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BLACK CUTWORM ALERT PROGRAMME IN ITALY

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Abstract
Agrotis ipsilon (BCW) has caused severe damage to maize in some years in Italy. Therefore a black cutworm alert programme able to inform farmers in a timely manner about the presence of black cutworm economic populations has been tested in Veneto region. The procedure suggested by Corn Belt of USA Universities and Extension Services was implemented in Veneto region beginning in 1991. Sex pheromone traps were placed in maize fields of the different Veneto provinces beginning in late February of each year. Air and soil temperatures, information about direction and strength of winds were supplied by A.R.P.A.V. Degree days (development zero = 10.4 °C) were calculated beginning with the first captures on the traps. Ten maize fields in the area where males had been captured were investigated every 2 days beginning in late April of each year.

Very low numbers of moths were observed in some years. In those years, no black cutworm damage on maize plants was observed. The alert programme gave reliable results by using soil surface temperatures in calculating Degree Day accumulations, while the use of air temperature underestimated the DDA. In most years, the first fourth larval instars were observed some days before the date forecasted by the model (176 DDA for 50% of 4^{th} instar larvae in the population). It was possible to forecast the period of larval damage thus making effective the rescue treatments where threshold had been met. Information was transmitted through a specific bulletin issued by A.R.P.A.V., Internet, newspapers and television channels.

Key words: *Agrotis ipsilon*, Alert Programme, maize.

Introduction

Agrotis ipsilon Hufnagel, (Lepidoptera, Noctuidae) (BCW) represents a serious problem in Europe (Bues *et al.,* 1990; Hachler, 1988, 1989); in Italy it has caused severe damage to maize and other crops (thousands of hectares were destroyed) in some years particularly in 1971 and 1983 (Zangheri and Ciampolini, 1971; Zangheri *et al.,* 1984). Almost yearly, local outbreaks can cause reductions of corn stand or even the need for replanting (Furlan, 1989). Usually the farmers realize the extent of damage too late and rescue treatments become ineffective. Studies carried out in Italy demonstrated that the irregular outbreaks of the Noctuid in Northern Italy could usually be associated with the oviposition of migrant females at the beginning of spring (Zangheri *et. al*., 1998). Therefore, a black cutworm alert programme that can inform the farmers about the presence of black cutworm economic populations in real time has been tested in the Veneto region.

Materials and methods

The procedure suggested and used by Universities and Extension Services in Corn Belt of USA (Archer and Musick, 1977, 1980; Showers *et al*., 1985, 1986; Showers, 1997; Troester *et al*., 1982; Von Kaster and Showers, 1984) was implemented in Veneto region beginning in 1991. Sex pheromone traps (Hartstack baited with lures prepared by INRA and Plant Protection Institute of Budapes, at least 10 to 35 per year) were placed in maize fields of the different Veneto provinces from late February of each year. Air and soil temperatures, information about direction and strength of winds were supplied by A.R.P.A.V. Degree days (development zero = 10.4 °C, Luckmann *et al*., 1976) were accumulated (average of maximum-minimum method) beginning with the first captures on traps. These captures occurred just after strong winds coming from Southern regions. 176 DDA were considered for 50% of 4th instar larvae in the population. Tens maize (and sometimes sugar beet and sunflower) fields (0,5 to 2 hectars each) in the area where males had been captured were investigated every 2 days from late April of each year to when the 4th instar larvae started damaging the young plants. Each field was scouted by choosing 8 random areas of 20 m X 10 maize rows per field and observing all plants. Plants with typical black cutworm damage were individually checked and all the larvae found near the collars on each plant were collected and determined to species. At least 20 to 200 larvae per year were collected on damaged plants. The larval instar of captured BCW was estimated by using the head capsule data of Archer and Music (1977).

Results

Moth captures greatly varied in different years and in different provinces of the region (*table 1*). Very low numbers of moths were observed in some years, especially when no or weak southern winds occurred; in these years (1992, 1993, 1995, 1997) no black cutworm damage on maize plants was observed. In contrast in 1998, first significant migrant flight was observed between 5 and 12 April just after strong southerly winds had occurred. Soil temperatures were constantly higher than air temperatures and thus reach 176 DD 2-3 days earlier (*table 2*).

Table 1 - Synthetic results of the implementation of the Black Cutworm Alert programme in Veneto over the last 11 years

Year	First month captures	First significant flight	Flight level	4th instar first larvae	peak of 4th instar larvae	Forecast date for 176 DD	Damage level
1991	6 March	21-26 March	medium	NO larvae found			very low
1992	1 April	3-6 April	low	NO larvae found			NO DAMAGE
1993	29 March	6 April	low	NO larvae found			NO DAMAGE
1994	4 March	23 - 26 March	medium	5 May	7-8 May	8-13 May	medium
1995	11 March	NO	very low	NO larvae found			NO DAMAGE
1996	18 March	3 April	medium	2 May	6-8 May	9-11 May	medium
1997	24 March	NO	very low	NO larvae found			NO DAMAGE
1998	16 March	5-12 April	high	13 May	15-17 May	8-13 May	medium
1999	26 March	6 April	low	10 May	14 May	5-10 May	low
2000	29 March	29 March - 5 April	medium	4 May	8 May	4-8 May	low
2001	2 March	17 March	medium	29 April	1-2 May	5-9 May	medium

Flight level: *very low* means less than 1 moth/trap/day at the peak; *low* means 1 to 5 moths/trap/day at the peak; *medium* means 5 to 10 moths/trap/day at the peak; *high* means > 10 moths/trap/day at the peak
Damage level: *very low* means no or less than 0.1% of plants damaged in all the fields; *low* means no replanted fields and number of plants damaged 0.1 to 2%; *medium* means 0.5 to 5% of sampled surface replanted and in other fields number of plants damaged 2 to 30%.

Table 2 - BCW Alert programme. Differences between the number of days to reach 176 Degree Days forecast using soil temperatures and that forecast using air (2 m) temperatures in different localities of Veneto region in different years

year	Vazzola	Sorgà	Portogruaro	Legnaro	average annual differences	average difference 1996-2001	standard deviation 1996-2001
	0	2	8	5	3,75		
1996	5	4	3	2	3,5		
1998	2	4	2	3	2,75		
1999	2	6	2	-1	2,25		
2000	2	2	2	-2	1		
2001	3	-	4	0	2,33	2,60	2,24

Since the 1st-3rd *A. ipsilon* instars live off young weed and crop plants close to soil surface, soil temperatures were chosen to implement the model. When conspicuous larval populations established model performances varied significantly (*table 1*) as was observed by Kaster and Showers, 1984. In some years (1998, 2000) the prediction matched very well to the field observations. In most cases, the first 4th instar larvae were found a few days (3-7) before the date forecast by BCW Alert programme. The differences were smaller taking into consideration the peak of larval presence (year 1994, 1996, 2001). These data are in agreement with those of Story *et. al.*, 1984 who observed that 4^{th} and 5^{th} BCW instars may be present in fields when < 125 degree-days (sine wave method) or 100 degree-days (average of maximum-minimum method) have accumulated since 1 January using developmental data of Luckmann *et al*., 1976. Only in one year (1999) was the predicted date slightly earlier than actual findings in the field, but in this case the population level was very low so that it is likely that the first larvae that moulted to 4^{th} instar were not found.

Conclusions

Moth capture levels by Hartstack traps can reliably indicate the years at risk from BCW. The BCW alert programme gave more reliable results by using soil surface temperatures in calculating Degree Days accumulation, while the use of air temperatures underestimated the DDA. The model tends to indicate 4^{th} instar larvae presence in corn fields some days later than actual findings. Some years the prediction was quite correct, while in other years the first fourth instar larvae were observed 3 to 7 days before the date forecast by the model (176 DDA for 50% of 4^{th} instars larvae in the population). Therefore, scouting in high-risk maize fields must begin about 7 days earlier than the model predicts to make sure that the first outbreaks can be detected in time. Taking this into consideration, it was possible to forecast the period of larval damage. This allowed for effective rescue treatments where thresholds had been reached or exceeded. Information was transmitted through specific bulletins issued by A.R.P.A.V., Internet, newspapers and television channels.

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