Crop Protection 62 (2014) 32–39

Contents lists available at ScienceDirect

Crop Protection

journal homepage: www.elsevier.com/locate/cropro

Factors determining adoption of integrated pest management by vegetable growers in Nakhon Ratchasima Province, Thailand

Sirada Timprasert, Avishek Datta*, S.L. Ranamukhaarachchi

Agricultural Systems and Engineering, School of Environment, Resources and Development, Asian Institute of Technology, Pathumthani 12120, Thailand

ARTICLE INFO

Article history:
Received 14 October 2013
Received in revised form
2 April 2014
Accepted 4 April 2014

Keywords:
IPM
Vegetables
Insect pests
Factors influencing adoption
Farmers' knowledge

ABSTRACT

Widespread use of highly toxic pesticides primarily for agricultural purpose has generated increasing concerns about the negative impact of pesticides on human health and the environment. Integrated pest management (IPM) usually seeks to minimize the use of pesticides and can be utilized to solve pest problems while minimizing risks to people and the environment. A total of 220 vegetable farmers in Nakhon Ratchasima Province of Thailand was interviewed with the objective of investigating the factors determining their adoption or non-adoption of IPM practices. The findings demonstrated that farmers had different uncompromising reasons for determining the use of IPM for their insect pest management. Higher costs of insecticides (91%), adverse effects of insecticides on human health and the environment (80%), and a greater risk of insect pests developing resistance to insecticides (28%) were the primary reasons for the adoption of IPM by vegetable growers in the study area. The reasons for the rejection of IPM practice were unsuitability of IPM for a large farm (52%), implementation difficulties (80%) and a greater belief in synthetic insecticides and their efficacy for target pest control (39%). A comparison between the IPM and the non-IPM farmers showed a significant difference ($P < 0.01$) in farmers' knowledge of pest management, which influenced IPM adoption or non-adoption. The IPM farmers had greater knowledge about identifying natural enemies and their beneficial role in controlling insect pests, about plant extracts and their efficacy in controlling insect pests and about sticky traps and their efficacy in monitoring natural enemies and controlling insect pests. For example, 24% of IPM farmers had knowledge of natural enemies whereas it was only 4% for the non-IPM farmers. A logistic regression model was fitted which showed that lower cost of pest management, better knowledge on IPM after training and availability of extension services were the factors which influenced farmers' adoption of IPM practice. The non-IPM farmers rejected adoption of IPM due to the common belief that natural enemies would not be effective in controlling insect pests and yields of vegetables would not be increased by practicing IPM.

1. Introduction

Vegetable production is a lucrative livelihood for the farmers in Thailand as it brings attractive incomes in a short period of time. Different vegetables are grown during different periods of a year depending upon weather, soil conditions and suitability of crops to such conditions. However, due to high demand, leafy vegetables such as Chinese kale (*Brassica alboglabra* L.H. Bailey) and pak choi (*Brassica chinensis* L.) and popular green pod producing yard long bean (*Vigna sesquipedalis* L.) are largely grown year-round in Thailand (FAO, 1999).

Insect pests pose a serious threat for economic production of vegetables in Thailand. Diamondback moth (*Plutella xylostella* L.) and flea beetles (*Phyllotreta* spp.) are important insect pests throughout the year for cruciferous vegetables (Pipithsangchan et al., 2001), whereas both pod borer (*Maruca vitrata* Fab.) and aphids (*Aphis craccivora* Koch) damage yard long bean pods (AVRDC, 2001). Direct feeding by aphids on young shoots and pods and deposits of honeydew on pods promote the development of sooty mold, thus reducing the market value of the pods. Since these insects can cause heavy economic damage and are resistant to commonly applied insecticides (Rowell, 2010), growers frequently apply synthetic insecticides at high doses to protect their crops and their incomes. Pesticides have been found to be the easiest and the most effective method of pest control for vegetables (Jirachaiyabhas et al., 2004). Thai farmers frequently spray pesticides on vegetables and such

* Corresponding author. Tel.: +66 2524 5479; fax: +66 2524 6200.
E-mail addresses: datta@ait.ac.th, avishek.ait@gmail.com, davishek2002@yahoo.com (A. Datta).

http://dx.doi.org/10.1016/j.cropro.2014.04.008
0261-2194/

crops are harvested and supplied to the market before the recommended safety period for consumption is reached (Kearns, 2008). Excessive use of insecticides in vegetable production would cause adverse effects on agricultural ecosystem and human health (Poapongsakorn et al., 1998; Xu, 2006). Tirado et al. (2008) reported that around 37% of vegetables supplied to markets in Thailand had been contaminated with some insecticide residues.

Integrated pest management (IPM) is often promoted as a viable alternative to sole and over reliance on synthetic pesticides (Hashemi et al., 2008). IPM practice uses a combination of biological, cultural, physical and chemical methods to reduce pest populations. Pest management through the IPM approach should be carried out by developing the right mix of control measures which are cost effective and safe for both the farmer and consumer, and are ecologically sustainable at the same time. IPM may include chemical control; however, pesticides are allowed to be used only as a last resort when other control methods have failed to achieve satisfactory control. IPM practice has played an important role in vegetable production systems and has enabled farmers to improve quality in terms of appearance of vegetables and to minimize input costs. IPM emphasizes the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms (FAO, 2013). IPM approaches have succeeded in reducing the use of a number of broad-spectrum pesticides, and have also been shown to be more economical than conventional methods that rely on insecticides. It aims to suppress pest populations below the economic injury level instead of eradication, and helps in making plant protection feasible, safe and economical, even for the smallholder farmers (Sharma et al., 2009). Farmers typically tend to adopt cost-effective pest management approaches that minimize their financial risks (Zalucki et al., 2009).

IPM helps maintain pests at a low level of population by managing the agro-ecosystem to enhance natural enemies and thereby reduce yield losses below economically damaging levels. However, many farmers apply broad-spectrum insecticides to control insect pests for their convenience and rapid results, which in turn impair the balance between insect pests (prey) and natural enemies. This is partly because continuous monitoring of the populations of insect pests, natural enemies and other factors in the natural ecosystem on a regular basis is time-consuming as well as an in-depth knowledge is needed about pests and natural enemies and their behavior (Moser et al., 2008). However with all such difficulties, many farmers continue to avert the use of insecticides, and adopt IPM practices for the management of insect pests. Therefore, it is essential to examine and identify causes that would discourage farmers from adopting IPM practices and thus encourage their decision to use insecticides.

The objectives of this research were to identify farmers' knowledge and awareness about IPM, IPM practices that had been adopted and factors that influence the adoption or non-adoption of IPM among vegetable growers in Nakhon Ratchasima Province of Thailand. The findings of this study will enable the Department of Agricultural Extension (DOAE) to device suitable mechanism(s) to facilitate and promote the adoption of IPM in vegetable cultivation in Thailand through policy formulation and implementation.

2. Materials and methods

2.1. Study place and sample selection

The study was conducted in 2008–2009 in Muaeng, Chok Chai and Huai Thalaeng districts in Nakhon Ratchasima Province, Thailand. These three districts were purposely selected for the study as they produce a large volume of vegetables for Thai market. A total sample of 220 farmers was selected that included 110 IPM and 110 non-IPM farmers. A list of farmers practicing both IPM and non-IPM measures was obtained from the Department of Agricultural Extension (DOAE) of Nakhon Ratchasima Province prior to conduct of the survey. The list revealed a total of 110 IPM farmers in three districts of Nakhon Ratchasima Province who were trained on IPM practice by extension officers of DOAE that included 55 farmers from Muaeng, 25 farmers from Chok Chai and 30 farmers from Huai Thalaeng. It was, therefore, decided to survey all of IPM farmers from those three districts. The same list also provided a total of 200 non-IPM farmers, out of which 110 non-IPM farmers were selected. The number of non-IPM farmers was kept the same as IPM farmers in three districts, and was determined using the simple random sampling method. Both the IPM and the non-IPM farmers were interviewed by using a questionnaire-based survey during July–September 2008 and June–August 2009.

2.2. Data collection

Pre-testing of the questionnaire was carried out by interviewing other farmers not included for the study in order to evaluate the questionnaire and ensure the adequacy of information needed to fulfill the study objectives. The primary data were collected through field survey from the IPM and the non-IPM vegetable growers. Two surveys were conducted to collect both the primary and secondary data. In the vegetable farming community survey to gather the primary data, questions were divided into three main sections. The first section was designed to collect information on the personal characteristics of farmers, including age, gender, education level, and area under vegetable cultivation. The second section focused on knowledge of farmers on different pest management practices. The third section contained questions pertaining to factors which influence the decision-making of farmers on their adoption or non-adoption of IPM practice.

The second survey involved interviews and discussion with personnel from different government offices in Nakhon Ratchasima Province, including DOAE, Department of Agriculture (DOA), Tambon Center for Agricultural Technology Transfer and Market Organization. Mainly government officers from the DOAE and DOA in Nakhon Ratchasima Province provided the secondary information such as institutional role and contribution with knowledge dissemination, advising on pest problems and management measures, frequency of meeting farmers, conduct of farmer field school (FFS) and participation of farmers.

2.3. Data analysis

Pearson's Chi-squared test (χ^2) was performed to determine whether the proportions of the categorical survey data (percentage of farmers with specific knowledge on pest management and frequency of extension officers' visit to their farms) differed significantly. The Chi-squared test is useful to determine if there are significant differences between two independent characteristics or attributes. This test has certain limitations. Conventionally, the condition is that the expected frequency of any category should not be less than five.

The logistic regression procedure is a popular statistical technique in which the probability of a dichotomous result such as adoption or non-adoption is related to a set of explanatory variables that are hypothesized to influence the result (Hair et al., 1998). Logistic regression was considered to be the most appropriate analytical tool to investigate the factors determining adoption.

2.4. Model specification

In this study, the logistic regression model characterizing the adoption of IPM practice by the vegetable farmers is specified by the following Eq. (1).