

## End of January results from Bt resistance monitoring 2009/10

### ***Hatching and species composition***

Across all sampled valleys there were 20793 samples submitted to the program until 31 January 2010. The majority of samples were eggs, although there were some early season collections of larvae from chick pea. Of the eggs submitted, 65% successfully hatched. Of the eggs from cotton and pigeon pea that successfully hatched and the larvae from chick pea, 33% were *H. armigera*.

**The following table shows the data on total number of samples, and average hatching, and species composition separately for each valley.** The % *H. armigera* values do not include hosts that are known to be dominated by this species (i.e., maize and sorghum).

The levels of hatching and species composition presented in the table are averages for each valley and the actual levels vary greatly among properties. The values in brackets to the right of % hatch and % *H. armigera* indicate the range among collections. For instance, for the period between 2 September and 25 November, in Macintyre the % *H. armigera* is 53 and ranges from 31 to 83 among properties sampled. The periods across the top of the table represent the dates at which the samples were identified to species, which is about 12 days after they were received as eggs or up to 7 days after larvae collections were received.

Valley	Trait	2 Sep-25 Nov	26 Nov-31 Dec	1-31 Jan	Season total
Lower Namoi	No. of samples	550	1210	381	2141
	% hatch	71 (55-93)	62 (40-71)	83 (69-100)	72 (40-100)
	% <i>H. armigera</i>	4 (0-23)	55 (2-75)	75 (71-77)	46 (0-77)
Upper Namoi	No. of samples	374	65	1346	1785
	% hatch	55 (55)	74 (74)	65 (46-91)	65 (55-91)
	% <i>H. armigera</i>	13 (13)	1 sample from maize <sup>a</sup>	46 (17-66)	29 (13-66)
Emerald	No. of samples	73	645	157	875
	% hatch	98 (98-100)	61 (38-84)	47 (31-62)	68 (38-100)
	% <i>H. armigera</i>	93 (73-100)	45 (21-76)	74 (42-93)	70 (21-100)
Darling Downes	No. of samples	137	539	499	1175
	% hatch	93 (58-100)	86 (19-100)	79 (34-100)	86 (19-100)
	% <i>H. armigera</i>	91 (78-100)	27 (21-94)	77 (28-100)	65 (21-100)
St George	No. of samples	-	2209	343	2552
	% hatch	-	65 (7-85)	31 (17-50)	53 (7-85)
	% <i>H. armigera</i>	-	9 (0-23)	13 (0-36)	10 (0-36)
Gwydir	No. of samples	-	342	284	626
	% hatch	-	79 (60-84)	40 (37-41)	62 (37-84)
	% <i>H. armigera</i>	-	3 (0-8)	81 (70-89)	39 (0-89)
Macintyre	No. of samples	399	1479	330	2208
	% hatch	81 (63-98)	82 (50-100)	70 (66-73)	76 (50-100)
	% <i>H. armigera</i>	53 (31-83)	5 (0-33)	91 (88-93)	29 (0-93)
Hillston	No. of samples	-	119	-	119
	% hatch	-	32 (32)	-	32 (32)
	% <i>H. armigera</i>	-	3 (3)	-	3 (3)
Mungindi	No. of samples	-	368	72 <sup>b</sup>	440
	% hatch	-	28 (6-63)	67 <sup>b</sup>	40 (6-63)
	% <i>H. armigera</i>	-	4 (0-100)	48 <sup>b</sup>	18 (0-100)
Macquarie	No. of samples	-	-	-	-
	% hatch	-	-	-	-
	% <i>H. armigera</i>	-	-	-	-

<sup>a</sup> this entry represents one sample from a maize crop

<sup>b</sup> this entry represents one sample from a non-Bt cotton crop

### ***F<sub>2</sub> screens for Cry1Ac and Cry2Ab resistance***

F<sub>2</sub> screens can detect heterozygote individuals (RS). They involve testing the grandchildren of pairs of moths raised from eggs collected from field populations, and therefore take about 10 weeks to run. Our screens test for genes that confer high level resistance that is likely to be of threat to the industry.

So far in 2009/10 for *H. punctigera* we screened 640 alleles against Cry1Ac and 664 alleles against Cry2Ab. **We isolated no cases in *H. punctigera* of alleles conferring resistance to Cry1Ac** (see Table below). For *H. punctigera* the cumulative frequency of alleles conferring resistance to Cry1Ac since the program began in 2002/03 is 2/5130. **We isolated four cases in *H. punctigera* of alleles conferring resistance to Cry2Ab** ( $4/664 = 0.006$ ; see the following Table). The frequency of Cry2Ab resistance alleles in *H. punctigera* until the end of January 2009/10 (0.006) is higher than at the end of January 2008/09 (0/208 tested). For *H. punctigera* the cumulative frequency of alleles conferring resistance to Cry2Ab since the program began is 25/5166 (0.005). We have tested 6 of these 21 cases and all are of the same kind of Cry2Ab resistance.

So far in 2009/10 we screened 20 alleles from *H. armigera* against Cry1Ac and Cry2Ab. **We isolated no cases in *H. armigera* of alleles conferring resistance to Cry1Ac** (see Table below). For *H. armigera* the cumulative frequency of alleles conferring resistance to Cry1Ac since the program began in 2002/03 is 0/3800. **We isolated no cases in *H. armigera* of alleles conferring resistance to Cry2Ab** (0/20; see the following Table). At the end of January in 2008/09 the frequency of alleles conferring Cry2Ab resistance in *H. armigera* was 1/64. For *H. armigera* the cumulative frequency of alleles conferring resistance to Cry2Ab since the program began is 24/3812 (0.006). We have tested more than 10 of these 24 cases and all are of the same kind of Cry2Ab resistance.

Species	Year	Cry1Ac F <sub>2</sub> screen		Cry2Ab F <sub>2</sub> screen	
		alleles tested	positive	alleles tested	positive
<i>H. punctigera</i>	2002/03	8	0	8	0
	2003/04	60	0	60	0
	2004/05	1012	0	1024	1
	2005/06	468	0	468	0
	2006/07	712	0	712	2
	2007/08	1142	0	1142	5
	2008/09	1088	2	1088	13
	<b>2009/10</b>	<b>640</b>	<b>0</b>	<b>664</b>	<b>4</b>
	Total	5130	2	5166	25
<b>2008/09 January</b>	<b>212</b>	<b>0</b>	<b>208</b>	<b>0</b>	
<i>H. armigera</i>	2002/03	136	0	132	1
	2003/04	280	0	284	2
	2004/05	364	0	368	0
	2005/06	900	0	900	4
	2006/07	524	0	524	5
	2007/08	772	0	772	4
	2008/09	804	0	812	8
	<b>2009/10</b>	<b>20</b>	<b>0</b>	<b>20</b>	<b>0</b>
	Total	3800	0	3812	24
<b>2008/09 January</b>	<b>64</b>	<b>0</b>	<b>64</b>	<b>1</b>	

### ***F<sub>1</sub> screens for SP15-like and Hp4.13-like Cry2Ab resistance***

To increase the number of insects that could be processed during the season, CSIRO developed protocols for testing the frequency of the common Cry2Ab resistance detected with F<sub>2</sub> screens using a shorter method called an F<sub>1</sub> test. F<sub>1</sub> screens can detect heterozygote (RS) individuals. They involve testing the offspring of single-pair matings between moths from a Cry2Ab resistant strain maintained in the laboratory (SP15 for *H. armigera* and Hp4-13 for *H. punctigera*) and moths raised from eggs collected from field populations. They take around 5 weeks to complete.

So far in 2009/10 we screened 686 alleles from *H. punctigera* and **isolated 3 cases of alleles conferring resistance to Cry2Ab** (see Table below). **Two of these alleles were from the same individual that was homozygous (RR) for resistance.** The frequency of Cry2Ab resistance alleles in *H. punctigera* until the end of January 2009/10 (0.004) is significantly lower than at the end of 2008/09 (0.047) and until the end of January in 2008/09 (0.039). For *H. punctigera* the cumulative frequency of alleles conferring resistance to Cry2Ab since the CSIRO program began (2007/08) is 35/1522.

So far in 2009/10 we screened 648 alleles from *H. armigera* and **isolated 11 cases of alleles conferring resistance to Cry2Ab** (see Table below). The frequency of Cry2Ab resistance alleles in *H. armigera* until the end of January 2009/10 (0.017) is lower than that obtained until the end of January in 2008/09 (0.023). For *H. armigera* the cumulative frequency of alleles conferring resistance to Cry2Ab since the CSIRO program began (2007/08) is 89/4030.

Species	Year	Cry2Ab F <sub>1</sub> screen		
		alleles tested	scored positive	frequency
<i>H. punctigera</i>	2007/08	196	2	0.010
	2008/09	640	30	0.047
	<b>2009/10</b>	<b>686</b>	<b>3</b>	<b>0.007</b>
	Total	1522	35	0.027
	<b>2008/09 January</b>	<b>232</b>	<b>9</b>	<b>0.039</b>
<i>H. armigera</i>	2007/08	278	9	0.032
	2008/09	3104	69	0.022
	<b>2009/10</b>	<b>648</b>	<b>11</b>	<b>0.017</b>
	Total	4030	89	0.022
	<b>2008/09 January</b>	<b>712</b>	<b>16</b>	<b>0.023</b>

**‘Survivors’ from Bollgard II<sup>®</sup> plants**

We have received a total of around 200 medium-large larvae from Bollgard II fields in Hillston, Namoi, Gwydir, St George, and Emerald. Healthy moths will be contributed to the F<sub>2</sub> screening component of the Bt resistance monitoring program.

Results since the program began in 2005/06 suggest that in both species there is **no significant difference among Bollgard II survivors vs. a random sample** in the cumulative frequency of alleles conferring Cry2Ab resistance. In order to keep a check on resistance we need to continue to sample larvae collected as survivors on Bollgard II.

**If your crop reaches or is close to threshold, please let myself, Trudy Staines and/or your RCEO know ASAP so that we can try and arrange for samples to be collected for further testing.**

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