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Attitude towards and intention to use biological control among citrus farmers in Iran

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ABSTRACT

Biological control (BC) through the release of BC agents is regarded as a potential strategy for achieving sustainable pest control and provides a way to substantially reduce pesticide use without sacrificing crop yield. Despite all its potential, understanding attitude and intention to use BC still remains low, especially among smallholder farmers. This study explored the extent to which knowledge of the adverse effects of pesticides and two components of the Health Belief Model (i.e., belief in the efficacy of BC and perceived barriers to BC) are related to: (i) farmers' attitude towards BC as a pest control method and (ii) farmers' intention to use BC in the future as a pest management practice. A random sample of 381 citrus farmers from Sari County in Mazandaran Province of Iran was used. The majority of the farmers (71.1%) had a positive attitude towards BC, while 60.1% agreed that they would use BC in the future as a pest management practice. Farmers were not well aware of the adverse effects of pesticides used in citrus fields, such as pyriproxyfen, buprofezin, and chlorpyrifos. Knowledge of the adverse effects of pesticides was not significantly associated with either dependent variable (i.e., belief in the efficacy of BC and perceived barriers to BC). However, farmers who believed in the efficacy of BC as a pest management method were more likely ($P < 0.01$) to have a positive attitude towards BC, while those who perceived more barriers to BC use were less likely ($P < 0.01$) to have a positive attitude towards BC. Findings support that (i) the promotion of the BC effectiveness is a worthy goal for providers of extension services for the promotion of BC adoption and (ii) if the perceived barriers to the adoption of BC are overcome, the rate of BC use among farmers would increase. Overall, extension programs aiming only at increasing awareness and knowledge of pesticide impacts may not succeed in promoting BC adoption. Efforts should target farmers' views of BC, promoting farmers' belief in the efficacy of BC and lessening perceived barriers to BC use.

1. Introduction

Iran is the fifth largest citrus-producing country in the world in terms of volume of production (FAO, 2016). Citrus fruits are widely produced in the northern parts of Iran (Sharifzadeh et al., 2017) and especially in the province of Mazandaran, where rural livelihoods are highly dependent on agriculture. In the recent past, the net income from citrus production in Mazandaran Province has fallen, partly due to infestations of harmful pests (Esmaeili, 1996). The citrus mealybug (*Planococcus citri* Risso) and the citrus cottony scale (*Pulvinaria aurantii* Cockerell) are dominant pests of citrus fruits in the area, influencing both yield and producers' income (Gharizadeh Gelsefidi et al., 2004; Aghajanzadeh et al., 2016). The control of these pests largely relies on insecticides, such as pyriproxyfen, buprofezin, and chlorpyrifos. However, repeated and improper application of insecticides favored the development of resistance and the resurgence of different generations of pests (Gharizadeh Gelsefidi et al., 2004). Farmers responded with higher doses of chemicals, which led to ever higher costs of production. While most subsistence farmers in northern Iran cannot afford chemical pesticides, the situation deteriorated by changes in the government policy concerning lowering subsidy for pesticides in the end of 2010s (Hashemi et al., 2012; Abdollahzadeh et al., 2015a). At the same time, several health and environmental costs of extensive pesticide use have become starkly apparent (Abdollahzadeh et al., 2016b).

In response to these challenges, Mazandaran Agriculture-Jahad Organization (MAJO) has developed ecologically sustainable pest

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control strategies that are affordable and accessible to small-scale farmers (MAJ, 2016). These strategies emphasized the use of the mealybug ladybird (*Cryptolaemus montrouzieri* Mulsant), one of the most common natural enemies of the dominant pests of citrus-producing areas in Iran, introduced in northern Iran as a biological control (BC) agent for the control of *P. citri* (Gharizadeh Gelsefidi et al., 2004). Historically, BC programs in Iran through the release of BC agents were introduced in the 1990s and since then, there have been various incentives by the ministry of agriculture and local agricultural offices to promote BC among farmers (Razzaghi-Borkhani et al., 2013; Abdollahzadeh et al., 2015a). These incentives included frequent on-farm visits by the local extension personnel, partial coverage of the cost of BC, farmers' field schools, farm courses about BC, educational visits to pilot demonstrations, capacity building, and provision of subsidies to farmers, so as to increase BC adoption. Nevertheless, despite efforts to promote BC in northern Iran, the prevalence of pesticide-related problems is a proof that BC adoption is far from widespread (Abdollahzadeh et al., 2017). It has been argued that such limited adoption of BC is due to lack of favorable attitude towards BC programs. Given the complexity of pest management, the success of any measure to promote BC depends on various factors that can emerge in different arenas. The attitude of farmers may be one of these factors.

The issue of farmers' attitude towards BC and intention to adopt BC and other IPM technologies has been investigated in several countries. In Honduras, IPM training recipients were consulted by their peers, while farmers connected to training recipients had a better appreciation of arthropod natural enemies and knew more about pesticide alternatives and natural enemy conservation methods (Wyckhuys and O'Neil, 2007). In a multi-national study, the media coverage as a source of information and the positive characteristics of the biocontrol agent were the most significant factors affecting farmers' confidence in BC (Moser et al., 2008). In Iran, non-adoption of IPM technologies was attributed to a lack of sufficient technical information and of clear guidance for proper application (Veisi et al., 2009), while IPM adoption behaviors were influenced by external factors as well as the gender, knowledge, and experience level of farmers (Veisi, 2012). Other research from Iran pointed economic barriers that farmers often face as the most important limiting factor for IPM acceptance (Mohammadrezaei et al., 2014), while BC was perceived to be highly skillful-oriented (Abdollahzadeh et al., 2015a). However, farming experience, family size, and extension activities grouped farmers accurately with respect to IPM adoption in olive production (Allahyari et al., 2016). In Thailand, lower cost of pest management with IPM, better knowledge on IPM after training, and availability of extension services positively influenced farmers' adoption of IPM practice (Timprasert et al., 2014). The awareness of the success of some BC programs and the higher cost of BC practices affected BC adoption in USA (Goldberger and Lehrer, 2016), whereas perceived self-efficacy, facilitating conditions, compatibility, and perceived usefulness of BC affected adoption in Iran (Sharifzadeh et al., 2017). Moreover, training and more knowledge about pesticide alternatives and natural enemy conservation methods as well as perceptions of the beneficial and harmful effects of pesticides affected BC adoption (Hashemi and Damalas, 2010; Abdollahzadeh et al., 2015a).

While previous studies have clearly identified the impact of certain socio-economic characteristics of farmers, farm characteristics, and technology attributes on farmers' adoption of IPM practices, no research has investigated citrus farmers' attitudes towards BC, especially via adopting a theoretically rigorous approach. Informed by the Health Belief Model (HBM) framework (Becker, 1974; Rosenstock, 1974) as one of the best known health behavior models widely used in health behavior change analysis, we studied farmers' attitudes towards and intention to BC use among citrus farmers to assess the feasibility of efforts to promote use of this method of IPM as an alternative to chemical control in citrus-growing areas of Mazandaran Province of northern Iran. In this study, BC refers to pest control through the release of BC agents in the field. Analysis of farmers' attitudes can help agricultural policy-makers to develop policy instruments and management plans taking into consideration the views of key stakeholders.

2. Theoretical background and hypotheses

The Health Belief Model (HBM), one of the most widely used conceptual frameworks for explaining, predicting, and influencing health-related behavior (Becker, 1974; Rosenstock, 1974), has received empirical support from a wide variety of studies. HBM suggests that when individuals believe that a condition is a threat to their personal health and developing a specific behavior will reduce the perceived threat, the likelihood of engaging in that behavior will increase (Becker, 1974, 1993; Rosenstock, 1966; Rosenstock et al., 1988).

In this research, we exploited parts of the Health Belief Model as an organizing tool to explore the attitude towards and intention to use BC among citrus farmers. According to this model, the factors that affect farmers' use of a preventive health measure, such as BC as alternative to chemical pest control, are (i) perceived susceptibility (i.e., the likelihood of getting sickness or poisoning by pesticides), (ii) perceived severity (i.e., the perception of how serious an outcome or consequence is from the sickness), iii) perceived benefits (i.e., the efficacy of the preventive measure undertaken), and iv) perceived barriers (i.e., time, skill, money, accessibility, side effects of the preventive action). In the present study, the components of the HBM which received focus were: i) belief in the efficacy of BC to control pests or prevent pest outbreaks and ii) having no considerable barriers to the adoption of BC. In this research, we wanted to examine 'perceived barriers' and 'belief in efficacy' as two important components in BC adoption. With reference to the other components of the model (i.e., perceived susceptibility and perceived severity), it should be kept in mind that HBM is a model for assessing health behaviors and, therefore, measuring the model construct in other fields of research is a difficult task. To achieve this (especially measuring perceived susceptibility and perceived severity), we need standard validated questionnaires, but a standard validated questionnaire about BC technology is not currently available. Since our primary concern is BC use as an alternative pest control method to chemical pesticides, we feel that farmers' knowledge of the adverse effects of pesticides is an essential component in the selection of pest management strategies (Abdollahzadeh et al., 2015a). We therefore examined the effect of farmers' knowledge of the adverse effects of pesticides on BC use. Further, we investigated the extent to which farmers connect BC use or no use, with decrease or increase of the adverse effects of pesticides on the environment and human health (sickness or poisoning by pesticides). We saw this perception as highly influential on both attitude towards BC and intention to use BC in the future as a pest management practice. Therefore, farmers' knowledge of the adverse effects of pesticides and two components of the HBM, i.e., i) belief in the efficacy of BC and ii) perceived barriers to BC use, constituted our independent variables of main interest.

2.1. Hypotheses

Based on the theoretical components of the HBM, this study proposes the following hypotheses with regard to use of BC:

Hypothesis 1. There is a significant relationship between knowledge of the adverse effect of pesticide use and (i) attitude towards BC, (ii) intention to use BC as a future pest management practice.

Hypothesis 2. There is a significant relationship between belief in the efficacy of BC and (i) attitude towards BC, (ii) intention to use BC as a future pest management practice.

Hypothesis 3. There is a significant relationship between perceived barriers to BC use and (i) attitude towards BC, (ii) intention to use BC as a future pest management practice.