

**Compendium of Bioagents in Agriculture:
Information on Biocontrol agents used in Biological control of crop insect pests**

S.N	Chemical name	Common name	Concept of active ingredient in the formulation	Target organism /host	Physiological stage for application	Recommended dose & mode of application	Reason for recommendation	Side effects, if any	Not for use on
		<i>Acerophagus papayae</i>	<i>Endoparasitoids of papaya mealybug</i>	<i>On papaya mealybug Paracoccus marginatus</i>	Field release	250 per ha	To reduce mealybug infestation	Nil	
		<i>Anagyrus loecki</i>	<i>Endoparasitoids of papaya mealybug</i>	<i>On papaya mealybug Paracoccus marginatus</i>	Field release	250 per ha	To reduce mealybug infestation	Nil	
		<i>Pseudleptomastix mexicana</i>	<i>Endoparasitoids of papaya mealybug</i>	<i>On papaya mealybug Paracoccus marginatus</i>	Field release	250 per ha	To reduce mealybug infestation	Nil	
		<i>Trichogramma chilonis</i> Ishii (I) # Hymenoptera: Trichogrammatidae	Parasitised egg cards	Sugarcane borers <i>Chilo infuscatellus</i> , <i>Chilo sacchariphagus indicus</i> , <i>Chilo auricilius</i> , <i>Acigona steniellus</i> ; Cotton (Non Bt) bollworms <i>Helicoverpa armigera</i> , <i>Pectinophora gossypiella</i> & <i>Earias</i> spp.; Maize stem borer <i>Chilo partellus</i> , Diamond back moth <i>Plutella</i>	Field release	50,000/ha on sugarcane and vegetables; 100,000/ha on maize and 1,50,000/ha on cotton	Sugarcane: 4 to 6 releases at 10 days intervals for early shoot borer; 8 to 10 releases for stalk, internode and Gurdaspur borers Cotton (Non Bt) & Vegetables: Six weekly releases Maize: Three releases at five		

				<i>xylostella</i> ; Tomato fruit borer <i>Helicoverpa armigera</i>			days intervals		
		<i>Trichogramma japonicum</i> (I) Hymenoptera: Trichogrammatidae	Parasitised egg cards	Top shoot borer of sugarcane <i>Scirpophaga excerptalis</i> and Paddy stem borer <i>Scirpophaga incertulas</i>	Field release	Sugarcane & Paddy: 50,000/ha	Sugarcane: 4 to 6 releases at 10 days intervals on observing pest or from 60 th day Paddy: 6 releases on appearance of pest or from 30 th day after transplantation		
		<i>Trichogramma achaeae</i> (I)* Hymenoptera: Trichogrammatidae	Parasitised egg cards	Cotton (Non Bt) bollworms and Bhendi Borer	Field release	1,50,000/ha on cotton (Non Bt) 50,000/ha on vegetables	Six releases at weekly intervals		
		<i>Trichogramma pretiosum</i> (E)* Hymenoptera: Trichogrammatidae	Parasitised egg cards	Tomato fruit borer <i>Helicoverpa armigera</i>	Field release	50,000/ha	Six releases at weekly intervals on appearance of pest or from 45 th day from transplatation		
		<i>Trichogramma embryophagum</i> (E)* Hymenoptera:	Parasitised egg cards	Apple Codling moth <i>Cydia pomonella</i>	Field release	2000 adults per tree or 100,000/ha	Releases starting from the first moth catch, continue at weekly intervals till pest egg availability in the		

		Trichogrammatidae					field		
		<i>Trichogramma dendrolimi</i> Matsumara (E)* Hymenoptera: Trichogrammatidae	Parasitised egg cards	Targeted against tissue borers on maize and sugarcane – For Research work	Field release	-	-		
		<i>Trichogramma brassicae</i> (E)* Hymenoptera: Trichogrammatidae	Parasitised egg cards	Diamondback moth <i>Plutella xylostella</i> and Cabbage butterfly <i>Pieris brassicae</i> on cabbage and cauliflower	Field release	100,000/ha	Six releases at weekly intervals		
		<i>Trichogramma evanescens</i> Westwood Hymenoptera: Trichogrammatidae	Parasitised egg cards	Targeted against tissue borers on maize and sugarcane - For Research work	Field release	-	-		
		<i>Trichogramma mwanzai</i> (E)* Hymenoptera: Trichogrammatidae	Parasitised egg cards	Targeted against <i>Helicoverpa armigera</i> - For Research work	Field release	-	-		
		<i>Trichogrammatoidea armigera</i> (E)* Hymenoptera:	Parasitised egg cards	Targeted against <i>Helicoverpa armigera</i> - For	Field release	-	-		

		Trichogrammatidae		Research work					
		<i>Trichogrammatoidea bactrae</i> (E)* Hymenoptera: Trichogrammatidae	Parasitised egg cards	Diamond back moth <i>Plutella xylostella</i> on cabbage	Field release	2,50,000/ha	Five releases at weekly intervals		
		<i>Telenomus remus</i> Nixon (E) Hymenoptera: Scelionidae	Parasitised egg cards	Tobacco caterpillar <i>Spodoptera litura</i>	Field release	1 lakh /ha	Three to four releases		
		<i>Goniozus nephantidis</i> (Muesebeck) (I) Hymenoptera: Bethylidae	Cocoons	Coconut black-headed caterpillar <i>Opisina areosella</i>	Field release on tree trunks	10 adults per palm	Four releases		
		<i>Chelonus Blackburnii</i> Cameron (E)* Hymenoptera: Braconidae	Adults	Potato tuber moth <i>Phthorimaea operculella</i>	Field release	50000 adults /ha in the field 2 adults per kg of potatoes in godowns	Two releases at weekly intervals Three to four releases (or as per need) at fortnightly intervals		
		<i>Cryptolaemus</i>	Adults / Grubs	Mealy bugs	Field release	10 beetles or 50	One or more		

		<i>montrouzieri</i> Mulsant (E) Coleoptera: Coccinellidae		<i>Maconellicoccus hirsutus</i> , <i>Planococcus citri</i> , <i>P. lilacinus</i>		grubs /infested plant or tree or 5000 beetles/ha	releases based on pest intensity		
		<i>Scymnus coccivora</i> (Ramakrishna Ayyar) (I) <i>Coleoptera: Coccinellidae</i>	Adults	Mealy bugs on citrus, grapes and other fruit crops (<i>M. hirsutus</i> , <i>Planococcus</i> spp.)	Field release	600 – 2500 adults/ha	One or more releases based on pest intensity	Nil	
		<i>Chilocorus nigrita</i> (Fabricius) (I) <i>Coleoptera: Coccinellidae</i>	Adults / Eggs	Sugarcane scale insect <i>Melanaspis glomerata</i> Citrus scale <i>Aonidiella aurantii</i>	Field release	1500 beetles/ha; or 10 egg pads (with 40 eggs per pad) in 100 spots/ha (40,000 eggs/ha) 10 adults/tree	One or more releases based on pest intensity		
		<i>Cheilomenes sexmaculata</i> Fabricius (I)* <i>Coleoptera: Coccinellidae</i>	Adults / Eggs	<i>Aphis craccivora</i> on legumes and <i>Lipaphis erysimi</i> on oilseed crops	Field release	5000 larvae or 500 adults per ha	Two releases; first release to coincide with the appearance of aphids		
		<i>Coccinella septempunctata</i> Linnaeus (I)* <i>Coleoptera:</i>	Adults / Eggs	<i>Aphis craccivora</i> on legumes and <i>Lipaphis erysimi</i> on	Field release	5000 larvae or 500 adults per ha	Two releases; first release to coincide with the appearance of		

		Coccinellidae		oilseed crops			aphids		
		<i>Brumoides suturalis</i> (Fabricius) (I)* Coleoptera: Coccinellidae	Adults	Aphids and white flies	Field release	-	-		
		<i>Curinus coeruleus</i> Mulsant (E) Coleoptera: Coccinellidae	Adults	Subabul psyllid <i>Hetropsylla cubana</i>	Field release	20 Adults per tree	Two releases during July and October		
		<i>Chrysoperla carnea</i> (Stephens) (I) Coleoptera: Coccinellidae	Eggs / First instar larvae	Sucking pests on cotton, tobacco, sunflower, groundnut & some fruit crops	Field release	10,000 first instar larvae/ha	Twice during the season with an interval of 15 days On fruit crops, 10 – 20 larvae per infested tree		
		<i>Mallada</i> spp. (I) * Neuroptera: Chrysopidae	Cocoons	Sucking pests on cotton, tobacco, sunflower, groundnut & some fruit crops	Field release	10,000 first instar larvae/ha	Twice during the season with an interval of 15 days On fruit crops, 10 – 20 larvae per infested tree		
		<i>Ischiodon scutellaris</i> (Fabricius) (I) * Diptera: Syrphidae	Cocoons	<i>Aphis craccivora</i> on legumes and <i>Lipaphis erysimi</i> on oilseed crops	Field release	5000 larvae/ha	-		
		<i>Micromus timidus</i> (Hagen) (I) *	Larvae	<i>A. craccivora</i> on legumes & oilseeds	Field release	Research in	Research in		

		Neuroptera: Hemerobidae		& Sugarcane Woolly Aphid		progress	progress		
		<i>Cardiastethus exiguus</i> Poppius (I) Hemiptera: Anthocoridae	Adults/Nymphs	<i>Opisina arenosella</i> Coconut black- headed caterpillar		50 nymphs/adults per tree	Three releases		
		<i>Blaptostethus pallenscens</i> Poppius (I) Hemiptera: Anthocoridae	Adults/Nymphs	Spider mites on bhendi	Field release	5 to 10 nymphs per plant	Five releases		
		<i>Xylocoris flavipes</i> (Reuter) (I) * Hemiptera: Anthocoridae	Adults/Nymphs	Storage pests	Field release	For research work	-		
		<i>Orius tantillus / Orius maxidentex.</i> (I) Hemiptera: Anthocoridae *	Adults/Nymphs	Thrips	Field release	For research work	-		
		<i>Heterorhabditis indica</i> (Entomo pathogenic nematodes)	Infective juveniles in wetable powder	White grubs, Root weevils & soil pests	Soil Application	20kg/ha	For combating Soil insect pests and reducing chemical insecticide usage		
		<i>Bacillus thuringiensis</i>	Bt crystals and Bt spores 5%	Lepidopteran, coleopteran and dipteran pests of crops	Foliar spray	1kg/ha	To reduce the use of chemical pesticides	Nil	-
		<i>Spodoptera litura Nuclear Polyhdrosis</i>	Poly hedral bodies of the	<i>Spodoptera litura</i>	Foliar spray	250 Larval Equivalent (LE)	To reduce the use of		

		<i>virus(SI NPV)</i>	NPV Virus 1 X 10 ⁹ PIB/ml			/ha	chemical pesticides		
		<i>Helicoverpa armigera</i> <i>Nuclear Polyhdrosis virus(Ha NPV)</i>	Poly hedral bodies of the NPV Virus 1 X 10 ⁹ PIB/ml	<i>Helicoverpa armigera</i>	Foliar spray	250 Larval Equivalent (LE) /ha	To reduce the use of chemical pesticides		
5		<i>Beauveria bassiana</i>	Spore cum mycelia formulation 1X10 ⁸ CFU/g/ml	Several insect pests of crops	Foliar spray for foliar pests Soil application for soil pests	2.5-5.0kg/ hafor foliar spray 2.5-5.0 kg+250-500kg FYM /ha for soil application	For combating insect pests and reducing chemical insecticide usage	-Nil-	-
		<i>Metarhizium anisopliae</i>	-do-	-do-	-do-	-do-	-do-	-Nil-	-
		<i>Verticillium lecanii</i>	-do-	Sucking pests of various crops	Foliar spray	2.5-5.0kg/ hafor foliar spray	-do-	-Nil-	-
		<i>Paecilomyces fumosoroseus</i>	-do-	For mite control	-do-	2.5-5.0kg/ hafor foliar spray	-do-	-Nil-	-

**Compendium of Bioagents in Agriculture:
Information on Biocontrol agents used in Biological control of nematodes**

S.N	Chemical name	Common name	Concept of active ingredient in the formulation	Target organism /host	Physiological stage for application	Recommended dose & mode of application	Reason for recommendation	Side effects, if any	Not for use on
1		<i>Pochonia chlamydosporia</i>	Spore cum mycelia formulation	Plant parasitic nematodes (PPN)	Soil application	15kg/ha	For combating PPN & reducing chemical nematicide usage	-Nil-	-
2		<i>Paecilomyces lilacinus</i>	Spore cum mycelia formulation	-do-	-do-	-do-	-do-	-Nil-	-

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S.N	Chemical name	Common name	Concept of active ingredient in the formulation	Target organism /host	Physiological stage for application	Recommended dose & mode of application	Reason for recommendation	Side effects, if any	Not for use on
1		<i>Trichoderma viride</i>	Spore cum mycelia formulation of 2×10^6 CFU/g/ml	Soil-borne plant pathogens like <i>Rhizoctonia</i> , <i>Phythium</i> , <i>Phytophthora</i> , <i>Scleroterium</i> , <i>Fusarium</i> etc.	Seed treatment and soil application	Seed treatment dosage: 4-10g/kg seeds Soil application dosage: 2.5-5.0 kg+250-500kg FYM /ha for soil application	For combating soil borne plant pathogens and reducing chemical fungicide usage	-Nil-	-
2		<i>T. harzianum</i>	-do-	-do-	-do-	-do-	-do-	-Nil-	-
3		<i>T. virens</i>	-do-	-do-	-do-	-do-	-do-	-Nil-	-
4		<i>Pseudomonas fluorescens</i>	The formulation consists of live cells 1×10^8 CFU/g/ml	Fungal pathogens	Seed treatment Foliar spray	Seed treatment - 10g per Kg of seeds. Foliar spray- 0.1% of formulation mixed in water	Suppression of plant pathogens. Plant growth promoter.	Nil	
5		<i>Bacillus subtilis</i>	The formulation consists of live cells 1×10^8 CFU/g/ml	Fungal pathogens	Seed treatment Foliar spray	Seed treatment - 10g per Kg of seeds. Foliar spray- 0.1% of formulation mixed in water	Suppression of plant pathogens. Plant growth promoter.	Nil	