

# Maize Pest Status and Their Natural Enemies in Maize Production Area of Donggala, Central Sulawesi, Indonesia

Asni Ardjanhar, Amran Muis and Nurnina Nonci

Assessment Institute for Agricultural Technology (AIAT), Central Sulawesi, Indonesia.

\*E-mail: nurnina\_nonci@yahoo.com

**Abstract.** This experiment was aimed at understanding the species composition and status of maize pests in Donggala district of Central Sulawesi province in Indonesia in order to identify an appropriate control strategy and make location-specific IPM recommendations. Observations were recorded in seven villages in three subdistricts on 0.5-1 ha plots of farmers' fields during May-Aug 2007. The observations were recorded visually using sweep nets. The results showed that the maize pests found in Donggala were almost the same as elsewhere in terms of structure, infection and distribution. The most important of the maize insect pests were *Ostrinia furnacalis* Guenee, *Helicoverpa armigera* Boddie and *Atherigana* sp. The second rung of important pests were *Dalbulus maidis* Delong and Walcott, *Rhopalosiphum maidis* Fitch and *Nezara viridula* L. Another pest, *Nicentrites testaceipes*, was also found in high numbers. The other maize pests found were not important. These were *Spodoptera litura* F., *Plusia calisites* Esp., *Lamprosema indicata* F., *Locusta migratoria* and *Valanga* sp. Their natural enemies were predators and parasites. There were 12 species of predators found in our survey: *Menochilus sexmaculatus*, *Scymnus* sp, *Epilachna* sp, *Coccinella transversali*, *Ophinea* sp, *Rodolia*, *Chrysopa*, *Euborellia annulata* and *Lycosa pseudoannulata*. One species of larval parasite was found from the order/family Hymenoptera/Ichneumonidae. We also found that egg parasites were more effective in controlling *O. furnacalis* population compared with larval parasites. The percentage of egg mass of *O. furnacalis* parasited was 96% in all locations.

**Key words:** Maize pests, natural enemies, species composition

## Introduction

A number of insect pests are associated with maize in Indonesia. Baco and Tandiang (1988) reported that 50 insect species attack the crop, some of them important, causing serious damage. Rejesus and Javier (1985) and Teetes *et al.* (1983) also reported similar results in other Asian countries. One of the most important of these pests is the Asian corn borer (ACB; *Ostrinia furnacalis*). Annual maize yield loss caused by insect pests in developing countries was reported to be 30% (Berger 1962), and this is mainly caused by ACB, ear borer and army worm.

The egg parasite of the Asian corn borer and ear borer is *Trichogramma evanescens* (Nonci *et al.* 2000; Gonzales and Cadapan 2001; Javier *et al.* 2001), while the pathogens found to be effective in controlling the larvae of ACB and ear borer are *Beauveria bassiana* (Bals) and *Metarrhizium anisopliae* (Metch) (Supriyatin 1993; Yasin *et al.* 2000; Baco 2000). Information about the occurrence of these natural enemies of insect pests in the maize production area of Central Sulawesi is limited. Against this context, we conducted an experiment to understand the species composition and status of maize pests in Donggala district of Central Sulawesi.

## Materials and Method

The experiment was conducted (May-Aug 2007) in farmers' fields in seven villages in three subdistricts of Donggala: Jono Oge and Sidondo villages in Biromaru subdistrict; Bahagia, Petimbe and Bobo in Palolo; and Labuan Toposo and Labuan Panimba in Labuan. Samples were collected from 0.25-1 ha maize plots, including 50 samples from each location, 10 samples from every corner and 10 samples from the middle of the plots.

Observation on insect pest species and their natural enemies was done visually by using a sweep net. The collected insect eggs were kept in a petri dish containing wet filter paper and labeled. Larvae were placed in plastic boxes (7 cm in diameter; 8 cm height) and also labeled. The larvae were fed corn stalks. The parasited pests were observed under a microscope at the AIAT laboratory with the help of identification guides by Teetes *et al.* (1983), Ortega (1987) and van der Laan (1981). Observations were done daily and the species and number of parasites were recorded and identified using the identification guides.

The parasited eggs were counted as per the formula:

$$P = \frac{a}{b} \times 100\%$$

where

P = Parasited eggs

a = Number of parasited egg masses

b = Number of observed eggs

## Results and Discussion

### Insect pests found

The result of our observations on maize pests and their natural enemies in Donggala are presented in Table 1. The maize pests found in Jono Oge and Sidondo villages in subdistrict Biromaru were *Ostrinia furnacalis*, *Dalbulus maidis*, *Spodoptera litura*, *Mythimna separata*, *Rhopalosiphum maidis*, *Nezara viridula*, *Nicentritis testaceipes*, *Valanga spp*, *Locusta migratoria* and one species of locust from the family Tettigonidae. On the basis of the level of infection, the plant part damaged and distribution, it was found that *O. furnacalis*, *R. maidis* and *N. viridula* were the most important maize pests in Biromaru followed by *S. litura*, *N. testaceipes*, *M. separata*, *Valanga spp*, *L. migratoria*, and pests from the families Tettigonidae and Accaridae.

*Ostrinia furnacalis*, *D. maidis* and *N. testaceipes* were the most important pests in the three villages in Palolo subdistrict. The other maize pests found were *H. armigera*, *R. maidis*, *L. indicata*, *Valanga spp* and *L. migratoria*.

In Labuan subdistrict, the pests found were *O. furnacalis*, *R. maidis*, *N. viridula*, *Atherigona sp*, *D. maidis*, *S. litura*, *M. separata*, *N. testaceipes*, *Valanga sp* and *L.*

*migratoria*. *Ostrinia furnacalis*, *Atherigona sp*, *R. maidis*, *N. viridula*, *D. maidis* and *N. testaceipes* were the most important.

The occurrence of these pests is related to the availability of host plant, plant stage, and climate. Fourteen species of maize pests were found in the villages, six from the order Lepidoptera (*O. furnacalis*, *H. armigera*, *S. litura*, *M. separata*, *Plusia calcites* and *Lamprosema indicata*, one species (*Atherigona sp*) from the order Diptera, one species (*R. maidis*) from the order Homoptera, one species (*N. viridula*) from the order Heteroptera, one species (*D. maidis*) from the order Hemiptera and two species (*Valanga sp* and *Locusta migratoria*) from the order Orthoptera, and two unidentified species from the families Tettigonidae and Accaridae. In this observation there was one newly found species, *Necentritis testaceipes*, with a high population. This insect pest attacked the maize plant in an early stage and the highest population was usually found at the beginning of the silking stage. According to Teetes *et al.* (1983), its larvae consume the green part of the leaf, leaving only the epidermal tissue.

The status and spread of all the maize pests in Donggala were almost the same. The most important pest was *O. furnacalis*. It was found in all locations in high numbers – an average of 1.2-7.3 insects per plant. This pest is the most important maize pest in Indonesia and in some Asia and West Pacific countries (Nonci *et al.* 1996; Nafus and Schreiner 1987; Tseng 2000). The next highest pest population was of *D. maidis*, *R. maidis* and *N. viridula*. Economically, *D. maidis* inflicts a huge financial loss because besides being an insect pest itself, it also acts as a vector of maize stunt spiroplasma, maize stunt mycoplasma and maize rayado fino virus (Pitree 1970; de Oliveira *et al.* 2007). Most of the damage done by this pest occurs during the seedling stage (4-6 weeks after planting).

**Table 1. Maize pest<sup>1</sup> composition<sup>2</sup> in Donggala, Central Sulawesi, Indonesia, May-Aug 2007.**

Location		Corn pest species															
Sub	Valley	O.f.	H.a.	At.	D.m.	S.l.	M.s.	R.m.	N.v.	N.t.	P.c.	L.i.	A.	V.	L.m.	T.	S.i.
Biromaru	Jono Oge	+++	-	-	++	+	+	++	++	++	-	-	+	+	+	+	+
	Sidondo	++	-	-	++	+	-	++	++	+	-	-	-	+	+	-	-
Palolo	Bahagia	+++	++	-	+++	-	-	++	++	+++	+	+	+	+	+	+	+
	Patimbe	++	+	-	+++	-	-	++	++	+++	-	-	-	+	+	-	-
	Bobo	++	+	-	+++	-	-	++	+	+++	-	-	-	+	+	-	-
Labuan	Labuan	+++	-	++	++	+	+	++	++	++	-	-	+	+	+	+	+
	Toposo																
	Labuan Panimba	++	-	-	+	-	+	++	++	++	-	-	-	+	+	-	-

<sup>1</sup> O.f. = *Ostrinia furnacalis*; H.a. = *Helicoverpa armigera*; At = *Atherigona sp*, D.m. = *Dalbulus maidis*; S.l. = *Spodoptera litura*; M.s. = *Mithymna separate*; R.m. = *Rhopalosiphum maidis*; N.v. = *Nezara viridula*; N.t. = *Nicentritis testaceipes*; P.c. = *Plusia calcites*; L.i. = *Lamprosema indicate*; A = Acrididae; V. = *Valanga sp.*, L.m. = *Locusta migratoria*, S.i. = *Sesamia inferenae*; T. = Tettigonidae

<sup>2</sup> - = Not found; + = Low population; ++ = Moderately high population; +++ = High population.

**Table 2. Average egg mass of *O. furnacalis* parasited by *T. evanescens* in three subdistricts of Donggala, Central Sulawesi, Indonesia.**

No.	Location		Parasited egg mass (%)
	Subdistrict	Village	
1	Biomaru	Jono Oge	96.00
2		Sidondo	89.80
3	Palolo	Bahagia	59.73
4		Petimbe	-
5	Labuan	Bobo	77.23
6		Labuan Toposo	75.00
7		Labuan Panimba	81.95

Due to its role as vector of the sugarcane mosaic virus, maize dwarf mosaic virus and maize leaf-fleck virus, *R. maidis* is considered an economically important insect pest too (Anonymous 2008).

*Nezara viridula* is a polyphagous cosmopolitan insect and an important pest of maize. It attacks the plant by sucking the fluid from young ears. The symptoms are indicated by rolled husk. The rolling is very clear as the ear develops, resulting in opened ears.

*Atherigona* sp was found in Labuan but not in the other locations because when observations were taken in Labuan the maize plants were still young (2 weeks) while in the other locations they were already 4-8 weeks old. According to Kardinan *et al.* (1993) and Iqbal *et al.* (1993), *Atherigona* sp is a pest that attacks young maize plants, especially during the rainy season.

### Natural enemies

The natural enemies of these pests found in our observation in Donggala were one parasite and 12 predators. The predators were *Menochilus sexmaculatus*, *Scymnus* sp, *Epilachna* sp, *Ophionea* sp, *Solenopsis geminata*, *Rodolia* sp, *Afidenta gradaria*, *Euborellia annulata*, *Chrysopa* sp, *Lycosa pseudoannulata*, and *Atipena* sp. *Euborellia annulata* has the potential to be developed as a biological control agent because it has a high predation rate (Sitomurang and Gabriel 1988; Gonzales *et al.* 1995; Nonci 2005). This predator is available in enough pressure in the field and potentially can suppress the pest population, especially lepidopterous pests.

It was found that egg masses of *O. furnacalis* and *H. armigera* were parasited by *Trichogramma evanescens*. According to Pabbage *et al.* (1999) and Nonci *et al.* (2001), *T. evanescens* was effective in attacking the egg masses of *O. furnacalis* and *H. armigera* both in the laboratory and in the field.

The percentage of egg mass of *O. furnacalis* parasited by *T. evanescens* in the Donggala maize production area is presented in Table 1. The highest percentage of egg mass parasited (96.0 %) was found in the village Jono Oge in the subdistrict of Biomaru due to which the number of plants damaged by the pest was low. The number of holes found was two to three holes per plant. This result is almost the same as that reported by Pabbage *et al.* (2001) who found a *T. evanescens* parasite rate of 91.96% in the field.

Natural enemies in the field can be used by farmers to reduce the use of pesticides to control maize pests.

### Conclusions

The most important insect pests of maize found in Donggala district was *Ostrinia furnacalis* Guenee, *Helicoverpa armigera* Boddie and *Atherigona* sp. Next in importance were *Dalbulus maidis* Delong and Walcott, *Rhopalosiphum maidis* Fitch and *Nezara viridula* L. *Nicentrites testaceipes* was also found in high numbers.

The other maize pests found were not important. These were *Spodoptera litura* F., *Plusia calsites* Esp., *Lamprosema indicata* F., *Locusta migratoria* and *Valanga* sp.

The natural enemies of these pests were predators and parasites. There were 12 species of predator found: *Menochilus sexmaculatus*, *Scymnus* sp, *Epilachna* sp, *Ophionea* sp, *Solenopsis geminata*, *Rodolia* sp, *Afidenta gradaria*, *Euborellia annulata*, *Chrysopa* sp, *Lycosa pseudoannulata*, and *Atipena* sp.

One species of larval parasites found was from the order/family Hymenoptera/Ichneumonidae.

Egg parasites were more effective in the control of *O. furnacalis* compared with the larval parasite. The percentage of egg mass of *O. furnacalis* parasited ranged from 59.73% to 96% in all locations.

### References

- Anonymous. 2008. Corn aphids. University of California. Agriculture and Natural Resources. [http://www.ipm.ucdavis.edu/PMG/rl\\_11330061\\_1.htm](http://www.ipm.ucdavis.edu/PMG/rl_11330061_1.htm). 02/10/2008.
- Baco D. and Tandiang J. 1998. Hama utama jagung dan pengendaliannya. Dalam Sub M. Syam, dan A. Wijono (eds). Jagung. P. 185-204. Badan Penelitian dan Pengembangan Pertanian.

- Dinas Pertanian, Perkebunan dan Peternakan Provinsi Sulawesi Tengah. 2004. Statistik Peternakan Sulawesi Tengah.
- Dinas Pertanian, Perkebunan dan Peternakan Provinsi Sulawesi Tengah. 2005. Statistik Peternakan Sulawesi Tengah.
- Baco D. 2000. Potensi agen hayati untuk pengendalian penggerek jagung, *Ostrinia furnacalis* Guenee. Seminar jati diri. Balitjas. 23 Agustus 2000. 12 hal.
- Berger J. 1962. Maize production and the manuring of maize. Series no. 5. Geneva, Switzerland: Centre d'Etude de l'Azote. 315pp
- Gonzales P.G., Javier P.A. and Rejesus B.M. 1995. Dispersal of *Euborellia annulata* (Fabricius) (Dermaptera: Anisolabidae) in corn fields. *Philipp. Ent.* 9(6):587-604.
- Gonzales P.G. and Cadapan E.P. 2001. *Trichogramma* parasitoid. Los Baños, Philippines: National Crop Protection Center, University of the Philippines Los Baños. 3pp
- Iqbal, Kardinan A. and Harnoto. 1993. Pengendalian lalat Bibit pada Jagung. Prosiding Simposium Penelitian tanaman Pangan III Puslitbangtan. Pp 1113-1118.
- Javier P.A., Dayoen-Abellon C. and Rejesus B.M. 1993. Studies on the life history of earwigs predatory to the Asian corn borer *O. furnacalis* (Guenee). *Philippines Journal of Science* 122(4):357-376.
- Javier P.A., Gonzales P.G. and Rosales A.M. 2001. Precedure of monitoring Asian corn borer egg masses and damage. Los Baños, Philippines: National Crop Protection Center, University of the Philippines Los Baños. 3p.
- Kardinan A., Harnoto, Setiyadi P. and Setiyono R.T. 1993. Ketahanan beberapa galir dan varietas jagung terhadap hama lalat bibit *Atherigona* spp. Risalah Hasil Penelitian Tanaman Pangan. 3:41-46. Balittan Bogor.
- Nafus D.M. and Schreiner I.H. 1987. Location of *Ostrinia furnacalis* Guenee. eggs and larvae on wet corn in relation to plant growth. *Journal of Econ. Entomol.* 84(2):411-416.
- Nonci N., Tandiabang J., Masmawati and Muis A. 1996. Kehilangan hasil oleh penggerek jagung *O. furnacalis* pada berbagai stadia tanaman jagung. Hasil penelitian Hama/Penyakit. 1995/1996. BALitjas Maros. Hal:27-33.
- Nonci N., Tandiabang J., Masmawati and Muis A. 2000. Inventarisasi Musuh Alami Penggerek Batang Jagung (*O. furnacalis*) di Sentra Produksi Sulawesi Selatan. Penelitian Pertanian. Pusat Penelitian Tanaman Pangan. Hal: 38-49.
- Nonci N., Pabbage M.S. and Baco D. 2001. Keefektifan *Trichogramma evanescens* dalam mengendalikan penggerek batang jagung *O. furnacalis*. Laporan tahunan Penelitian Hama dan Penyakit, Balitjas, 2000.
- Nonci N. 2005. Biology and intrinsic growth rate of earwig (*Euborellia annulata* F). *Indonesian Journal of Agricultural Science* 6(2): 2005.
- de Oliveira C.M., Lopes J.R.S., Camargo L.E.A., Fungaro M.H.P. and Nault L.R. 2007. Genetic diversity in populations of *Dalbulus maidis* (Delong and Wolcott) (Hemiptera: Cicadellidae) from distant localities in Brazil assessed by RADP-PCR markers. *Environmental Entomology* 36(1):204-212.
- Ortega A.C. 1986. Insect pests of maize: a guide for field identification. Mexico, D.F.: CIMMYT. 106pp
- Pabbage M.S., Nonci N. and Baco D. 1999. Efektivitas *Trichogramma evanescens* pada berbagai umur telur penggerek batang jagung *O. furnacalis*. Laporan Tahunan Penelitian hama dan Penyakit. Balitjas, 2000.
- Pabbage M.S., Nonci N. and Baco D. 2001. Keefektifitas *Trichogrammaoidea bachtera fumata* dalam mengendalikan penggerek tongkol jagung (*Helicoverpa armigera*) di lapang. Laporan Tahunan Penelitian Hama dan Penyakit., Balitjas, 2002.
- Pitree H.N. 1970. Observations on the life cycle of *Dalbulus maidis* on three plant species. JSTOR: Florida Entomological Society 53(1):33-37.
- Rejesus B.M. and Javier P.A. 1985. Detasseling technique for the control of corn borer (*O. furnacalis*). *Philipp. Ent.* 6(3):287-306.
- Situmorang J. and Gabril B.P. 1988. Biology of two species of predatory earwigs *Nala lividipis* (Dufour) (Dermaptera: Labiduridea) and *Euborellia annulata* (Fabricius) (Dermaptera: Carconophoridae). *Philipp. Ent.* 7(3) 215-238.
- Supriyatin. 1993. Pengendalian hama Tanaman Palawija secara biologis. Simposium Tanaman Pangan III. Jakarta/Bogor. 23-25 Agustus 1993. 10pp.
- Teetes G.L., Seshu Reddy K.V., Leushner K. and House L.R. 1983. Sorghum insect identification handbook. 121pp.
- Tseng C.T. 1008. Use of *Trichogramma ostriniae* (Hymenoptera: Trichogrammatidae) to control the Asian corn borer *O. furnacalis* (Lepidoptera: Pyralidae): pages 340-356 in proceedings of the Seventh Asian Regional Maize Workshop, Los Baños, Philippines, Feb 23-27, 1998.
- van der Laan P.A. 1981. Pests of crops in Indonesia. Jakarta, Indonesia: Ichtiar Baru Van Hoeve. 701pp.
- Yasin M., Masmawati, Talanca A.H., Masud S. and Baco D. 2000. Pengendalian ulat grayak pada tanaman jagung menggunakan metarrhizium anisopliae dan carbofuran di lanrang, Sidrap. Sulawesi Selatan. Laporan Tahunan Penelitian Hama dan Penyakit. Balitjas 2001.