as humectants /stabiliser and prevents the composition from drying out and further aids in preserving the texture. A rheology modifier is used to provide flow of the composition from the tube without being stingy which may be selected from the group of sorbitol, propylene glycol, glycerine, magnesium stearate, carbon HBET.

In an embodiment of the present disclosure, the semi-solid composition is used alone. In another embodiment of the present disclosure, the semi-solid composition is used in combination with insecticides or agricultural adjuvants or colouring agent for its application.

Typically, the semi-solid composition of the present disclosure is used in a form selected from the group consisting of cream, paste, gel, and glue.

The foregoing description of the embodiments has been provided for purposes of illustration and not intended to limit the scope of the present disclosure. Individual components of a particular embodiment are generally not limited to that particular embodiment, but, are interchangeable. Such variations are not to be regarded as a departure from the present disclosure, and all such modifications are considered to be within the scope of the present disclosure.

The present disclosure is further described in light of the following examples which are set forth for illustration purpose only and not to be construed for limiting the scope of the disclosure. The following examples, which include preferred embodiments, will serve to illustrate the practice of this invention, it being understood that the particulars shown are by way of example and for purpose of illustrative discussion of preferred embodiments of the invention.

General Procedure for preparing the semi-solid composition of the present disclosure:

A method for preparing a semi-solid emulsion composition which comprises dispersed phase and dispersion media, the method comprising the following steps:

(a) Preparation of dispersed phase :

   i. wax and diluent oil were mixed together at melting temperature of wax – oil blend to obtain molten waxy liquid

   ii. Semiochemical/s alone or adsorbed on mesoporous silica and carbon HBET, diluent, antioxidant, and texture modifier were dispersed in the molten waxy liquid under stirring.

(b) Preparation of dispersion medium :

   Separate aqueous phase prepared by mixing aqueous polymer solution and a surfactant blend under stirring at same temperature to the melting temperature of wax –oil blend.

(c) The aqueous phase obtained in step (b) added to the mixture obtained in (a) and mixed at about 3000 rpm using bottom homogeniser; and

(d) Finally humectant/ stabiliser was added along with preservative at a temperature in the range of 60°C to 65°C to obtain the semi-solid emulsion composition.

An active semiochemical/s used is preferably PBW, OFM, TML,FCM, TUTA, RHY, ME, CL, Lobesia, BFSB, Helico, DBM, Carob moth, Codling moth, YSB, NOW, ESB, Verbenone, Spodo, etc.).

Field studies:

The semi-solid formulation of the present disclosure controlled release paste technology along with PBW semiochemical/s was applied in the form of dollops in five different cotton fields each in Maharashtra, Karnataka and Gujarat for disrupting the mating of pink bollworm, *Pectinophora gossypiella* successfully to an average of 93.94% respectively. This contributed to an average yield increase of 58% in Maharashtra, 44% in Karnataka and 41.4 % in Gujarat over control. The percentage green boll damage was lesser in the controlled release paste (PBW) treated plots when compared to the farmer's practices adopted control plot. The percentage green boll damage was in the range of 5.14% to 17.1% and 14.0 to 24.29% in the treated and control plots, respectively.

The semi-solid formulation of the present disclosure controlled release paste along with BFSB semiochemical/s was applied in the form of dollops in different fields of brinjal in Karnataka and Maharashtra for disrupting the mating of Brinjal fruit and shoot borer, *Leucinodes orbonalis* by and 90.6% respectively. This contributed to an average yield increase of 8.5%. The percentage fruit damage was lesser in the controlled release paste (BFSB) treated plot when compared to the farmer's practices adopted control plot. The percentage fruit damage was in the range of 0.27% to 4% and 6.79% to 20% in the treated and control plots, respectively. The semi-solid formulation of the present disclosure controlled release paste along with TUTA semiochemical/s was applied in the form of dollops in a tomato field in Kolar, Karnataka for disrupting the mating of Tomato Leaf Miner, *Tuta absoluta* by 97.8%. This contributed to a substantial yield increase of 45% over control. The fruit damage in treated plot was about 4%, whereas the fruit damage in control was about 38.6%.

The semi-solid formulation of the present disclosure controlled release paste along with DBM semiochemical/s was applied in the form of dollops in cauliflower fields in Maharashtra for disrupting the mating of diamondback moth, *Plutella xylostella* by 91.67% on an average. Similarly, treatment of controlled release technology (Helio) in chilli fields for the management of *Helicoverpa armigera* in Gujarat disrupted mating by 95.6%.

All these controlled release paste formulations were found to be non-phytotoxic for selected crops under investigation. The rainfast nature of formulation is tested especially during rainy seasons in the states of Punjab, Gujarath, Maharashtra, Tamilnadu, Andhra Pradesh as well as Telangana regions and precent retention on the plant foliage is found satisfactory more than 80 percent and meeting the amount the active per hectare required to control the pest population during the season long crop cycle.

The release data of the semi-solid formulation of the present disclosure is provided in **Figures 1 to 8**.

Based on the agricultural field exposure data, the release profile of the semi-solid formulation of the present disclosure with respect to different active at the same level of loading are illustrated in **Figures 1-8**.

Figure-1 illustrates the effect of active release on agricultural field exposure of Lobesia controlled release paste formulations prepared by using different types of waxes. It is seen from

Figure-1 that at the same level of active loading, effect of wax change is minimal, and they don't have any effect on active release. The non-effectiveness of wax change is clearly concluded in the formulations prepared by using microcrystalline (MC) wax and rice brain wax exhibiting similar release pattern.

It is seen from **Figures 2-3** that active release is sustained up to at least eight weeks, and which may be further extended (more than twelve weeks or three months) due to higher retention of the actives within the formulation, which will be released during further time period.

Figure-4 illustrates the effect of open agricultural field exposure on release of different Scale-up batches of controlled release paste manufactured in commercial scale equipment's for PBW active. It is seen from **Figure-4** that the sustained release duration from PBW formulation is at least three to four months.

.

Figure 5: illustrates the effect of field exposure on the release profile in controlled release paste formulations prepared for different semiochemical/s containing different functional groups with different carbon chain length between C8 to C16 along with functional groups. The formulation characteristics are modulated based on the different vapour pressure and escape rates of different actives containing functional groups are sufficiently demonstrated with controlled release mechanism.

Figure-6: illustrates the effect of field exposure on the release profile in controlled release paste formulations prepared for different semiochemicals containing different functional groups with different carbon chain length between C8 to C16 along with functional groups. The formulation characteristics are modulated based on the different vapour pressure and escape rates of different actives containing functional groups are sufficiently demonstrated with controlled release mechanism.

Figure-7: illustrates the effect of field exposure on the release profile in controlled release paste for prepared by modified microcrystalline wax formulations. The release duration of OFM, LOBESIA, TUTA, TML, RHY and PBW sustain at least up to three months.

Figure-8 illustrates the effect of field exposure on the release profile in controlled release paste formulations prepared by modified rice bran wax formulations with prolonged release of actives to suit the crop period to manage the pest control measures for at least two to three months. Examples of actives extensively studies are FAW, HELIO, PBW and DBM.

The semi-solid formulation of the present disclosure is non-phytotoxic, rain fast, releases semiochemical/s in a controlled release close to zero or first order for season long upto 6 months stable under various environmental conditions, dose dependent release to cover different semiochemical/ss with different crop cycles, uses renewable source of raw materials, and is economical and biodegradable. The preparation and use of natural wax derivatives for controlled and prolonged emission of semio-chemicals, based on the modification of the physicochemical properties of molecules may be able to satisfy the high demand for alternatives insect control in such a way that they provide an emission kinetics adapted to the specific properties of each semiochemical/s. Thus, such semi-solid formulation of the present disclosure offers an advanced slow-release matrix that suits for all sorts of agricultural crops viz., vegetables, fruits, nuts, row crops etc.

The semi-solid formulation of the present disclosure with semiochemical/s will be useful for insect pest management either as mass trapping or attract & kill or mating disruption that exhibits delayed release plaform technology. The semi-solid formulations of the present disclosure are target specific insect which significantly controls the economically important injurious insect pests like *Tuta absoluta* in tomato, *Plutella xylostella* in cabbage, cauliflower and broccoli, Leucinodes orbonalis in brinjal, Pectinophora gossypiella in cotton, *Spodoptera frugiperda* in Maize, *Helicoverpa armigera* in chilli, cotton, capsicum, maize and the like, *Lobesia botrana* in grapes, *Cydia pomonella* in apple, *Phyllocnistis citrella* in citrus crops, *Amyelois transitella* in almond and pistachios, *Bactrocera dorasalis* in fruit crops, *Bactrocera cucurbitae* in cucurbits and the like.

The present disclosure envisages semi-solid emulsion compositions that are highly effective in achieving insect behavioural modification in insect pests for season long control achieved through controlled release pattern of semiochemical. The semi-solid composition is capable of gradually releasing a semiochemical/s suitable for developing season long insect pest control solutions. The composition is amenable in various forms & nature. It can be easily dispensed and applied on a tree or a crop or any substrate available in the field for uniform distribution of the composition such that the release of semiochemical/s is uniform across the applied area.

The semi-solid compositions of the present disclosure are capable of controlling insect/ pests that are harmful to agrarian crops by means of attraction and kill technique, confusion and disorientation or mating disruption, wherein the composition resistant to high humid conditions and is highly rain fast.

TECHNICAL ADVANCES AND ECONOMICAL SIGNIFICANCE

The present disclosure described herein above has several technical advantages including, but not limited to a semi solid composition comprises the semiochemical/s and/or attractant along with mesoporous materials

1. the composition is water dispersible, environmentally friendly can be applied manually or using any mechanical devices, drones and airplanes to conveniently adopt and incorporate pest management program in wide areas. It has low cost, and works for the entire duration of the crop season.
2. the composition possesses physio-chemical properties of the delivery vehicle with hydrophobicity, water repellence, rain fastness in order to adhere to plant or any solid substrate, liner release of semiochemical/ss and are resistant to environmental conditions such as, temperature, rain, humidity and UV rays;
3. use of renewable food grade biodegradable excipients with low semiochemical per acre with superior pest control levels so that the technology can be adopted for large scale operation in par with conventional insecticides; and

Throughout this specification the word “comprise of”, or variations such as “comprises” or “comprising”, will be understood to imply the inclusion of a stated element, integer or step, or group of elements, integers, or steps, but not the exclusion of any other element, integer or step, or group of elements, integers, or steps.

The use of the expression “at least” or “at least one” suggests the use of one or more elements or ingredients or quantities, as the use may be in the embodiment of the invention to achieve one or more of the desired objects or results. While certain embodiments of the inventions have been described, these embodiments have been presented by way of experiment only and are not intended to limit the scope of the inventions. Variations or modifications to the formulation of this invention, within the scope of the invention, may occur to those skilled in the art upon

reviewing the disclosure herein. Such variations or modifications are well within the spirit of this invention.

The numerical values given for various physical parameters, dimensions, and quantities are only approximate values and it is envisaged that the values higher than the numerical value assigned to the physical parameters, dimensions and quantities fall within the scope of the invention unless there is a statement in the specification to the contrary.

While considerable emphasis has been placed herein on the specific features of the preferred embodiment, it will be appreciated that many additional features can be added and that many changes can be made in the preferred embodiment without departing from the principles of the disclosure. These and other changes in the preferred embodiment of the disclosure will be apparent to those skilled in the art from the disclosure herein, whereby it is to be distinctly understood that the foregoing descriptive matter is to be interpreted merely as illustrative of the disclosure and not as a limitation.

A liquid sprayable emulsion and a semi-solid emulsion with a paste like consistency including the applicant's semiochemical/s can be developed by optimizing the concentration of each ingredient proposed according to organoleptic acceptance and stability criteria.

The semi-solid composition of the present disclosure is non-phytotoxic, rain fast, releases semiochemical/s in a controlled linear release close to zero order for long time, stable under various environmental conditions, dose dependent release to cover different semiochemical/ss with different crop cycles, uses renewable source of raw materials, and is economical and biodegradable. The preparation and use of natural wax derivatives for controlled and prolonged emission of semio-chemicals, based on the modification of the physicochemical properties of molecules may be able to satisfy the high demand for alternatives insect control in such a way that they provide an emission kinetics adapted to the specific properties of each semiochemical/s. Thus, such semi-solid composition of the present disclosure offers an advanced slow-release matrix that suits for all sorts of agricultural crops viz., vegetables, fruits, nuts, row crops etc.

The semi-solid composition of the present disclosure with semio-chemicals will be useful for insect pest management either as mass trapping or attract & kill or mating disruption that

exhibits delayed release plot form technology. The semi-soild compositions of the present disclosure are target specific insect which significantly controls the economically important injurious insect pests like *Tuta absoluta* in tomato, *Plutella xylostella* in cabbage, cauliflower and broccoli, Leucinodes orbonalis in brinjal, Pectinophora gossypiella in cotton, *Spodoptera frugiperda* in Maize, *Helicoverpa armigera* in chilli, cotton, capsicum, maize and the like, *Lobesia botrana* in grapes, *Cydia pomonella* in apple, *Phyllocnistis citrella* in citrus crops, *Amyelois transitella* in almond and pistachios, *Bactrocera dorasalis* in fruit crops, *Bactrocera cucurbitae* in cucurbits and the like.

EXEMPLARY DETAILS WITH VARIATIONS OF SEMIOCHEMICAL/S

Example 1: Semi-solid composition with 2% AI – TUTA

A mixture of 26g of microcrystalline wax ,5g of soya bean oil and 6 g of Cetostearyl alcohol is charged in glass vessel, and heated at 80-85^{0}C in water bath, under stirring to obtain liquid wax. 2.9 g of Magnesium stearate is added in the same vessel under stirring at 700 rpm, and. Further a mixture of 2g AI (**TUTA**), 5 g of Soyabean oil, and 50 mg of BHT is adsorbed on to mesoporous silica and Carbon HBT combination and then added under stirring to the molten waxy liquid and kept under continuous stirring for about 10-15 minutes. Another solution called aqueous phase is prepared in a separate vessel by melting 4.46 g of span 60 and 5.55g of tween 60 in 37 g of 4.5% polyvinyl alcohol solution. This aqueous phase is mixed in the molten wax under stirring at 85^{0}C and homogenise at 2000rpm. After mixing, the resulting mixture is allowed to cool to 65^{0}C. After attaining 65^{0}C, 5 g of propylene glycol containing 120 mg of methyl paraben is added and further allowed to cool at room temperature. pH of the pasty material is adjusted in the range of 5.5 to 6.5 using 10% HCl solution or ethanolamine solution.

Example 2: Semi-solid composition with 4% AI – RHY

A mixture of 26g of rice bran wax, 4g of sunflower oil and 3 g Stearic acid melt together in a glass vessel equipped with suitable size propeller at about 85^{o}C and kept under stirring at 700 rpm to get a molten waxy liquid. 2.9 g of Magnesium stearate is added in the same vessel in the molten wax under stirring at 700 rpm. Further a mixture of 4g AI (**RHY**), 5 g of sunflower oil, and 50 mg of BHT adsorbed on to mesoporous silica / Carbon HBT combination and then

added under stirring to the molten waxy liquid and kept under continuous stirring for about 10-15 minutes. Another solution called aqueous phase is prepared in a separate vessel by melting 5.74 g of span 60 and 7.68 tween 60 in 35.51 g of 4.5% polyvinyl alcohol solution. This aqueous phase is mixed in the molten wax under stirring at 85^0C and homogenise at 2000rpm using laboratory homogeniser. After mixing, the resulting mixture is allowed to cool to 65^0C. After attaining 65^0C, 5 g of propylene glycol containing 120 mg of methyl paraben is added and further allowed to cool at room temperature. pH of the pasty material is adjusted in the range of 5.5 to 6.5 using 10% HCl or ethanolamine solution.

Example 3: Semi-solid composition with 4% AI - RHY

26 g of microcrystalline wax, 6 g of bees wax, 2 g of peanut oil and 2 g of cetostearyl alcohol mixed together in a glass vessel equipped with suitable size propeller, and heated at about 85°C and kept under stirring at 700 rpm. 2.9 g of Magnesium stearate is added in the same vessel under stirring at 700 rpm. Further a mixture of 4g AI (**RHY**), 2 g of peanut oil, and 50 mg of BHT adsorbed on to mesoporous silica / Carbon HBT combination and then added under stirring to the molten waxy liquid and kept under continuous stirring for about 10-15 minutes. Another solution called aqueous phase is prepared in a separate vessel by melting 5.74 g of span 60 and 7.68 tween 60 in 35 g of 4.5% polyvinyl alcohol solution. This aqueous phase is mixed in the molten wax under stirring at 85^0C and homogenise at 2000rpm using laboratory homogeniser. After mixing, mixture is allowed to cool to 65^0C. After attaining 65^0C, 5 g of propylene glycol containing 120 mg of methyl paraben is added and further allowed to cool at room temperature. pH of the pasty material is adjusted in the range of 5.5 to 6.5.

Example 4: Semi-solid composition with 4% AI – OFM

25 g of carnauba wax, 6 g of microcrystalline wax, 2 g of cetostearyl alcohol and 5 g of soyabean oil mixed together in a glass vessel equipped with suitable size propeller and heated at about 85°C and kept under stirring at 700 rpm. 2.9 g of Magnesium stearate is added in the same vessel under stirring at 700 rpm. Further a mixture of 4g AI (**OFM**), 5 g of Soyabean oil, and 50 mg of BHT is adsorbed on to mesoporous silica / Carbon HBT combination and then added under stirring to the molten waxy liquid and kept under continuous stirring for about 10-15 minutes. Another solution called aqueous phase is prepared in a separate vessel by melting 4.65 g of span 60 and 5.35 tween 60 in 34 g of 4.5% polyvinyl alcohol solution. This

hot aqueous phase is mixed in the molten wax under stirring at 85^0C and homogenise at 2000rpm using laboratory homogeniser. After mixing, resulting mixture is allowed to cool to 65^0C. After attaining 65^0C, 5 g of propylene glycol containing 120 mg of methyl paraben is added and further allowed to cool at room temperature. pH of the pasty material is adjusted in the range of 5.5 to 6.5.

Example 5: Semi-solid composition with 4% AI – TML

26 g of carnauba wax, 4 g of microcrystalline wax, 5 g of olive oil and 2 g of stearic acid mixed together in a glass vessel equipped with suitable size propeller, and heated at about 85ºC and kept under stirring at 700 rpm. 2.9 g of Magnesium stearate is added in the same vessel under stirring at 700 rpm. Further a mixture of 4g AI (**TML**), 3 g of olive oil, and 50 mg of BHT mixed with mesoporous mesoporous silica / Carbon HBT combination and added into liquid wax and kept under continuous stirring at 700rpm and mix for 10-15 minutes. Another solution called aqueous phase is prepared in a separate vessel by melting 4.31 g of span 60 and 5.69g of tween 60 in 36.5% polyvinyl alcohol solution. This aqueous phase is mixed in the molten wax under stirring at 85^0C and homogenise at 2000rpm using laboratory homogeniser. After mixing, the resulting mixture is allowed to cool to 65^0C. After attaining 65^0C, 5 g of propylene glycol containing 120 mg of methyl paraben is added and further allowed to cool at room temperature. pH of the pasty material is adjusted in the range of 5.5 to 6.5.

Example 6: Semi-solid composition with 1% AI – TUTA

A mixture of 26g of microcrystalline wax and 6 g of carnauba wax, 5 g of Soyabean oil and 2.g of stearic acid is charged in glass vessel, and heated at 80-85^0C in water bath under stirring to obtain liquid wax. 2.9 g of Magnesium stearate is added in the same vessel under stirring Further a mixture of 1g AI (**TUTA**), 3 g of Soyabean oil, and 50 mg of BHT is adsorbed on to mesoporous silica / Carbon HBT combination and then added under stirring to the molten waxy liquid and kept under continuous stirring for about 10-15. Another solution called aqueous phase is prepared in a separate vessel by melting 4.46 g of span 60 and 5.55g of tween 60 in 37.5 g of 4.5% polyvinyl alcohol solution. This aqueous phase is mixed in the molten wax under stirring at 85^0C and homogenise at 2000rpm using laboratory homogeniser. After mixing, the resulting mixture is allowed to cool to 65^0C. After attaining 65^0C, 5 g of propylene

glycol containing 120 mg of methyl paraben is added and further allowed to cool at room temperature. pH of the pasty material is adjusted in the range of 5.5 to 6.5.

Example 7: Semi-solid composition with 4% AI – FAW

26g of microcrystalline wax, 6 g of carnauba wax, 3g of soyabean oil and 2g of cetostearyl alcohol are mixed together, charged in glass vessel, and heated at 80-85^{0}C in water bath, under stirring to obtain waxy liquid. 2.9 g of Magnesium stearate is added in the same vessel under stirring at 700 rpm. Further a mixture of 4g AI (**FAW**), 6 g of Soyabean oil, and 50 mg of BHT is adsorbed on to mesoporous silica / Carbon HBT combination and then added under stirring to the molten waxy liquid and kept under continuous stirring for about 10-15. Another solution called aqueous phase is prepared in a separate vessel by melting 4.46 g of span 60 and 5.55g of tween 60 in 33.5 g of 4.5% polyvinyl alcohol solution. This aqueous phase is mixed in the molten wax under stirring at 85^{0}C and homogenise at 2000rpm using laboratory homogeniser. After mixing, the resulting mixture is allowed to cool to 65^{0}C. After attaining 65^{0}C, 5 g of propylene glycol containing 120 mg of methyl paraben is added and further allowed to cool at room temperature. pH of the pasty material is adjusted in the range of 5.5 to 6.5 using 10% HCl solution.

Example 8: Semi-solid composition with 4% AI – PBW

A mixture of 26g of microcrystalline wax, 6 g of montanic acid, and 8 g of soyabean oil is charged in glass vessel, and heated at 80-85^{0}C in water bath, under stirring to obtain liquid wax. 2.9 g of Magnesium stearate is added in the same vessel under stirring at 700 rpm. Further a mixture of 4g AI (**PBW**), 2g of Soyabean oil, and 50 mg of BHT is adsorbed on to mesoporous silica / Carbon HBT combination and then added under stirring to the molten waxy liquid and kept under continuous stirring for about 10-15. Another solution called aqueous phase is prepared in a separate vessel by melting 4.46 g of span 60 and 5.55g of tween 60 in 35.5 g of 4.5% polyvinyl alcohol solution. This aqueous phase is mixed in the molten wax under stirring at 85^{0}C and homogenise at 2000rpm using laboratory homogeniser. After mixing, the resulting mixture is allowed to cool to 65^{0}C. After attaining 65^{0}C, 5 g of propylene glycol containing 120 mg of methyl paraben is added and further allowed to cool at room temperature. pH of the pasty material is adjusted in the range of 5.5 to 6.5.

Example 9: Semi-solid composition with 4% AI – RYSB

26 g of microcrystalline wax, 4 g of Soyabean oil, and 3 g of stearic acid and 3 g of carnauba wax are mixed together in a glass vessel equipped with suitable size propeller, heated at about 85^{o}C and kept under stirring at 700 rpm. 2.9 g of Magnesium stearate is added in the same vessel under stirring at 700 rpm. Further a mixture of 4g AI (**RYSB**), 0.5 g of Compritol 888ATO, 3 g of Soyabean oil, and 50 mg of BHT is adsorbed on to mesoporous silica / Carbon HBT combination and then added under stirring to the molten waxy liquid and kept under continuous stirring for about 10-15. Another solution called aqueous phase is prepared in a separate vessel by melting 5.74 g of span 60 and 7.68 tween 60 in 33.51 g of 4.5% polyvinyl alcohol solution. This aqueous phase is mixed in the molten wax under stirring at 85^{0}C and homogenise at 2000rpm using laboratory homogeniser. After mixing, the resulting mixture is allowed to cool to 65^{0}C. After attaining 65^{0}C, 5 g of propylene glycol containing 120 mg of methyl paraben is added and further allowed to cool at room temperature. pH of the pasty material is adjusted in the range of 5.5 to 6.5 using 10% HCl solution.

I/WE CLAIM:

1. A semiochemical/s based semi-solid emulsion composition comprising a dispersed phase and dispersion medium that is characterised as -
    (a) Dispersed phase in an amount of about 50 w/w% of the total composition which comprises semiochemical/s, wax, mesoporous material, long chain saturated or unsaturated fatty acid or/and alcohols, diluent, and antioxidant,
    (b) Mesoporous material in an amount of up to 10 w/w% of the dispersed phase
    (c) Long chain saturated or unsaturated fatty acid or alcohols in an amount up to10 w/w% of dispersed phase
    (d) Dispersion medium comprises an amount about 50 w/w% of the total amount of the composition;
    (e) additives comprises in an amount of about 2 to 30 w/w% of the total amount of the dispersion medium;

    Wherein, the said composition exhibits rain-fastness, non-phytotoxicity to plant surface, controlled release of semiochemical/s for minimum of about twelve weeks is stable under drastic environmental conditions, suitable for mating disruption, attract and kill, mass trapping of the insect pests.

2. The semi-solid composition as claimed in claim 1, wherein
    (a) Dispersed phase comprises a semiochemical/s and/or attractant either alone or encapsulated in polymer matrix or both or premixed or adsorbed with mesoporous material in an amount of about 0.1 to 20 w/w% or combination of thereof ; the wax carrier is in an amount of about 0.1 to 50 w/w%; saturated or unsaturated long chain fatty acid/alcohol of about 0.1 to 20 w/w%; diluent of about 0.1 to 15w/w% ; antioxidant of about 0.01 to 6 w/w%; lubricant/ texture modifier of about 0.1 to 10 w/w% of the total composition;
    (b) Dispersion medium comprises emulsifier in an amount of about 0.1 w/w% to 20 w/w% by of the total amount of dispersion medium; along with additives and;
    (c) Additives comprises
        I. Film forming or adhesion promoting agent in an amount in the range of about 0.1 to 7.5 w/w% of the total amount of the composition;

II. Preservative in an amount of about 0.01 to 0.5 w/w% of the total amount of the composition ;

III. Stabilizer in an amount of about 0.1 to 10 w/w% of the total amount of the dispersion medium;

IV. UV screening agent and controlled release materials such as carbon HBET 0.1 to 10 w/w% of the total amount of the composition and,

V. Rheology modifier such as hydrophilic silica of about 0.1 to 10 w/w% of the total amount of the composition;

wherein the additives are selected from the group comprising stabilizer or humectant, preservative, rheology modifier, adhesion promoter or film former, UV screening agents or mixtures thereof.

3. The semi-solid composition as claimed in claim 1 wherein the semiochemical/s is selected from the group consisting of pheromones, allomone/s, kairomone/s, synomone and combinations thereof.

4. The semi-solid composition as claimed in claim 2, wherein the mesoporuos material used for premix or adsorption of semiochemical/s is Carbon HBET optionally used in combination with mesoporous silica in the ratio with semiochemical/s from 1:10 to 10:1 for prolonged release of semiochemical/s.

5. The semi-solid composition as claimed in claim 2, wherein the mesoporous material nanostructured materials or carbon HBET have surface area of about 2000 m^2/g measured using nitrogen adsorption method.

6. The semi-solid composition as claimed in claim 1, wherein wax carrier is selected from the group consisting of natural wax, synthetic wax and combinations thereof.

7. The semi-solid composition as claimed in claim 2, wherein the semiochemical encapsulated in natural or synthetic polymer matrix *viz.*, gelatine, alginates, chitin, aminoplast resin or the alkoxy cellulose or its derivatives or poly urea derivatives or methacrylate coated particles or embedded in wax particles;

8. The semi-solid composition as claimed in claims 1, wherein the emulsion is an oil-in-water emulsion system.

9. The semi-solid composition as claimed in claim 2, wherein the insect semio-chemical/s are selected from the group consisting of the active blend of (Z, Z)-7, 11-hexadecadien-1-yl acetate and (Z, E)-7, 11- hexadecadien-1-yl acetate; the active blend of Z 9- Tetradecenyl acetate, Z7- Dodecenyl acetate and Z11- Hexadecenyl acetate; the active blend of E-11-hexadecen-1-yl acetate and (E)-11-hexadecen-1-ol; the active blend of 3E,8Z,11Z-Tetradecatrienyl acetate and 3E,8Z-Tetradecadienyl acetate; the active, (Z,Z,E)-7,11,13-Hexadeca trien-1-al; the active blend of Z-11-Hexadecenal, Z-11-Hexadecenyl-1-acetate and Z-11-Hexadecenol; the active blend of Z-11-Hexadecenal and Z-9- Hexadecenal; the active blend of Z-11-Hexadecenal and Z-9-Hexadecenal; the active blend of (Z,E)-9,11-Tetradecadienyl acetate and Z9,E-12-Tetradecadienyl acetate; the active blend of Cis-3-Hexenyl acetate and 2E- Hexen-1-ol; the active blend of Z-11-Hexadecenyl-1-acetate and Z-11-Hexadecenol; the active of Z-11-Hexadecenol; the active of (7Z,9E)-Dodeca-7,9,11-trien-1-yl formate; 11Z,13Z-Hexadeca dienal; the active blend of 4 methyl 5 nonanol and 4 methyl 5 nonanone; the active of Ethyl-4-Methyl octanoate; the active of Methyl eugenol; the active blend of Methyl eugenol and Cuelure; the active of (E,E) -8,10-Dodecadien-1-ol; the active blend of (Z)-8-Dodecen-1-yl acetate, (E)-8-Dodecen-1-yl-acetate and (Z)-8-Dodecen-1-ol; the active, (1R)-cis-4,6,6-Trimethylbicyclo [3.1.1]hept-3-en-2-one; the active trans-3,7-Dimethyl-2,6-octadien-1-ol & cis-3,7-Dimethyl-2,6-octadien-1-ol; the blend of Z-13-Octadecynyl acetate and Z-13-Octadecenol; the blend of (E,E)-10,12-hexadecadienal, (E,E)-10,12-hexadecadienol and E-10-hexadecenal; the blend of Z,E-9,12-Tetradecadien-1-yl-Acetate and Z-9 Tetradecenol; the blend of (Z)-8-Dodecen-1-yl acetate and (E)-8-Dodecen-1-yl-acetate; the active, (7E,9Z) dodeca- 7,9-dien-1-yl acetate, and the active 4-vinyl Anisole; Methyl Isonicotinate; Mono terpenes and Terpene alcohols; and wherein the semio-chemical/s are used individually or in the form of blends.

10. The semi-solid composition as claimed in claim 12, wherein the semio-chemical/s is selected from the group consisting of (Z, Z)-7, 11- hexadecadien-1-yl acetate and (Z, E)-7, 11- hexadecadien-1-yl acetate for Pink Bollworm; Z 9- Tetradecenyl acetate, Z7-

Dodecenyl acetate and Z11- Hexadecenyl acetate for Fall armyworm; Methyl eugenol; Methyl eugenol for fruit fly and Culure for melon fly; (E,E) -8,10-Dodecadien-1-ol for Codling Moth, Z-11-Hexadecenal and Z-9-Hexadecenal for Helico, for stink bug and Yellow stem borer, and wherein the semio-chemical/s are used individually or in the form of blends.

11. The semi-solid composition as claimed in claim 2, wherein the synthetic wax is selected from the group consisting of microcrystalline wax, ozokerite, ceresin, montane wax, paraffin and combinations thereof.

12. The semi-solid composition as claimed in claim 2, wherein the natural wax is selected from the group consisting of rice bran wax, sunflower wax, bees wax, candelilla wax, carnauba wax, Chinese insect wax, esparto wax, Japan wax, spermaceti wax, lanolin wax and combinations thereof.

13. The semi-solid composition as claimed in claim 2, wherein the long chain saturated fatty acids/alcohols is selected from the group consisting of cetostearyl alcohol, cetyl alcohol, stearyl alcohol, stearic acid, montanic acid, oleic acid, polyhydroxy alcohol or combination thereof.

14. The semi-solid composition as claimed in claim 2, wherein the emulsifier is selected from the group consisting of phospholipid, Brij50, Brij 52, Brij 30, Brij 35, Brij 90, Brij 92, Span 20, Span 40, Span 60, Span 80, tween 20, tween 40, tween 60 or tween 80, and combinations thereof.

15. The semi-solid composition as claimed in claim 2, wherein the diluent is selected from either paraffin oil, soyabean oil, cotton seed oil, olive oil, jojoba oil, sunflower oil, corn oil, peanut oil, sesame oil, castor oil, medium chain triglycerides, Isopropyl palmitate alone or combinations of thereof.

16. The semi-solid composition as claimed in claim 2, wherein the film forming or adhesion prompting agent is selected from poly vinyl pyrrolidone, Poly vinyl alcohol solution or mixture of thereof preferably PVP.

17. The semi-solid composition as claimed in claim 2, wherein the stabiliser or humectant is selected from the group ethylene glycol, diethylene glycol, propylene glycol, glycerol either alone or mixture of thereof.

18. The semi-solid composition as claimed in claim 2, wherein the preservative is selected from methyl paraben, propyl paraben, sodium benzoate and potassium sorbat either alone or mixture of thereof.

19. The semi-solid composition as claimed in claim 2, wherein the antioxidants is selected from BHT, BHA and tocopherol.

20. The semi-solid composition as claimed in claim 2, wherein the lubricants / texture modifier selected from group of metallic stearates like magnesium stearate, zinc stearate, calcium stearate most preferably magnesium stearate.

21. The semi-solid composition as claimed in claim 2, wherein the UV protectants selected from group of activated charcoal, carbon powder or carbon HBET.

22. A method for preparing a semi-solid emulsion composition, the method comprising the following steps:
    (a) Preparation of dispersed phase :
        i. Wax, part of diluent and saturated or unsaturated fatty acid and/or alcohol were mixed together at melting temperature of blend to obtain molten waxy liquid.
        ii. Semiochemical/s either alone or adsorbed on mesoporous silica and carbon HBET or encapsulated form along with diluent, antioxidant, and texture modifier were dispersed in the molten waxy liquid under stirring.
    (b) Preparation of dispersion medium :
        Separate aqueous phase was prepared by mixing aqueous adhesion promoter polymer solution and a surfactant blend under stirring at same temperature to the melting temperature of wax blend.
    (c) The aqueous phase obtained in step (b) added to the mixture obtained in (a) and mixed at about 2000 rpm using bottom or laboratory homogeniser; and

(d) Finally humectant/ stabiliser along with preservative was added at a temperature in the range of 60°C to 65°C to obtain the semi-solid emulsion composition.

(e) pH of the resulting semisolid composition was adjusted to 5.5 to 6.5.

23. The semi-solid composition as claimed in claim 1, wherein the composition exhibits chemical and physical stability at least eight weeks at accelerated condition of 54°C temperature, and two years at room temperature.

24. The semi-solid composition as claimed in claim 1, wherein the composition exhibits controlled release of semiochemical/s in range of 1 to 20 milligrams per day per gram of semisolid composition under open field exposure with respect to the function of semiochemical characteristics, whereas the release rate can be modulated with respect to specific crop requirement.

25. The semi-solid composition as claimed in claim 1, wherein the composition is applied onto plant foliage, plant surface or any support system in agricultural field in need thereof.

26. The semi-solid composition as claimed in claim 1, wherein the semi-solid composition is optionally used alone or in combination with compatible insecticides or agricultural adjuvants or colouring agent for its application.

27. The semi-solid composition as claimed in claim 1, wherein the composition can prepared and utilized in a form of cream, paste, gel, and glue.

Dated this the 12th day of January, 2023

R. Sakthiya Dakshi (IN/PA-2533)

(Agent for the Applicant)

ABSTRACT:

"CONTROLLED RELEASE SEMI-SOLID EMULSION COMPOSITIONS OF SEMIOCHEMICALS"

The present disclosure relates to a water dispersible, semi-solid emulsion which can be applied as dollops or sprayable on plant foliage, its surfaces, any support systems in agricultural field to treat, and prevent insect population either by mass trapping, mating disruption or attract & kill technique and method of preparing the composition. The semi-solid composition includes either semiochemical/s alone or adsorbed on mesoporous materials or encapsulated with polymer matrix and combination thereof which displays sustained release for a longer period of time. It shows prolonged release and protects crop effectively, independent of environmental temperature and shows high stability even under humid conditions. The composition is water dispersible, eco-friendly in nature, cost-effective, exhibits stable physiochemical properties with good adhesion properties to plant surface after application and necessary rain fastness. It can be stored at room temperature with caped tube for longer time without any change in quality. It is advantageous for camouflaging the treated area with composition to achieving mating interruption/disruption or male annihilation in insect or attracting adult insects.