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## Checkmate the Pink Bollworm

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This article is meant to sensitise the non-technical reader to the term pheromone.

'Pheromone' derived from the Greek word 'pherein' meaning 'to convey' with 'mone' from 'hormone', is a chemical substance produced and released into the environment by an animal, especially a mammal or an insect, affecting the behaviour or physiology of others of its species. Pheromones are intraspecific in action and therefore are safe to natural enemies.

Pheromones are predominantly volatile, but sometimes are liquid, contact chemicals. All are produced by

exocrine glands. Pheromones are effective in very small quantities and are categorised as sex pheromones, alarm pheromones, aggregating pheromones, trail marking pheromones, spacing pheromones, etc. Sex pheromones and its use are discussed in this article in the context of pink bollworm management. The sex pheromone in the pink bollworm called gossyplure, is emitted by the female and is responsible for attracting the male for the purposes of mating. Male moths are active before female moths on a daily and seasonal

basis and synthetic pheromones can intercept and trap male moths before calling begins. By itself, pheromones are not toxic and do not kill through properties such as those possessed by insecticides. They have been exploited for management of insect pests such as the Gypsy moth, Codling moth, Med Fly, Japanese Beetle and the Pink bollworm.

Semio-chemical pest management programs in crops deploy pheromones as lures for one or more of the following: monitoring, mass trapping, mating disruption and as lure and kill. Pheromones are rarely used as a standalone management tool. They are used in combination with other interventions for effective and timely pest management.

### Monitoring

PBW sex pheromone, gossyplure is used to quantify the influx of moths into a given area over a specified

period, so as to time the control measure when the vulnerable stage, larvae in this case, are best targeted. Monitoring should begin well before the pest becomes established in a given area. It should be done to ensure the utility of an expensive control measure. Monitoring using pheromones is best carried out for pink bollworm, a pest whose trap catches correlate well with larval damage in green bolls. Eight moths per trap per night over three consecutive nights, is the economic threshold level at which pest control actions must



### GUEST COLUMN

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1. Moth of Pink Bollworm



3. Moth catches collected in pheromone trap



2. Pheromone trap with moth catches



4. Pink bollworm damage on green boll

be initiated to prevent economic damage. The association between pink bollworm moth captures and boll infestation was positive and significant for non-Bt cotton fields but was not significant for Bt cotton fields in the US. This is not true with Bt resistant pink bollworm in parts of India.

### Mass Trapping

Mass trapping of insects is meant to remove insects from breeding and feeding. The insect must find and contact the pheromone source. A

suitable trap design is essential to handle large volumes of trapped adult moths. Efficacy of mass trapping depends on the density of the natural (virgin females) and synthetic pheromone that is used. It can be timed after or before a control measure, such as the use of insecticide. Eradication of new invasions of insect species is affected by this method. Mass trapping works well at low pest densities. The density and efficiency of traps as well as the strength of lures needs to be sufficient to catch enough insects to reduce economic damage. Mass trapping can be used as a standalone pest management tool or can be coupled with the use of insecticides either before or after the process of mass trapping.

Sticky or oil traps baited with 1 mg of gossyplure at a density of 10-20 traps per hectare were deployed in cotton fields with lure replacement every 2-3 weeks in Brazil.

The success of large-scale mass trapping against pink bollworm in the Brazil trial was attributed to: 1) low population present early in the cotton growing season, 2) cotton growing area needs to be isolated, and 3) other cotton pests do not cause severe problems.. Mass trapping has been used in long-term pest management [e.g., codling moth, *Cydia pomonella* (L.); pink bollworm, *Pectinophora gossypiella* (Saunders); bark beetles, palm weevils, corn rootworms (*Diabrotica* spp.); and fruitflies] or in eradication of invasive species [e.g., gypsy moth, *Lymantria dispar* (L.); and boll weevil, *Anthonomus grandis* Boheman). However latest reports suggest that mating disruption is more effective than mass trapping to control pink bollworm.

### Lure and Kill

This involves the use of pheromone to lure and insecticide/ sterilant/ insect pathogen to kill / sterilise/infect the lured insect. In this method the insect is not trapped as in mass trapping but is killed/sterilised or infected, instead. This method should be adopted from the time of first adult to last adult emergence and is less effective at higher pest densities due to greater number of calling wild females. Pyrethroids are commonly used to kill the lured moths. When the male pink bollworm is lured by the pheromone and touches the pyrethroid treated surface, not only does it die in 24 hours, its flight behaviour is significantly affected, preventing it from locating a female.

### Mating Disruption

Preventing pheromone communication between sexes by saturating the area with high concentration of pheromone, thus disrupting mating, is the basic principal of this method. The sex that responds to the pheromone is unable to find the sex that is emitting it. Insects remain alive, but are disoriented and do not mate and therefore do not breed. Male moths that come in contact with the pheromone and fly away also become a potential source for emitting the pheromone, having acquired it through contact, further aiding in mating confusion. This method is recommended for use in cotton grown in the US, from the six node growth stage, i.e. before the pinhead stage.

## Strategy of Pheromone Use for PBW Management

**USA:** An area wide pink bollworm eradication program, categorised into three phases, and executed between 2001-2008, involving growers and federal agencies was proposed. Operational elements involved mapping to identify field locations, quantify the acreage and determine the genotypes. Detection by trapping (one trap per 10 acres with each trap having rubber septa impregnated with 4mg of gossyplure) and visual inspection (10 randomly selected non Bt fields per work unit of 12000-15000 acres) inspected weekly at bloom stage for rosette bloom. This was associated with larval surveys at green boll stage. Cultural control practises, mating disruption was associated with sterile insect release and cultivation of Bt cotton with minimal insecticides. Community wide application of the PB Rope R a commercial pheromone formulation at pin head square growth stage offered effective control of PBW for 60 days. This was accompanied by release of sterile males of pink bollworm into the environment. One hundred sterile moths per acre per day at 4 leaf growth stage were released on all conventional cotton fields.

When larval infestation exceeded 5% chlorpyrifos @0.75lbs/acre (0.85 kg/ha) was applied. Cultural control involving shredding and ploughing of earlier crop reduced moth emergence by 80%. This killed diapausing larvae in late season bolls, trash and soil. Practised along with uniform planting, harvesting and off-season irrigation limited pink bollworm incidence and damage in cotton. Phase I was implemented over 55000 acres that increased to 250,000 acres each in the second and third phase.

**Egypt:** Mating disruption was carried out using P B Rope L. One thousand PB Ropes were dispensed per hectare, 200mm long with a diameter of 25mm impregnated with 78mg of gossyplure. The COT plant and insect simulation model was initialised for the main long staple cotton varieties (Giza'75 and Giza'80) and for the release rate characteristics of several pheromone formulations and dispenser types. When primed with the magnitude of the spring bollworm emergence and certain agronomic data, the system predicted bollworm populations for given field management scenarios.





5. PB Rope L on cotton plant

Simulations have proved accurate and useful but have demonstrated problems with the use of pheromone traps as control decision tools.

**India:** Pink bollworm emerged as a major problem on cotton due to the cultivation of Bt hybrids of variable duration almost all through the year as large contiguous tracts with selection of the worm first on Cry 1Ac and then to the combination of toxins Cry1Ac+Cry2Ab. Field resistance is not recorded yet, in North Indian populations of the pink bollworm largely due to synchronous sowing and crop termination to facilitate timely sowing of the succeeding wheat crop. Cultivation of short duration Bt varieties is an imminent necessity especially in Central and South India where Bt resistance in the pink bollworm has recently been reported. The Bt in these short duration cultivars is expected to control the other bollworms while a short duration genotype is essential to escape the pink bollworm. These measures should be accompanied by timely sowing, harvesting and terminating the crop while monitoring moth activity using pheromone traps with assured quality of lures, using recommended insecticidal interventions as moths cross ETL. Implemented as an area wide program especially in Central and South India it would hold the key to successful

cotton cultivation in the next few years. Trials for other methods of pheromone use are still nascent and need well planned, unbiased experimentation in multi-location trials. Detailed strategies for the management of pink bollworm have been enlisted by Kranthi K.R. at [http://www.cicr.org.in/pdf/Kranthi\\_art/Pinkbollworm.pdf](http://www.cicr.org.in/pdf/Kranthi_art/Pinkbollworm.pdf).

#### Examples of Pheromone Formulations:

Nomate R is a slow release formulation of gossypure and hexane contained in 1.5cm length of 200u hollow fibres sealed at one end. Nomate PBW attract and Kill contains a small amount of permethrin 0.004 kg ai/Ha added to the polybutene sticker Botax used to adhere fibres to leaves. DisruptR a slow release system of gossypure consisting of 3 layer plastic dispenser with gossypure concentrated in the central reservoir. PB Rope L a high rate slow release system consisting of a wire based sealed polyethylene tube 8 inches filled with gossypure. Gossypure was used for PBW monitoring in India. It was popular as a monitoring tool in the 1990s. In fact, PB Rope L tested then was found to be economically non-viable. With newer and inexpensive methods for the production of synthetic gossypure, pheromones are being revisited as pest management tools. SPLAT (Specialised Pheromone & Lure Application Technology), a new technology, is a proprietary base matrix formulation of biologically inert materials used to control the release of semio-chemicals and/or odours with or without pesticides. SPLAT facilitates and automates the dispensing of semio-chemicals and attractants; by simplifying the delivery of these chemicals in the field. Pheromones thus formulated can be applied through multiple methods as these formulations are available in a wide range of viscosity. SPLAT facilitates mechanisation of application. The amorphous and flowable quality of this formulation allows for an easy transition from small scale manual applications to large-scale mechanical applications. These formulations demonstrate rain fastness on vegetation being effective upto six months. It is being demonstrated for pink bollworm management on Bt cotton in India.

Stake holders need to understand and take aggressive, simple steps to mitigate pink bollworm damage in Bt cotton in India to prevent the collapse of the cotton sector as larvae not only affect quantity but also the quality of the fibre.

*(The views expressed in this column are of the author and not that of Cotton Association of India)*



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• **Madhya Pradesh :** Indore • **Karnataka :** Hubli • **Punjab :** Bathinda • **Telangana :** Adilabad



#### COTTON ASSOCIATION OF INDIA

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## CAI Retains its Estimate of Cotton Crop for 2017-18 Crop Year at 360 Lakh Bales

Cotton Association of India (CAI) has released its April estimate of the cotton crop for the season 2017-18 beginning from 1st October 2017. The CAI has retained its cotton crop estimate for the ongoing crop year 2017-18 at 360 lakh bales of 170 kgs. each. However, the CAI has made small changes in the state-wise production figures. The production figures for the states of Maharashtra and Karnataka are estimated to be higher by 2 lakh bales and 50,000 bales respectively while the production in the states of Telangana and Andhra Pradesh are now estimated lower by 1.50 lakh bales and 1 lakh bales respectively thus retaining the crop at the same level as in the previous estimate made by the CAI in the last month. Statements containing the state-wise estimate of the cotton crop and the Balance Sheet for the crop year 2017-18 with the corresponding data for the previous year are given below:-

While taking stock of the situation, the Statistics Committee of the Association has projected total cotton supply upto 30th April 2018 at 347 lakh bales of 170 kgs. each which consists of the arrivals of 311 lakh bales upto 30th April 2018 and imports which the Committee has estimated at 6 lakh bales upto April end. Further, the Committee has estimated cotton consumption for 7 months i.e. from October 2017 to April 2018 at 189 lakh bales at an average of 27 lakh bales per month while the shipment of cotton till 30th April 2018 has been estimated at 61 lakh bales. The stock at the end of April 2018 is estimated at 97 lakh bales including 52 lakh bales with textile mills while the remaining 45 lakh bales are estimated to be held by CCI and others (MNCs, traders, ginners, etc.).

The projected yearly Balance Sheet for the Season 2017-18 drawn by the CAI has estimated total cotton supply till end of the season i.e. upto 30th September 2018 at 410 lakh bales of 170 kgs. each which includes opening stock of 30 lakh bales at the beginning of the season. The CAI has estimated domestic consumption for the season at 324 lakh bales while the exports are estimated to be 65 lakh bales. The carry-over stock at the end of the 2017-18 season is estimated by the CAI at 21 lakh bales.

It may be noted that the crop size of 360 lakh bales of 170 kgs. each is equal to 382.50 lakh running bales of 160 kgs. each and the estimated arrival of 311 lakh bales 170 kgs. each upto 30th April 2018 is equal to 330.50 lakh running bales of 160 kgs. each. Around 86% of the crop has already arrived in the market upto 30th April 2018. In order to avoid confusion and have more clarity on production, consumption, export and import figures, the Statistics Committee of the Association has convened another meeting on 11th June 2018 and the President has invited all its 30 crop committee members including CCI, all MNCs and textile mills associations to attend this important meeting positively.

### CAI's Estimates of Cotton Crop as on 30th April 2018 for the Seasons 2017-18 and 2016-17

(in lakh bales)

State	Production *		Arrivals as on 30th April 2018 (2017-18)
	2017-18	2016-17	
Punjab	11.00	8.75	8.85
Haryana	24.00	20.50	21.20
Upper Rajasthan	10.00	7.25	9.40
Lower Rajasthan	11.00	9.25	10.80
<b>Total North Zone</b>	<b>56.00</b>	<b>45.75</b>	<b>50.25</b>
Gujarat	105.00	89.00	83.10
Maharashtra	82.00	88.00	73.25
Madhya Pradesh	21.00	20.50	19.50
<b>Total Central Zone</b>	<b>208.00</b>	<b>197.50</b>	<b>175.85</b>
Telangana	51.50	48.00	48.10
Andhra Pradesh	18.00	18.50	15.10
Karnataka	17.50	17.00	15.60
Tamil Nadu	5.00	5.50	2.50
<b>Total South Zone</b>	<b>92.00</b>	<b>89.00</b>	<b>81.30</b>
Orissa	3.00	3.00	3.00
<b>Others</b>	<b>1.00</b>	<b>2.00</b>	<b>0.60</b>
<b>Total</b>	<b>360.00</b>	<b>337.25</b>	<b>311.00</b>

\* Including loose

The Balance Sheet drawn by the Association for 2017-18 and 2016-17 is reproduced below:-  
(in lakh bales)

Details	2017-18	2016-17
Opening Stock	30.00	36.50
Production	360.00	337.25
Imports	20.00	27.00
<b>Total Supply</b>	<b>410.00</b>	<b>400.75</b>
Mill Consumption	280.00	265.00
Consumption by SSI Units	29.00	27.00
Non-Mill Use	15.00	15.75
<b>Total Domestic Demand</b>	<b>324.00</b>	<b>307.75</b>
<b>Available Surplus</b>	<b>86.00</b>	<b>93.00</b>
Exports	65.00	63.00
<b>Closing Stock</b>	<b>21.00</b>	<b>30.00</b>

**Balance Sheet of 7 months i.e. from 1.10.2017 to 30.04.2018 for the season 2017-18**

Details	(in lakh b/s of 170 kg)
Opening Stock as on 01.10.2017	30.00
Arrivals upto 30.04.2018	311.00
Imports upto 30.04.2018	6.00
<b>Total Available</b>	<b>347.00</b>
Consumption (27 Lakhs X 7 months)	189.00
Export Shipment upto 30.04.2018	61.00
Stock with Mills	52.00
Stock with CCI, MNCs, MCX & Ginners	45.00
<b>Total</b>	<b>347.00</b>

## Cotton Consumption - Cotton Year-wise

(In Lakh bales)

	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17 (P)	2017-18 (P)
Oct.	16.54	18.13	22.09	17.77	21.84	24.03	24.17	24.70	21.52	22.23
Nov.	16.94	18.47	21.09	18.34	21.09	22.96	25.05	23.35	23.06	18.98
Dec.	17.98	19.49	22.57	20.13	22.63	25.16	25.89	25.49	24.59	20.90
Jan.	16.93	19.54	22.1	20.33	23.3	25.19	25.77	25.26	25.02	21.04
Feb.	16.23	18.81	20.23	20.31	22.24	23.22	24.58	24.64	24.44	20.53
March	17.51	20.01	21.77	20.38	23.61	25.07	26.18	25.61	25.90	
April	17.12	20.53	20.17	20.31	23.22	24.32	25.57	24.95	24.82	
May	17.83	20.93	18.64	21.27	22.85	24.38	25.62	25.38	24.86	
June	18.01	20.71	18.23	21.17	22.51	24.11	25.61	25.38	24.57	
July	18.98	22.11	19	22.14	24.11	24.54	25.56	25.01	24.68	
Aug.	18.59	21.73	18.64	22.08	24.23	24.46	25.86	24.37	23.17	
Sept.	18.29	21.42	21.71	21.46	23.7	25.81	24.58	23.14	22.28	
<b>TOTAL</b>	<b>210.96</b>	<b>241.88</b>	<b>246.23</b>	<b>245.47</b>	<b>275.34</b>	<b>293.24</b>	<b>304.43</b>	<b>297.28</b>	<b>288.91</b>	<b>103.67</b>

P – Provisional

(Source: Office of the Textile Commissioner)



UPCOUNTRY SPOT RATES							(Rs./Qtl)					
Standard Descriptions with Basic Grade & Staple in Millimetres based on Upper Half Mean Length [ By law 66 (A) (a) (4) ]							Spot Rate (Upcountry) 2017-18 Crop APRIL - MAY 2018					
Sr. No.	Growth	Grade Standard	Grade	Staple	Micronaire	Strength /GPT	30th	1st	2nd	3rd	4th	5th
1	P/H/R	ICS-101	Fine	Below 22mm	5.0-7.0	15	11698 (41600)		11782 (41900)	11782 (41900)	11782 (41900)	11782 (41900)
2	P/H/R	ICS-201	Fine	Below 22mm	5.0-7.0	15	11838 (42100)	H	11923 (42400)	11923 (42400)	11923 (42400)	11923 (42400)
3	GUJ	ICS-102	Fine	22mm	4.0-6.0	20	7452 (26500)		7452 (26500)	7452 (26500)	7452 (26500)	7452 (26500)
4	KAR	ICS-103	Fine	23mm	4.0-5.5	21	9026 (32100)		9026 (32100)	9026 (32100)	9026 (32100)	9026 (32100)
5	M/M	ICS-104	Fine	24mm	4.0-5.0	23	9898 (35200)	O	9898 (35200)	9898 (35200)	9898 (35200)	9898 (35200)
6	P/H/R	ICS-202	Fine	26mm	3.5-4.9	26	11473 (40800)		11585 (41200)	11614 (41300)	11642 (41400)	11698 (41600)
7	M/M/A	ICS-105	Fine	26mm	3.0-3.4	25	8548 (30400)	L	8548 (30400)	8577 (30500)	8577 (30500)	8577 (30500)
8	M/M/A	ICS-105	Fine	26mm	3.5-4.9	25	9476 (33700)		9561 (34000)	9561 (34000)	9561 (34000)	9561 (34000)
9	P/H/R	ICS-105	Fine	27mm	3.5-4.9	26	11614 (41300)		11726 (41700)	11754 (41800)	11782 (41900)	11838 (42100)
10	M/M/A	ICS-105	Fine	27mm	3.0-3.4	26	8998 (32000)	I	8998 (32000)	9026 (32100)	9055 (32200)	9055 (32200)
11	M/M/A	ICS-105	Fine	27mm	3.5-4.9	26	10151 (36100)		10208 (36300)	10208 (36300)	10208 (36300)	10208 (36300)
12	P/H/R	ICS-105	Fine	28mm	3.5-4.9	27	11670 (41500)	D	11782 (41900)	11810 (42000)	11838 (42100)	11895 (42300)
13	M/M/A	ICS-105	Fine	28mm	3.5-4.9	27	10967 (39000)		10967 (39000)	11023 (39200)	11023 (39200)	11023 (39200)
14	GUJ	ICS-105	Fine	28mm	3.5-4.9	27	11360 (40400)		11389 (40500)	11417 (40600)	11417 (40600)	11473 (40800)
15	M/M/A/K	ICS-105	Fine	29mm	3.5-4.9	28	11445 (40700)	A	11445 (40700)	11445 (40700)	11445 (40700)	11501 (40900)
16	GUJ	ICS-105	Fine	29mm	3.5-4.9	28	11642 (41400)		11670 (41500)	11698 (41600)	11698 (41600)	11754 (41800)
17	M/M/A/K	ICS-105	Fine	30mm	3.5-4.9	29	11810 (42000)	Y	11810 (42000)	11810 (42000)	11810 (42000)	11867 (42200)
18	M/M/A/K/T/O	ICS-105	Fine	31mm	3.5-4.9	30	12092 (43000)		12092 (43000)	12092 (43000)	12092 (43000)	12092 (43000)
19	A/K/T/O	ICS-106	Fine	32mm	3.5-4.9	31	12457 (44300)		12457 (44300)	12457 (44300)	12457 (44300)	12457 (44300)
20	M(P)/K/T	ICS-107	Fine	34mm	3.0-3.8	33	15325 (54500)		15466 (55000)	15522 (55200)	15663 (55700)	15747 (56000)

(Note: Figures in bracket indicate prices in Rs./Candy)