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Chemical Control of Codling Moth, *Cydia pomonella* L. (Lepidoptera: Tortricidae) in Relation to Pheromone Trap Catches and Degree Days in Upland Balochistan

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Abstract.- The present study was aimed to protect apple crop from codling moth (*Cydia pomonella*) attack and to expand its production in the region. Study was conducted over two years (2010 and 2011) in apple field to evaluate number and proper time of pesticides application to kill maximum larvae of moth. Three chemicals, Lorsban (Chlorpyrifos), Match (Lufenuron) and Talstar (Bifenthrin) were used. Pheromone traps together with degree days (°DD) were utilized to monitor moth population and to time pesticides sprays. °DD was calculated using 10 °C as lower developmental threshold (base temperature) to examine their effect on flight activity of the moth. Result of analyzed data showed highly significant differences between generations and treatments at P- value < 0.01 in 2010 and 2011. All the three chemicals significantly controlled infestation compared with control (un-treated). A significant difference was observed between Lorsban and Talstar for three timely sprays in 2010. Treatments with Lorsban at 80% petal fall gave efficient control than peak emergence and 5 moths trapped per week methods in both years of this study. Flight activity of first and second generation moths in pheromone trap was observed at 97.04 and 663.04 °DD in 2010 respectively. First flight of the successive two generations in 2011 was recorded at 97.66 and 707.93 °DD respectively. The overall population of moth captured in pheromone traps was higher in the first year than in the second year. The results of the two years study demonstrate that application of 3 to 4 timely sprays (combined with monitoring moth traps and °DD) per year effectively control the larval infestation of *C. pomonella*t in field.

Key words: C*ydia pomonella*, pesticide application, pheromone trap, degree days.

INTRODUCTION

The codling moth (*Cydia pomonella* Linnaeus, 1758) is a polyphagous pest of global agricultural importance (Neven and Hansen, 2010). It infests apple in particular, but also attacks pears, quinces, and occasionally walnuts and stone fruits (Chidawanyika and Terblanche, 2011). *C. pomonella* is the major pest in apple growing regions of Balochistan province with two complete and partial third generations per year. It causes significant crop losses if not managed with adequate measures (Ashraf *et al*., 2007; Asmatullah-Kakar and Hazara, 2009). The use of pesticides against *C. pomonella* is one of the most effective methods since a number of these compounds are capable of killing the larvae in a very early stage of tunneling and many are effective against moths and the eggs as well (Hepdurgun *et al*., 2001; Ioriatti *et al*., 2009).

The codling moth monitoring has led to new developments. Pheromone traps have been used as an excellent tool for moth population detection, monitoring and spray timing (Khan and Chaudry, 1988; Asmatullah-Kakar and Hazara, 2002; Knight and Flexner, 2007; Khan *et al*., 2010). Trap counts can be used in combination with degree days (°DD) to accurately pinpoint not only the stages of moth development, but also the relative success of pesticide applications (Fadamiro, 2004; Borchert *et al*., 2004; Reyes and Sauphanor, 2008). Since insect growth and development is temperature dependent occurs only between an upper temperature (32°C) and lower temperature threshold (10 °C): development stops when the temperature drops below the lower and resumes when it rises above it, ideally when to predict pest development or flight, the 10°C for development is used as the base temperature or base line for calculating °DD: a reasonable approximation for monitoring many insect pest species including *C. pomonella* (Bajoi,

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1994; Ioriatti *et al.*, 2009; Chidawanyika and Terblanche, 2011).

Monitoring °DD accumulation is a valuable tool for predicting pest activity and to launch control practices (Graf *et al.*, 2001). A degree day (also called heat unit or thermal unit) is a measure of the amount of heat that accumulates above a specified base temperature during a 24-hour period, and cumulative degree days (°DD) are the total number of °DD that have accumulated since a designated starting date, and they are calculated simply by adding the number of °DD that accumulate each day: and if maximum temperature for the day never rises above the base temperature then no development occurs, and zero °DD accumulate (Herms, 2004). Any date can be utilized as starting date, but January 1st is used most commonly because many overwintering insects do not resume development until they are first exposed to a period of cold **(**Muray, 2008**;** Ioriatti *et al.*, 2009; Chidawanyika and Terblanche, 2011).

Several workers worldwide have tried to control *C. pomonella* by a number of pesticides but effective control could not be achieved without considering number and proper time of spray applications (Siddiqui *et al.*, 2007). Many studies have been conducted to establish the figure and accurate moment of chemical sprays against this pest. Authors like Zhigarevich and Yakubov (1990) have reported two sprays of pesticide for effective control of moth and recommended first spray after five moths trapped in a week and the next treatments at an interval of 8-10 days. According to Radjabi *et al.* (1980) two sprays against first generation moth larvae at 10-15 days interval greatly decrease the moth density. Hepdurgun *et al.* (2001) reported 2-4 sprays yearly to suppress the pest population considerably. Ioriatti *et al.* (2009) applied first spray at the time of first generation moth oviposition and the subsequent applications were made at 8 days interval. Two sprays of Dimethoate control the spring generation when 5 moths are captured in a week with repeat of treatment after 10-15 days (Mansour, 2010).

To control codling moth in Balochistan, a preventative chemical spray program is usually made every year. Khan (1991) recommended three to four sprays per year to control *C. pomonella*. Bajoi (1994) reported three timely sprays to reduce the pest infestation. SiddiquI *et al*. (2007) also support three to four pesticide sprays to diminish infestation. They also stated that delayed spray will not control damage and too early may require repeated applications.

Unfortunately, prior to the present investigation, no studies have been conducted to relate degree days, trap catches and chemical control to combat larval injury of the pest. This study would be helpful in devising effective control measures easily against *C. pomonella* in Balochistan.

MATERIALS AND METHODS

Study site

The present study was designed in a field plot of 1.4 ha (14000 sq m) in an apple orchard at Sariab near Hazarganji National Park, Quetta during 2010 and 2011. The area is typical basin of highlands of Balochistan (30° - 03° and 30°-27' N, 66° - 44° and 67° -18° E.) and one of the main apple producing regions in the district about 1700 m above sea level with an average annual rainfall of around 269 mm.

Traps catches

Pheromone (delta type) traps @ 4 traps /plot^{-1} were installed randomly on apple trees on March 24, 2010 to monitor first generation moths' emergence, peak activity and to time treatments. Traps were hung 1.5-2 m above the ground and suspended 30 meters apart from each other. Recommended lures (sex pheromones) of 3 mg impregnated with Z-7-dodecenyle acetate, E8E10-120H-symbol Z7-12AC (Shani Enterprises, Agriculture Division Gulgusht town, Multan, Pakistan) were used. The moths caught in each trap were counted daily and averages of all twelve trap counts were calculated. Traps were re-baited with lures after two weeks intervals. Pheromone traps were installed again on May 27 for second *C. pomonella* generation and the insects captured were counted daily. Method adopted to monitor 1st and 2nd generation in 2011 was similar to method used in 2010. Traps were installed on Mar 24 and May 23 for second year season.

Degree days (°DD) calculation

In order to correlate moth emergence with degree days (°DD), daily maximum and minimum temperatures in degree Celsius (^oC) were obtained from Agro-Meteorological Centre, Agriculture Research Institute, Sariab, Quetta located roughly 250 m away from the orchard where the traps were placed. The averaging method (max temp + min temp/2-10) was used in calculating the number of °DD followed Bajoi (1994) formula as this was found proper for moth and climatic features of upland Balochistan. The daily °DD were converted into accumulated °DD for the whole years started from the 1st January using 10°C as lower developmental threshold (base temperature):

a. If daily maximum temperature is less than base temperature (10 ºC), then A= 0
Where A= the daily sum of degrees in Celsius

b. If maximum is greater than 10°C.

$$A = \frac{\text{Maximum + Minimum}}{2} - 10$$

c. If maximum is above 10 and minimum is less than 10, then the fallowing is taken

$$A = \frac{\text{Maximum}}{2} + \frac{\text{Minimum}}{4} - 7.5^*$$

d. If $\frac{\text{maximum + minimum}}{2}$ is less than 10°C, then

$$A = \frac{\text{Maximum}}{4} - 2.5^*$$

(*These are constant figures calculated during formula development)

Numerous workers (Borchert *et al*., 2004; Fadamiro, 2004; Herms, 2004; Reyes and Sauphanor, 2008; Ioriatti *et al*., 2009) also used average method of degree day accumulations based on 10ºC base to monitor moth flight (Chidawanyika and Terblanche, 2011) and start-out spray against it. They calculated maximum and minimum temperatures for each day and fit them into the following equation: [(Max + Min)/2-10].

Experimental design and control measures

Chemical control against C. *pomonella* was performed in two parts assigned as part I and part II.

Part I

In order to evaluate the number of sprays of selected pesticides (Lorsban, Match and Talstar), arrangements were made in a split plot of six replicates and four treatments including control (untreated). This plot was divided up in two sub-plots each of 24 trees planted over six rows having 8 m distances from row to row and 6 m from tree to tree. One sub-plot was marked for three sprays and the other sub-plot for four spray applications (Table I). In sub-plot I, only one spray of each pesticide was applied against first generation moths and two against second generation, while in sub-plot II each pesticide was applied twice to control both the 1st and 2nd generations. Table I also indicates the given concentration, doses of each chemical per 75 liter of water during 2010 and 2011.

Part II

Experimental plot was followed in randomized complete block design (RCBD) with eight replicates and four treatments including control (untreated) (Table II). Four trees per replicate were randomly selected and tagged for treatment. The distance from row to row and tree to tree was same as in split plot. Table II shows treatments with Lorsban applied at different times against *C. pomonella* during both years of the study.

Spray application

Applications were made in accordance with standard doses of treatments recommended by the manufacturers of the pesticides. A trolley type power sprayer machine having 75 liter tank capacity with conventional nozzle was used. Cover sprays were applied after 10 days of first spray. Radjabi *et al*. (1980), Bajoi (1994) and Siddiqui *et al*. (2007) have also recommended cover spray 10 to 15 days after the first application.

Fruit sampling and pest damage

Apple fruits were examined for codling moth damage by walking around each tree of the plot selected for treatment. Maximum number of fruits sampled was 2524 per replicate and 573 per tree in 2010 and 2984, 725 in 2011. Number of infested and healthy fruits was counted and percentage infestation was calculated.

Table I.- Treatments used against *C. pomonella* first and second generations designed in a split plot during 2010 and 2011.

Treatments / Pesticides	Dose per 75 liter of water	Sub-plot 1			Sub-plot II		
		Number of sprays		Total No. of sprays	Number of sprays		Total no. of sprays
		1st generation	2nd generation		1st generation	2nd generation	
T_1 (Lorsban 40*EC)	188 ml	1	2	3	2	2	4
T_2 (Match 50*EC)	75 ml	1	2	3	2	2	4
T_3 (Talstar *10EC)	80 ml	1	2	3	2	2	4
T_4 (Control)	Untreated	-	-	-	-	-	-

* EC indicates Emulcifiable Concentrate

Table II.- Treatment with Lorsban applied at different times against *C. pomonella* first and second generations designed in RCBD during 2010 and 2011.

Treatments	Times of insecticide application
T_1	80% petal fall
T_2	peak moth emergence
T_3	5 moths trapped per week
T_4	Control (Un-treated)

Data analysis

The data recoded were analyzed by an analysis of variance at 5% level of significance using F-test. Least significant difference (LSD) test was further applied for multiple comparisons between groups. Data are presented as mean±SD error. All means were considered significant at the P= 0.05 level. Data were arcsine transformed before analysis using statistical software SPSS version19.

RESULTS

Determination of no. of spray applications

Statistical analysis of fruit infestation during 2010 revealed highly significant difference between generations ($F_{1,\ 60}$ =111.30; P<0.001). Difference between treatments was also found highly significant ($F_{3,\ 60}$ = 3934.63; P<0.001). For three timely sprays a significant difference was observed between Lorsban and Talstar ($F_{3,\ 16}$ = 2909.1; P < 0.001). Using LSD test we found that all the three pestiticides differ significantly from control (untreated). It was also observed that Talstar is more efficient compare to Match and Lorsban (Table III.). Four timely sprays of these chemicals showed better performance in terms of less average % infestation than three timely sprays practice **(**Table III and Fig.1). A highly significant difference occurred between generations ($F_{1,\ 60}$ = 128.63; P<0.001) and treatments ($F_{3,\ 60)}$ = 4386.83 and P<0.001) during 2011. The interaction between generations and treatments also found significant ($F_{3,\ 60}$ = 8.57; P < 0.001). Results of four timely sprays were better (due to less average % infestation) than three timely ones and in this regard it was further observed that Talstar is more effective than chemical treatments of Lorsban and Match against *C. pomonella* larvae (Table III, Fig.1).

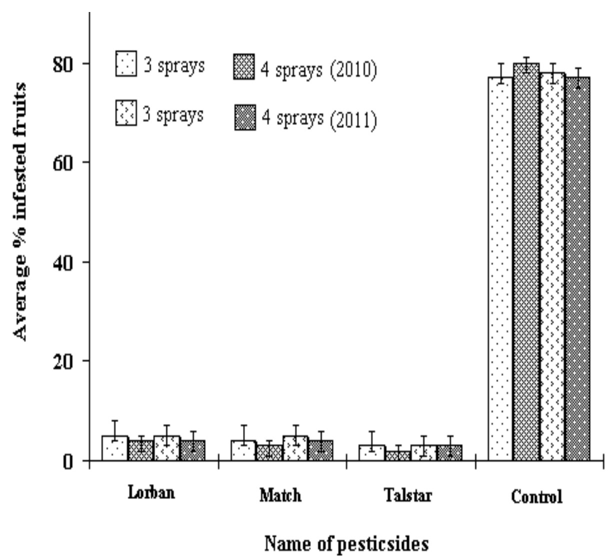

Fig. 1. Mean percent infested apple fruits treated with different pesticides during 2010 and 2011.

Table III.- Average % infestation of apple fruits treated with different pesticides applied for number of spray evaluation during 2010 and 2011.

Treatments	First generation (Mean ± SE)	Second generation (Mean ± SE)	Number of sprays (Mean ± SE)	
			3 sprays	4 sprays
2010				
Lorsban	9.84 ± 0.68a*	11.01 ± 0.97a	4.87 ± 0.15a	3.98 ± 0.34a
Match	9.23 ± 0.23a	10.28 ± 0.43a	3.95 ± 0.58ab	3.28 ± 0.45a
Talstar	8.43 ± 0.94a	8.95 ± 0.83a	2.34 ± 0.67b	2.13 ± 0.65a
Control (un-treated)	83.31 ± 2.24b	82.10 ± 3.42b	77.60 ± 1.13c	82.10 ±1.24b
2011				
Lorsban	11.37 ± 0.30a*	12.41 ± 0.60a	4.36 ± 0.36a	3.45 ± 0.42a
Match	10.56 ± 0.82a	12.06 ± 0.68a	3.56 ± 0.48a	2.71 ± 0.34a
Talstar	9.25 ± 0.64a	9.50 ± 2.12a	2.28 ± 0.50a	2.15 ± 0.30a
Control (un-treated)	84.99 ± 3.28b	81.31 ± 0.85b	75.32 ± 2.36b	81.31 ±0.83b

*Means followed by the same letter within a column not significantly different at P<0.05 (ANOVA followed by LSD test).

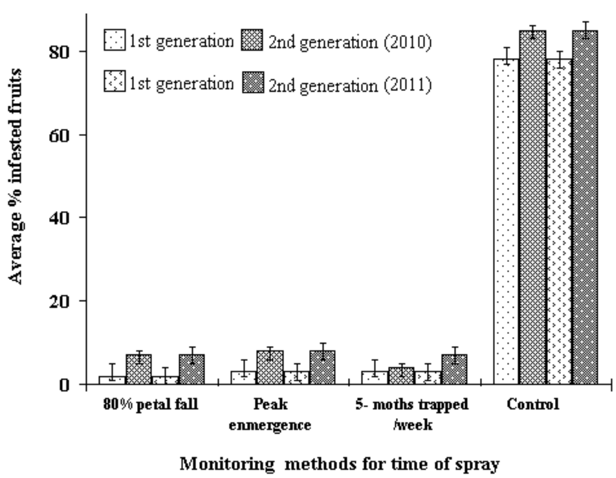

Fig. 2. Mean percent infested apple fruits treated with Lorsban monitored by different methods during 2010 and 2011.

Determination of time of spray application

In order to determine time of pesticide application during 2010 Lorsban was applied at different times as shown in Table II. Result of statistics revealed highly significant difference between generations ($F_{1, 60}$ = 79.65; P<0.001) and treatments ($F_{3, 60}$ = 3622.50; P<0.001). Though a significant difference was noted between timing of spray application and control (untreated) ($F_{3, 20}$ =2261.64; P<0.001) for first generation, and ($F_{3, 20}$ = 1269.7; P<0.001) for second generation moth. LSD test showed no significant difference between timing of spray for both 1st and 2nd generations. Based on average % infestation, treatment with Lorsban at 80% petal fall may be considered efficient than peak population of pest recorded in pheromone trap and five moths trapped per week methods (Table IV, Fig. 2). Similarly, the data obtained during 2011 also statistically highly significant between generations ($F_{1, 60)}$ = 263.916; P<0.001) and treatments ($F_{3, 60}$ = 6720.71; P<0.001) as well. A significant difference was detected between spraying time and control ($F_{3, 20}$ = 2276.1; P<0.001) for 1st generation, and ($F_{3, 20}$ = 3675. 2; P<0.001) for 2nd generation moths. LSD test showed no significant difference between timing of spray for both generations. Lorsban proved more effective tested at 80% petal fall than other methods as for as the mean percent infestation is concerned.

Table IV.- Average % infestation of apple fruits treated with Lorsban at different times during 2010 and 2011.

Treatments	1st generation	2nd generation
2010		
80% Petal fall	3.47 ± 0.72a*	8.10 ± 0.76a
Peak emergence	4.3 1 ± 0.56a	9.59 ± 0.73a
Five moth trapped / week	3.96 ± 0.46a	8.54 ± 0.91a
Control (un-treated)	79.49 ± 1.36b	87.96 ± 1.86b
2011		
80% Petal fall	3.12 ± 0.54a*	10.46 ± 0.67a
Peak emergence	3.40 ± 0.68a	11.17 ± 0.76a
Five moth trapped / week	3.28 ± 0.37a	10.86 ± 0.45a
Control (un-treated)	80.39 ± 1.46b	88.44 ± 0.88b

*Means followed by the same letter within a column not significantly different at P<0.05 (ANOVA followed by LSD test).

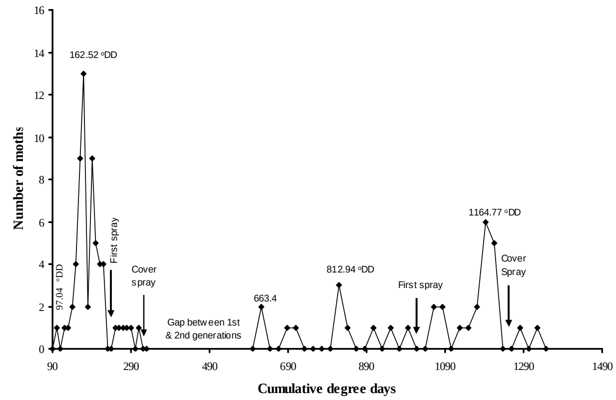

Fig. 3. Effects of cumulative degree days on emergence of *C. pomonella* first generation and second generation in apple orchard during 2010.

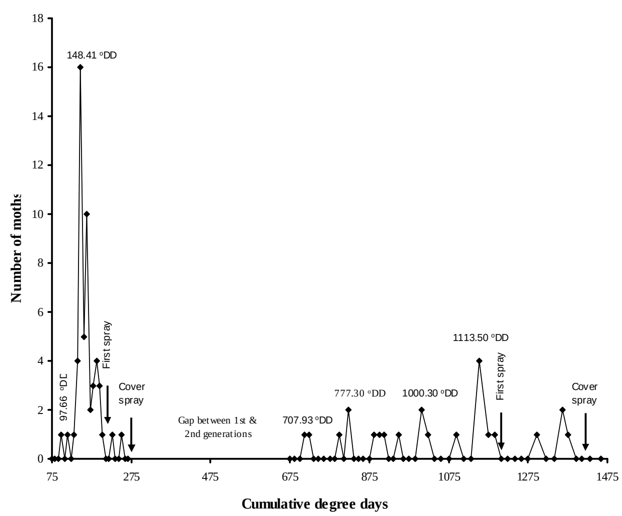

Fig. 4. Effects of cumulative degree days on the emergence of *C. pomonella* first generation and second generation in apple orchard during 2011.

Degree days (DD) timing moth emergence and pesticides application

The effect of degree days on moth emergence and trap counts appeared that start flying moths *C. pomonella* was in the end March at 97.04 and 97.66 °DD respectively during both seasons 2010 and 2011 (Figs. 3, 4; Table V). The pest formed three peaks in the season 2010 and two peaks in 2011, the first peak occurred in the first week of April (2010) at 162.52 °DD (average 4.70 male moths/trap) and the succeeding two in the second week of June, and first week of July at 812.94 and 1164.77 °DD (average 2.63 male moths/trap) respectively. Perusal of table V during 2011 indicates the first peak incidence in first week of April at 148.41°DD (average 4.67 male moths/trap) and the second peak in end June according to degree days sum (1113.50 °DD) (average1.85 male moths/trap). So, the first generations represented higher cumulative trap counts (113) than second generations trap counts (54) in two years of study. The chemicals (Lorsban, Match and Talstar) were tested to control the pest effectively. The first spray was applied at 220-230 °DD and the second (cover) spray at 320-330 °DD against 1st generation moths' larvae during 2010 (Fig. 3). Similar number of spray was applied against 2nd generation larvae at 1018-1040 °DD and 1238-1260 °DD respectively in the same year. Likewise, during 2011, two applications of each chemical were timed against 1st generation at 215-225 and 255-265 °DD, and subsequent applications at 1210-1225 and 1410-1432 °DD respectively to target the 2nd generation (Fig. 4).

DISCUSSION

Chemical control against codling moth (*C. pomonella*) in the present study during 2010 and 2011 suggest that economic damage of apple crop may significantly be reduced if pesticide applications are timely and thoroughly be made based on monitoring by pheromone trap and degree days. Treatments against first and second generation moth larvae were applied on same date in both parts of experiment during the study years. All the three tested pesticides applied in part I protected the crop significantly compared with control (untreated) (Table III, Fig. 1). This data (Table III) indicates that Talstar and Match appear more potent than Lorsban. Talstar may be attributed to high potency of strain compared with Match and Lorsban. Being a lepidoptericide and miticide, Talstar may be applied in critical conditions where any target predatory mites and insect species are not endangered.

As indicated in Table III and Figure 1, four timely sprays of the tested chemicals (applied in sub-plot II marked for four sprays) showed excellent

Table V.- Results of trap catches in relation to degree days and spray timing during 2010 and 2011.

Generation and date of pheromone trap installation	Date of first moth emergence with °D D		Date of peak moth emergence with °DD		Date of first spray	Date of cover spray	Total No. of moth captured
2010							
First generation 24-3-2010	28-3-10	97.04 °DD	5-4-10	162.52 °DD	12-4-10	23-4-10	57
Second generation 26-5-2010	28-5-10	663.04 °DD	9-6-10	812.94 °DD	19-6-10	8-7-10	32
			5-7-10	1164.77 °DD			
2011							
First generation 24-3-2011	28-3-11	97.66 °DD	4-4-11	148.41 °DD	11-4-11	21-4-11	56
Second generation 23-5-2011	27-5-11	707.93 °DD	23-6-11	1113.50 °DD	30-6-11	10-7-11	22

Note: In sub-plot 1 cover spray against first generation was not applied in portion marked for 3 sprays during the study years of 2010 and 2011.

control than three timely ones applied in sub-plot I. Cover spray against first generation larvae was not applied in sub-plot I during 2010 and 2011 (Table I and V). Findings of previous workers (Khan, 1991; Bajoi, 1994; Siddiqui *et al*., 2007) also support three to four timely sprays practice to control pest damage. Radjabi *et al*. (1980) reported two sprays of organophosphate (Azinophos-methyl) against first generation *C. pomonella* and suggested that this may greatly be reducing the moth population thus supporting our results.

Treatments with Lorsban at 80% petal fall has shown, in two years of testing, a better control of pest infestation if compared with peak emergence and 5 moths trapped per week methods. These findings are in line with those of Poswal and Groot (1995) who recommended Chlorpyrifos (Lorsban) against *C. pomonella* in field and suggested 80% petal fall as the proper time for spray applications. Lorsban appeared to be the most popular organophosphate pesticide among the apple growers of the area in Balochistan (Siddiqui *et al*., 2007). Lorsban offered excellent control of *C. pomonella* as suggested by Thwaite *et al*. (1994), Ioriatti *et al*. (2009). Findings of Zhigarevich and Yakubov (1990) also are in line with our results where they reported first spray at the time of 5 moths trapped per week methods. Results of the present study also are in agreement with Mansour (2010) who proposed two cover sprays against first generation when 5 moths were captured in a week. The present findings are not in agreement with Ioriatti *et al*. (2009) where they timed first spray at the event of first generation moth ovipositon. Our results have also not matched with findings of Hepdurgun *et al*. (2001) where they reported 2-4 sprayings yearly against *C. pomonella*.

The most effective way to time insecticide sprays is with a pheromone trap and a degree day calculation: a mechanism by which the combined treatment kills the moths' larvae promptly in pome fruits (Borchert *et al*., 2004; Fadamiro, 2004: Reyes and Sauphanor, 2008; Ioriatti *et al*., 2009). These authors achieved enhanced levels of control instead spraying chemicals alone against some lepidoptereous pests (including *C. pomonella*) in field. The trap helps when each generation or moth flight begins and the degree day calculation let's know when egg hatch will occur and when the next generation should begin to fly (Chidawanyika and Terblanche, 2011).

In the present two years study using combination treatment of pheromone trap and degree days, first generation *C. pomonella* flight was observed in trap on same date required 97.04 and 97.66 degree days (°DD) respectively (Table V, Figs. 3, 4). Least variation in the number of °DD between first moth appearances occurred impacted the moth body temperature and growth thus emerged early in 2010 than in 2011. These results are similar to some extent to those of Borchert *et al*. (2004) who observed 1st generation moth appearance at 97.09, 97.32 °DD during two years study, and to those of Chidawanyika and Terblanche

(2011) where they examined first moth flight at 97. 89 and 100 °DD. However, in contrast to them, we observed first appearance of pest on same calendar date (March 28) in 2010 and 2011 (Table V). Findings of Reyes and Sauphanor (2008) also are in line slightly to our result where they found a positive correlation between degree days and the first appearance of codling moth required 98 °DD. Likewise, the observed first moth emergence of 2nd generation required 663.04 (May 28) and 707.93 °DD (May 27) respectively (Table V and Figs. 3, 4). These findings are in line partly to that of aforesaid authors who recorded 2nd generation first moth flight in late May needed a degree day sum 689, 705 (Borchert *et al*., 2004), and 677, 700 (Chidawanyika and Terblanche, 2011), and 690, 707°DD respectively (Reyes and Sauphanor, 2008).

Treatment trail against *C. pomonella* was done with degree day combination in part II experiment during both years of research. It is important to note that certain life stages of this pest may susceptible to insecticide treatment such as young larvae or crawlers. In this connection degree days was found useful in predicting occurrence of these life stages and timing pesticidal treatments to kill them. Hence, at the time of first application against 1st generation larvae the number of observed DD was between 220-230 and 215-220 respectively during study years of 2010 and 2011(Figs. 3, 4). Our result reveals that for this pest, it is important to know when 220 degree days after 1st emergence will occur, because this point corresponds to first generation egg hatch, when fruit should begin to be protected. These results are in line with that of Fadamiro (2004) who timed first spray (Azinophos-methyl) against *C. pomonella* at 220 °DD. Findings of the present study are similar partly to those of Bochert *et al*. (2004) where they applied first spray (Teflubenzuron) against *C. pomonella* required 230 and to those (Reyes and Sauphanor, 2008) where first application (Chlorpyrifos) was made at 225 °DD to control this pest. Our findings are inconsistent to report of Ioriatti *et al*. (2009) who timed first application (Emamectin Benzoate and Chlorpyrifos) at the start of oviposition according to degree day sum (235 °DD).

CONCLUSIONS

This 2-years study has shown that three to four timely sprays not only did levels of damage low under a combined program of chemical control with trap catches and degree days, but population densities of adults measured using pheromone trap appeared to decrease under this combined plan. This practice be supposed to be maintained and may be considered as important tool for codling moth control in the region. Talstar was found the most effective among the three groups of pesticides and may be suggested for managing *C. pomonella* in field. Its collective advantages are: use as insecticide, acaricide and pyrthriod, much cheaper than the new miticides, high toxin efficacy, not to beneficial; control of secondary pest such as *Helicoverpa armigera* Hubner (larva infests apple, tomato, pea and cotton in the region), and two spotted spider mite, *Tetranychus urticae* Koch. In having multi-purpose significance, Talstar may be recommended for farmers. The present study further suggests that pesticide applications should never be delayed after 80% petal fall the most suitable time for spraying to get increased level of control in apple orchard.The combined treatment of chemicals followed by degree days has shown to have potential to target control treatments better.

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