Parasitism and Other Mortality in the Cotton Boll Weevil *Anthonomus grandis* Boh. (Coleoptera:Curculionidae) in Paraguay

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ABSTRACT

Boll weevil (Anthonomus grandis Boh.) parasitism by 2 hymenopterous parasites, tentatively identified as Catolaccus sp. and Bracon sp., was found in the San Pedro province, Paraguay, in 1995-96 to reach astonishingly high levels often killing 100 % of the immature host population. Another key mortality factor was egg non-viability; 27% of the eggs did not hatch. Parasitism in Anthonomus grandis appears to be much higher in Paraguay where the boll weevil was introduced recently in 1992, than in other countries where it is native. This is a case where a foreign pest reaching a new geographical region found efficacious natural antagonists already in place.

Introduction

The introduction of the boll weevil into Paraguay in 1992 has changed cotton crop protection and economics. Formerly, farmers sprayed up to three times per cropping season, now it is close to 10 times. Cotton production costs increased therefore and profitability has dropped.

Cotton is mainly grown by small-scale farmers in Paraguay, averaging 2.5 hectares with cotton as their most important cash crop. It is rainfed, planted in October and harvested in February-March. Yields average 1,200 kg/ha seed cotton. Farmer income and social well-being depend to a very large degree on cotton production. Therefore the boll weevil has a severe socio-economic impact.

In 1997 the Ministry of Agriculture (MAG) launched a national cotton recovery programme, *Programa Nacional de Recuperación del Algodón.* The programme also conducts field research on the boll weevil, other pests, beneficial organisms, the cotton varieties and agronomic aspects with the aim to develop an integrated crop/pest management system.

Information on boll weevil biology and ecology in Paraguay is as yet scant. MAG's Agricultural Experiment Station at Choré in the San Pedro Department has been conducting related studies since 1995. This paper reports the parasitism component of two field studies in 1995 and 1996.

Material and Methods

Season-long sampling of fallen cotton squares, 1995-96. Between June 11, 1995 and Febr.20, 1996 we collected fallen squares in several cotton fields of the Choré area and dissected them under a stereo microscope recording boll weevil instars, classifying them into alive, parasitised and dead for unknown causes. Prior to January 1996 the squares were collected in standing cotton stalks; thereafter it was in new cotton fields.

Life cycle study 1996. On 20 Jan.1996, in the 10 central rows of a 1/4 hectare (ha) cotton plot on the Experimental Station Choré, all boll weevil infested or otherwise damaged squares (flower buds) were picked, so that subsequent square damage could be dated. Starting the following day the remaining and newly appearing cotton fruit were inspected daily, large number of boll weevil punctured squares were tagged and leaving otherwise damaged squares without a tag. The small cardboard tags tied to the peduncle of the squares showed the date on which oviposition on the square took place. Each day thus formed a cohort of egg punctures of the same age. The last tagging day was Feb.22, 1996. For administrative reasons the study had to be discontinued Feb.24, so the later cohorts were sampled for only a very short period.

Each day except Sundays we took a sample of usually 10 tagged squares from each cohort in the field and dissected them under a stereo microscope. Boll weevil stages were identified as to instar and classified as healthy, dead for unknown reasons, or parasitised. A larger round exit hole in a square was interpreted as weevil emergence, a smaller round hole as parasite emergence, jagged holes as ant predation (Sturm and Sterling, 1986). Squares damaged after tagging, e.g. by lepidopterous larvae, were discarded.

Quite often, immature parasites were found by themselves in the squares, apparently having consumed the host completely. As the instar from which these free parasites stemmed could not be determine, parasitism is reported as a total figure, i.e. not separated by host instar. Squares with oviposition punctures but no weevil instars inside indicated egg mortality (column heading "egg puncture only", Table 2) (Sturm and Sterling, 1986).

Results

Parasite species. We identified the parasites tentatively as *Catolaccus* and *Bracon* species. Specimens await expert identification in the USA.

Season-long square sampling. Extremely high levels of parasitism occurred in boll weevil larvae and very little in pupae (Table 1, Figure.1). Parasitism was highest in the stalks and declined in the new crop probably because of (1) habitat destruction when preparing the fields, and (2) scarcity of cotton squares.

Life cycle study. Out of 4,096 egg punctures by *A. grandis*, , 1,116 failed to develop a weevil instar (Table 2). That is, egg mortality was 27.2 %. The remaining 72.8 % mortality was caused mainly by parasitism and to a small degree by predation and unknown factors (Figure 2).

Since the number of instars varied on every sample date, analysis of mortality over time proceeded with percentages, as if 100 instars had been present on each day. Table 2 and Figure 2 present these percentages.

Parasitism was the most important mortality factor. It started low at 4 days of larval age, increased sigmoidally reaching a 55 % plateau between 13 and 21 days, then tended to rise to near 100 %. Second in importance came egg mortality. In conclusion, parasitism and egg mortality were the key factors of boll weevil immature instar mortality. Predation and unidentified mortality played a minor role.

Discussion

Parasitism in *Anthonomus grandis* appears to be much higher in Paraguay which not long ago had no boll weevil, than in other countries where the boll weevil is native. A case where a pest was introduced into a new region and found natural antagonists already in place. In Nicaragua parasitism can reach at times close to 60 % but is restricted mostly to the dry off-season (G.León, reported in Daxl 1996, p.185). In Paraguay parasitism seems to be strong throughout the year, the cotton stalks especially being a large reservoir of parasites.

Cotton pest management must strive to protect and foment this natural biological control using insecticides with utmost care. The BWACT (Boll Weevil Attract and Kill Tube, Plato Industries, Houston, TX) acquires even more significance in this situation as it is an alternative to insecticides which would suppress the parasites. Also, BWACT works best against low boll weevil populations which are rendered low by the formidable parasitism in Paraguay. Parasites and BWACT seem to supplement each other almost synergetically in this country. If this invaluable natural resource, boll weevil parasites, were harmed by misconceived cropping practices, especially irrational insecticide usage, the boll weevil could probably change from being a serious pest into a calamity.

References

Daxl, R. (1996): Manejo del Cultivo Algodonero. Editorial Hispamer, Managua, Nicaragua. 305 Pp.

Sturm, M.M., W.L. Sterling. (1986): Boll weevil mortality factors within flower buds of cotton. Bull.Ent.Soc.Am. 32 (4):239-247.

Table 1. Boll weevil: Instar development and mortality.

d	n	ep	Healthy instars						Parasitism				Unknown mortality					pr
			E	L1	L2	L3	P	A	L2	L3	P	FP	L1	L2	L3	P	A	
1	259	48	129	79	1	0	0	0	0	0	0	0	0	1	0	0	0	1
2	264	66	91	96	8	0	0	0	0	0	0	0	0	0	0	0	0	0
3	231	60	23	125	22	0	0	0	0	0	0	0	0	0	0	0	0	1
4	245	67	18	114	32	5	0	0	2	0	0	5	1	0	0	0	0	1
5	235	75	3	70	62	12	0	0	3	6	0	3	1	0	0	0	0	0
6	248	80	5	42	67	26	0	0	9	11	1	5	2	0	0	0	0	0
7	230	58	0	18	57	45	1	0	16	15	0	14	0	1	3	0	0	2
8	233	63	0	14	27	57	0	0	13	29	0	21	0	4	2	0	0	3
9	239	70	0	9	18	42	2	0	25	39	0	28	2	0	1	0	0	3
10	222	66	0	1	21	28	3	0	20	35	1	37	0	1	3	0	0	6
11	229	57	0	1	8	25	11	0	17	49	4	51	0	0	4	0	0	2
12	202	48	0	0	12	16	10	3	27	42	1	37	0	1	1	0	0	4
13	206	53	0	0	2	13	14	0	24	39	0	56	0	0	1	0	0	4
14	189	55	0	0	2	11	8	2	30	27	4	40	0	2	3	0	0	5
15	179	37	0	0	0	1	5	19	24	33	0	54	1	0	1	0	0	4
16	152	57	0	0	1	1	2	13	14	11	0	49	0	0	0	0	0	4
17	132	43	0	0	0	1	1	8	12	27	1	35	1	0	1	0	0	2
18	119	35	0	0	0	1	2	12	14	18	0	35	0	0	2	0	0	0
19	79	20	0	0	0	0	1	9	11	8	0	28	0	0	1	1	0	0
20	58	21	0	0	0	1	0	5	10	7	0	12	0	0	0	0	0	2
21	43	9	0	0	0	2	0	5	3	6	0	16	0	0	0	0	0	2
22	32	11	0	0	0	0	2	5	3	2	0	9	0	0	0	0	0	0
23	28	12	0	0	0	0	0	2	0	4	0	10	0	0	0	0	0	0
24	19	1	0	0	0	0	0	3	8	3	0	3	0	0	0	0	0	1
25	14	3	0	0	0	0	0	4	1	0	0	4	0	0	0	0	0	2
23	6	1	0	0	0	0	0	1	0	1	0	3	0	0	0	0	0	0
27	3	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0

d = days after oviposition; n = number of eggs; ep = egg punctures only;
E = eggs; L1 = first instar; L2 = second instar; L3 = third instar; P = pupae; A = adults
Pr = predation

Figure 1. Percent parasitism of larvae and pupae of boll weevil in Chorė Zone, 1995-96.

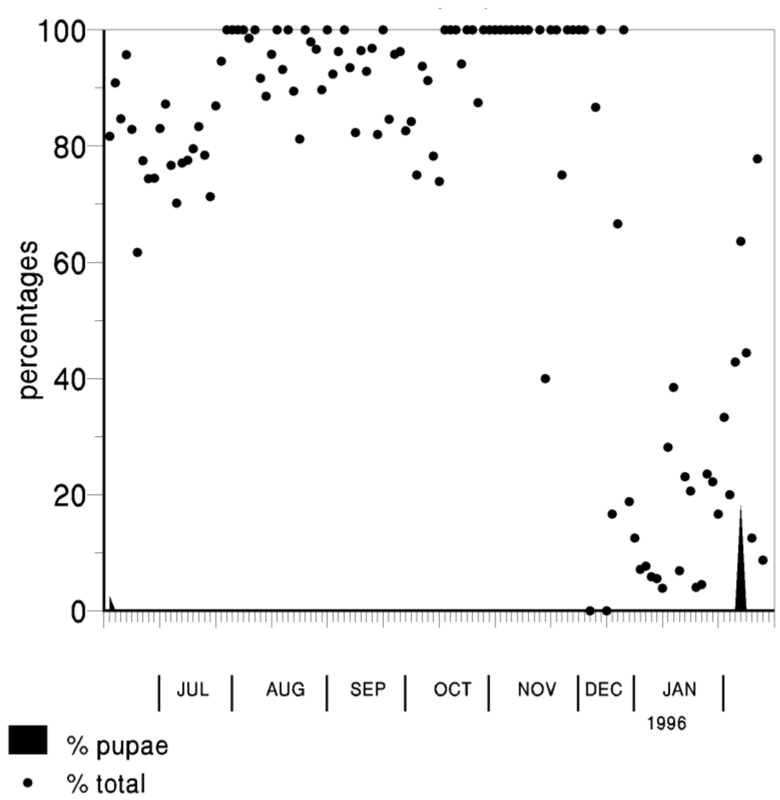

Figure 2. Percent mortality in egg/larval cohorts of the boll weevil, Anthonomis grandis in Chorė, Paraguay 1996.