Crop Protection 114 (2018) 53–59

Contents lists available at ScienceDirect

Crop Protection

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

What could encourage farmers to choose non-chemical pest management? Evidence from apple growers on the Loess Plateau of China

Yongqiang Wang[a,*], Yan Wang[b], Yuchun Zhu[a,**]

[a] College of Economics and Management, Northwest A & F University, Yangling, 712100, Shaanxi, PR China
[b] College of Science, Northwest A & F University, Yangling, 712100, Shaanxi, PR China

ARTICLE INFO

Keywords:
Encourage
Non-chemical methods
Poisson model
Fruit-growing areas

ABSTRACT

This paper reports a study aiming to ascertain how farmers may be encouraged to use more non-chemical methods of pest management. A randomly selected sample of 600 small-scale farmers on the Loess Plateau of China was investigated in 2016. We analysed the farmers' choice of non-chemical pest management by using a Poisson regression model. The results showed that subsidies for the use of non-chemical pest management methods play a key positive role in farmers' choices of these methods. Certification of green or organic agricultural products, signed sales contracts and years of formal education also have a positive role in relation to farmers' choices of non-chemical pest management. However, an increase in agricultural land has a negative impact on farmers' choices of non-chemical pest management. These results will be helpful for the improvement of related policies on the reduction in chemical pesticide use and the encouragement of non-chemical pest management in fruit-growing areas.

1. Introduction

Chemical pesticides play an important role in ensuring yields of agricultural products worldwide. However, the excessive use of chemical pesticides may cause pesticide residue problems in fresh agro-products, which are potentially harmful for consumers' health (Berrada et al., 2010; Rutsaert et al., 2013; Van Boxstael et al., 2013; Chen et al., 2015; Wang et al., 2015; Femenia and Letort, 2016). Moreover, constant and excessive chemical pesticide use can also contaminate the soil, groundwater, and air and negatively affect biodiversity (Pimentel et al., 1992; Wilson and Tisdell, 2001; Brethour and Weersink, 2003; Jacquet et al., 2011; Skevas et al., 2012; Bajwa et al., 2015; Lamichhane et al., 2016a). Concerns over human health and environmental problems caused by chemical pesticides in agriculture have led to efforts to transition from conventional pesticides to integrated pest management (IPM), which incorporates both chemical and non-chemical means of crop protection (Lamichhane et al., 2016a). To make an IPM system successful, there is a necessity to partially or totally replace conventional pesticides. Non-chemical pest management measures have the potential to become one of the main pillars of IPM systems (Rekha and Prasad, 2006; Hernandez-Moreno et al., 2013; Lamichhane et al., 2016b).

Many countries are implementing programmes to reduce chemical pesticides and thereby minimize the potential adverse impacts of chemical pesticides (Jean-Philippe et al., 2011). In 2008, France announced that it planned to halve the use of chemical pesticides by 2025 and introduced a tax policy related to the potential toxicity of pesticides as well as subsidies for organic farming (Jacquet et al., 2011). Denmark has reported success with its policies for reducing the use of pesticides without harm to agricultural production (Nielsen, 2005; Neumeister, 2007). In 2009, concerns regarding the negative use of chemical pesticides in the European Union (EU) led to a directive on sustainable use of pesticides that requires the adoption of eight integrated pest management (IPM) principles throughout the European member states beginning in 2014 (Barzman et al., 2015; Lamichhane et al., 2016b). Since 2012, all countries in the EU have been required to launch chemical pesticide reduction campaigns in agriculture (Femenia and Letort, 2016). As the largest consumer of pesticides, there has been a rapid increase in the quantity of pesticides used in agriculture over the past 20 years in China. To control the over-use and enhance the efficiency of pesticide use, China has launched a campaign that sets an objective of no further annual increases in pesticide use as of 2020 (Department of Planting, Ministry of Agriculture, 2015). This issue has attracted the attention of many researchers.

Studies on how to reduce pesticide use and promote non-chemical pest management fall into four categories: economics studies, extension

* Corresponding author.
** Corresponding author.
E-mail addresses: holdmydream@163.com (Y. Wang), zhuyuchun321@126.com (Y. Zhu).

https://doi.org/10.1016/j.cropro.2018.08.015
Received 4 May 2018; Received in revised form 8 August 2018; Accepted 9 August 2018
0261-2194/ © 2018 Elsevier Ltd. All rights reserved.

studies, policy studies and technical studies. (1) Economics studies. In the current market economy of China, small-scale farmers are driven by profit maximization in their pest management choices. Because of the higher cost of biological pesticides, greater labour input, and higher labour cost of environment-friendly pest management methods compared with the lower costs of chemical pesticides (Maggio et al., 2008), most small-scale farmers in China lack the incentive to choose non-chemical or environment-friendly methods of pest management, especially under conditions of information asymmetry of agro-products combined with low efficiency in source traceability and imperfections in the quality of governance systems (Zhou and Jin, 2013; Wang et al., 2015; Jin et al., 2015). (2) Extension studies. Some researchers have concluded that the extension of environment-friendly pest management methods would be helpful in reducing chemical pesticide use. The training of farmers in non-chemical pest management would help farmers to reduce the use of chemical pesticides (Goodhue et al., 2010; Sun et al., 2012; Sharma and Peshin, 2016). Studies have shown that field schools can potentially help farmers implement IPM (integrated pest management) strategies that use less chemical pesticides (Godtland et al., 2004). However, the lengthy and expensive registration process for bio-control solutions and their varying effectiveness are key obstacles hindering the adoption of bio-control solutions in Europe (Lamichhane et al., 2016a; Lamichhane, 2017). (3) Policy studies. Some researchers have advocated the adoption of taxation on pesticide use (Jacquet et al., 2011; Femenia and Letort, 2016). However, other researchers have concluded that chemical pesticide taxes or subsidies for non-chemical pest management have limited effect on the reduction in pesticide use, while pesticide quotas are more effective in reducing pesticide use (Skevas et al., 2012). (4) Technical studies. The use of genetically modified crops can reduce the use of chemical pesticides (James, 2015), but current evidence cannot prove that GMOs are risk-free for human health (Kou et al., 2015). Thus, the promotion of non-chemical pest management in China is one of the most challenging agricultural and environmental policy objectives (Wang and Gu, 2013).

Most of the previous research on the reduction of pesticide use and promotion of non-chemical pest management has focused on economic studies, extension studies, policy studies and technical studies. There has been limited empirical research on farmers' choice of non-chemical pest management based on a combination of utility, marketing, policy and psychological studies. Based on previous studies and excessive and restrictive methods of pesticide use (Tanaka and Nguyen, 2010; Wang et al., 2015), this paper provides a complex analytical framework to explain small-scale farmers' non-chemical pesticide choices. This study contributes to the growing literature on what could drive famers to use more non-chemical pest management methods instead of increasing their use of chemical pesticides, such as has been happening in the fruit orchards of developing countries.

2. Materials and method

2.1. Econometric model and hypothesis

The theoretical model for this analysis was based on a combination of utility, marketing, policy and psychological studies. First, according to prospect theory, a farmer's choice among different means of pest management is based on his or her assessment of different prospect utilities that involve risk. As more than half of Chinese farmers only have a junior high school education (Wang, 2015), in addition to future uncertainty, they are unlikely to compute precisely the potential losses and gains of the different options for pest management. When facing a choice of different pest management methods, usually, farmers rely on their planting experience to quickly make decisions and choose a method. The decision would be based on consideration of potential changes in apple output and prices and individual risk preferences. In this context, we denote farmers' experience in terms of cultivation years. The levels of risk preference of farmers can be derived in a formula based on prospect theory (Kahneman and Tversky, 1979; Tversky and Kahneman, 1992; Tanaka and Nguyen, 2010; Wang et al., 2015).

$$U(x, p; y, p) = \begin{cases} v(y) + \pi(p)[v(x) - v(y)], x > y > 0 \quad or \quad x < y < 0 \\ \pi(p)v(x) + \pi(q)v(y), x < 0 < y \end{cases}$$

where

$$v(x) = \begin{cases} x^{1-\sigma}, x > 0 \\ -\lambda(-x)^{1-\sigma}, x < 0 \end{cases} \text{and } w(p) = \exp\left[-(-\ln p)^{\alpha}\right]$$

Here, v denotes the expected utility of an outcome to the individual making the decision, x and p denote the potential outcomes and their respective probabilities, σ denotes degree of risk preference, λ measures the sensitivity to loss versus gain, and $w(p)$ is the probability weighting function. When farmers choose a pest management method, they will simplify the differences in prospect output and price among the pest management methods. According to the heuristic biases in prospect theory, in our econometric model, we simplified prospect utility of the pest management choices, namely, the differences in prospect output and price of agriculture products, and farmer's risk preference. We conducted a choice experiment to derive the risk parameter designed by Wang Y. (Wang et al., 2015). Farmers were asked to choose between different prospect payoffs involving different probabilities from series 1 to series 3. In every series, their choice of option A or B determined their risk parameter in the prospect theory formula. Further, the farmer's traits and the environment interact to provide the basis for their choice of pest management method. The farmer's traits in this context include the following: the size of his farm, years of apple cultivation experience, education level, off-farm experience, etc. The environment in this context includes the natural environment, market environment and policy environment (Wang, 2015). Pest problems show minimal variability among the orchards in the research area; thus, the nature of the environment was not reflected in the theoretical model. The market environment was considered in the context of sale modes for agricultural products. The policy variables included subsidies on non-chemical pest management, pesticide residue testing of apples, certification of different apple-growing areas, governance of pesticide use and extension guidance on pest management.

Based on the above analysis, an econometric model was built to identify and quantify the factors that affect the farmers' choice of pest management methods. When a farmer faces a decision on the control of pest infestation, some farmers choose chemical pesticides to control pests instead of non-chemical controls, while most of the farmers choose a combination of chemical pesticides and non-chemical control measures (namely, IPM). Few farmers only rely on non-chemical control measures. According to the permitted pest management list of China AA-grade green foods, which requires no use of chemical pesticides, AA-grade green food permits the use of plant origin and animal origin bio-pesticides, microbial pesticides, biochemical pesticides, mineral pesticides (such as lime-sulfur) and other non-chemical pest management methods, including solar light traps, sticky paper, and paper bag traps. The greater the cumulative types of adopted non-chemical pest management methods, the better the effects are on pest management; therefore, multiple methods must be combined.

In relation to the non-chemical pest management options by farmers, 'i' denotes a different farmer. The measurement of mineral pesticides and biological pesticides should be in relation to the amount of active ingredients applied. However, a problem exists in quantifying the amount of some of the other forms of pest management, such as solar light traps, sticky paper or paper bag traps, the use of which are completely different from that of mineral and biological pesticides. Mineral and biological pesticides also have differences among them due to their different ingredients. Expenditures on non-chemical pest management could be a measurement unit; however, cost comparisons of different non-chemical pest management may not always be

Download English Version:

https://daneshyari.com/en/article/8877829

Download Persian Version:

https://daneshyari.com/article/8877829

Daneshyari.com