

## การจัดการศัตรูพืชแบบผสมผสานในข้าวโพดข้าวเหนียว

### Integrated Pest Management in Waxy Corn

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#### Abstract

Integrated pest management (IPM) in waxy corn was compared with farmer practice (FP) in cold season and dry season. Brown earwig *Proreus simulans* and *Trichogramma* sp. were released 3 individuals per hill and 200,000 pupae per ha<sup>-1</sup>. The results were found that a total of 17 species and 23 species of insect pests have been recorded during cold season and dry season, respectively. Yields, marketable ears and profits were higher in IPM plot than farmer practice. In cold season, corn stalk damage, damaged ears and unmarketable ears were lower in IPM plot than FP plot for 5.95%, 7.4% and 5.85%, respectively. In this season, IPM plot increased a profit from pest control for 17.35, 31.17% and 8.71% in farmer 1, farmer 2 and farmer 3 respectively. It was nonprofitable from IPM in dry season in farmer 1, farmer 3 and farmer 4 but farmer 3 was increased a profit for 31.66%.

**Key words:** IPM, waxy corn, insect pest, natural enemy, damage

#### บทคัดย่อ

เปรียบเทียบการจัดการศัตรูพืชแบบผสมผสาน (IPM) กับวิธีการของเกษตรกรที่ปลูกข้าวโพดข้าวเหนียวในฤดูหนาวและฤดูแล้งแปลง IPM ปล่อยแมลงหางหนีบน้ำตาล *Proreus simulans* 3 ตัว/กอ ร่วมกับการใช้แตนเบียนไข่ *Trichogramma* sp. อัตรา 200,000 ตัวต่อแฮคคแตร์ ผลการศึกษาพบแมลงศัตรูข้าวโพด 17 ชนิด และ 23 ชนิด ในฤดูหนาวและฤดูแล้งตามลำดับ ผลผลิต ฝักที่ขายได้ และผลกำไรในแปลง IPM สูงกว่าแปลงของเกษตรกรในฤดูหนาวความเสียหายของต้นข้าวโพด ฝักที่ถูกทำลาย และฝักที่ขายไม่ได้ในแปลง IPM ต่ำกว่าในแปลงเกษตรกรร้อยละ 5.29, 7.40 และ 5.85 ตามลำดับ แปลง IPM มีกำไรร้อยละ 8.71 – 31.17 ส่วนในฤดูแล้งแปลง IPM มีผลกำไรเพียงรายเดียวยร้อยละ 31.66 จากเกษตรกร 4 ราย

**คำสำคัญ:** IPM ข้าวโพดข้าวเหนียว แมลงศัตรูพืช ศัตรูธรรมชาติ ความเสียหาย

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## Introduction

In Thailand, all waxy corn is commercial in the fresh market. Corn stalk can be infested throughout their life cycle by the number of insect pests. Corn stem borer, *Ostrinia furnacalis* (Guenee) is an important pest of sweet corn in Thailand (Kongkanjana and Choonhawong, 1997). The effect of predacious earwig *Proreus simulans* Stallen to control the important sweet corn pests was found that release of 4.37 earwigs per plant can control corn stem borer and corn earworm under the economic threshold (Choonhawong et al., 1999). Earwig (*P. simulans*) was found as a most important corn stem borer's egg, larvae predator and corn aphid (Jamjanya et al., 2000). Smith (1996) reported a number of egg parasites (largely Trichogrammatidae, Hymenoptera) have been considered for biological control of *Ostrinia nubilalis* and only one case where biological control of *Ostrinia* spp. using *Trichogramma* spp. in corn was considered to be economically feasible. To meet waxy corn production in sustainable agriculture that not contaminated of environment from pesticide use and reduces the risks of crop loss from insect damage, increasing both production, quality of waxy corn and farmer income, therefore, IPM technology in waxy corn is the most suitable package to be promoted.

## Materials and methods

The experiment was conducted in 4 farmer fields of Nongbua village, Amphur Banfang, Khon Kaen province during cold season (October 2005 to January 2006) and dry season (February to April 2006). Paired treatments of present farmer practice (FP) with integrated pest management plot (IPM) were compared. Plot size was 22 rows by 18x30m. The essential research materials were waxy corn, *Trichogramma* sp., brown earwig (*P. simulans*), stand balance, ruler and vernier. The additional technology in IPM are: the third instars and adult of brown earwigs (*P. simulans*) were released with 3 individuals per hill and *Trichogramma* sp. was released 2 times at 28, 38 day after planting at 200,000 pupae/ha. A total of 30 hills in between population in each plot were randomly checked for pest infestation every week. Fresh ears were harvested in 65DAP. The harvest plot had 12m<sup>2</sup> (3x4m) in 3 replications. Ear quality was graded following farmer practices (grade A and B). The total of damaged and undamaged ears were counted and percentage. Treatment mean was subjected to analysis of variance using the SAS (SAS1985). Significant treatment means were compared using DMRT.

## Results and Discussions

### 1. Insect pests of waxy corn in farmer fields in Nong Bua village Amphur Banfang, Khon Kaen province

A total of 17 species were recorded during cold season. Insects are noted as causing severe or moderate injuries in this season: corn stem borer (*O. furnacalis*), corn earworm (*Helicoverpa armigera*), corn armyworm (*Mythimna separata*) and rice green bug (*Nezara viridula*) and; causing light injuries are corn looper (*Phytometra chalcytes*), corn thrip (*Frankliniella williamsi*), derbid planthopper (*Phenice moesta*), rose beetle (*Adoretus compressus*), cletus bug (*Cletus trigonus*), mirid bug, leaf eating beetle (*Monolepta signata*), leafhopper (*Bothrogonia* sp.), leaf eating weevil (*Hypomeces squamosus*) and corn leaf aphids (*Rhopalosiphum maidis*). A total of 23 insect species were recorded from dry season. Insects are noted as causing severe or moderate injuries during this period were: corn stem borer (*O. furnacalis*), corn earworm (*H. armigera*), rose beetle (*A. compressus*) and leaf eating beetle (*M. signata*). However, six more species appeared in the dry season. There were: corn leaf miner, leaf footed bug, cucumber beetle, seed bug, sap beetle and long-horned grasshopper. This may be, concerned with changing in near by environment in this season as crop diversity in the field was less than in the cold season, warmer weather and higher humidity from frequent rain meant that some insect species could produce more. This is consistent with rose beetle damage after rain when corn age was one month up to harvest.

## 2. Natural enemies

A total of 12 species of natural enemies were found from both periods of time during cold season and dry season. In the group of natural enemies, predators were mostly found. Among them ladybird beetle (*Micraspis discolor*, *Menochilus sexmaculatus*), brown earwig (*P. simulans*) and spiders (*Lycosa* sp.) are the most abundant. Others are black ants (*Camponotus* sp.), big-eyed bug (*Geocoris* sp.), long-horned grasshopper (*Conocephalus longipennis*) and egg parasite (*Trichogramma* sp.) found commonly Black ants (*Camponotus* sp.) are including in dry season. We observed that some brown earwigs were found in the corn field nearby our field experiment where he planted nine days before other farmers. It may be that was a source of immigration of population. In dry season, brown earwig (*P. simulans*) was very low density in comparison with cold season. We observed that its population was dramatically decreased after heavy rain and the predator of brown earwig was found. They are black ant *Camponotus* sp. and spiders.

## 3. Crop damage and yield loss assessment

In the cold season, percentage of corn stalk damage at harvest was lower in IPM plot than FP plot of 9.49% and 15.43% respectively. Yield was higher 15.3% in IPM plot or 13.06 tons/ha than FP plot 11.06 tons/ha, but they were not significantly different at  $P \leq 0.05$ . However, percentage of ear damage and unmarketable ears were lower in IPM plot of 6.54% and 9.70% than FP plot of 13.95% and 15.55% were significantly different at  $P \leq 0.05$ . Marketable ear, brown earwig density per stalk and benefit in IPM plots were higher of 90.30%, 15.75 individuals and 157,100 Baht per hectare than in FP plot for 84.45%, 4.66 individuals and 132,637 Baht per hectare and were significantly different at  $P \leq 0.05$  (Table 1).

In the dry season, average from 4 farmer fields in terms of corn stalk damage from corn stem borer at harvest, yield, ear damage, marketable, unmarketable and return cost were not statistically significant difference at  $P \leq 0.05$  (Table 2).

**Table 1** Stalk, ear damage by corn stem borer, corn earworm, yield, marketable, unmarketable ears, brown earwig and benefit of waxy corn from three farmer's fields in Amphur Banfang Khon Kaen province during cold season

Treatment	Corn stalk damage at harvest (%)	Yield (t/ha)	Damage ear (%)	Marketable ear (%)	Unmarketable ear (%)	Brown earwig per hill	Benefit (Baht/ha)
Farmer practice	15.43	11.62	13.53a	84.45	15.55a <sup>1/</sup>	4.66b	132,637b
Integrated pest management	9.49	13.06	6.13b	90.3	9.70b	15.75a	157,856a
F-test	ns	ns	*	*	*	*	*
CV (%)	36.37	14.79	21.22	4.38	49.35	21.82	11.51

<sup>1/</sup>Means followed by the same letter in the same column are not significantly different at  $P \leq 0.05$  by DMRT.

**Table 2** Stalk, ear damage by corn stem borer, corn earworm, yield, marketable, unmarketable ears, brown earwig and benefit of waxy corn from four farmer's fields in Amphur Banfang Khon Kaen province during dry season

Treatment	Corn stalk damage at harvest (%)	Yield (t/ha)	Damage ear (%)	Marketable ear (%)	Unmarketable ear (%)	Brown earwig per hill	Benefit (Baht/ha)
Farmer practice	25.74	10.56	25.23	82.55	17.45	0.22b <sup>1/</sup>	68,825
Integrated pest management	20.45	9.75	21.19	79.63	20.37	0.44a	73,968
F-test	ns	ns	ns	ns	ns	*	ns
CV (%)	17.01	12.81	19.65	5.43	25.64	80.12	16

<sup>1/</sup>Means followed by the same letter in the same column are not significantly different at  $P \leq 0.05$  by DMRT.

#### 4. Economic cost structure of waxy corn production and incremental benefit from integrated pest management

In the cold season, the total production cost per hectare in IPM plot was higher than in FP plot at 57,522 Baht (4.9%), 51,348 Baht (2.2%) and 61,719 Baht (7.9%) per hectare in farmer field 1, farmer field 2 and farmer field 3 respectively. Profit was increased in IPM plot too at 12,594 Baht (12.4%), 33,208 Baht (31.2%), and 11,746 Baht (8.7%) per hectare in farmer field 1, 2 and 3 respectively. Similarly in dry season, total production cost per hectare was higher in IPM plot than FP at 59,499 Baht (9.7%), 48,874 Baht (10.1%), 66,094 Baht (10.1%) and 56,001 Baht (8.5%) in farmer 1, farmer 2, farmer 3 and farmer 4 respectively. Profit per hectare was different among four farmers. It was increased in FP plot of farmer 2 only at 32,306 Baht per hectare. Percentage increase of profit was 32.97%. However, nonprofits were found in farmer 1, farmer 3 and farmer 4 at -7.94%, -5.50% and -8.06% respectively.

#### Conclusion

Insects are noted as causing severe or moderate injuries in cold season: corn stem borer (*O. furnacalis*), corn earworm (*H. armigera*), corn armyworm (*M. separata*), rice green bug (*N. viridula*) and in dry season: corn stem borer (*O. furnacalis*), corn earworm (*H. armigera*), and rose beetle (*A. compressus*). A total of 12 species of natural enemies have been found from the field surveys in both periods of time during cold season and dry season. In the group of natural enemies, predators are mostly found. Brown earwig *P. simulans* could be effectively released in combination with *Trichogramma* sp. in sweet corn and waxy corn fields. Brown earwigs should have one release at 28-30 days after planting, but *Trichogramma* sp. should be released 3 times in cold season and 4 times in dry season.

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