INTRODUCTION

Potato is placed in 6th position in terms of production (376,452, 524 (MT) among the major food crop worldwide. China occupies the largest potato production area followed by India (Faostat, 2015). In Nepal, during the last decades (1994-2008), area of potato cultivation has been increased by 186% and the productivity increased by 155% (NPRP, 2009). Current area is 197234 ha with 2690421 MT and 13.6 tone/ha respectively (ABPSD, 2013). Recent Korean production and productivity of potato is 72,7438 MT and 26.5 tone/ha respectively (Faostat, 2015).

It was reported that more than 40 insect pests associated with potato crops (NPRP, 2005). Of them, potato tuber moth, Phthorimaea operculella (Zeller) (hereafter PTM) is one of the major insect pests of the potato in the tropics and subtropics which damage both foliage and tuber. The larva mines and feeds on potato foliage in fields and tubers in both field and storage (Joshi, 1989, 2004; Raman and Radcliffe, 1992). Tubers of potato with larval mines are unmarketable. Female moth lay eggs in the eyes of newly formed exposed tuber in the field, the newly hatched larvae bore into the tubers, which cause heavy loss in storage so that the potential yields are reduced. The larvae bore mostly near the eyes of the tubers, filling the tunnels with excreta. Mines in the leaf and petiole and tunnels in the stems are common nature of injuries in field condition (Raman, 1980; Kroschel and Canedo, 2008).

Global climate change scenarios have alarmed the possibilities of the pest becoming more severe and expanding from its current habitat to newer area of potato production posing greater plant quarantine concerns (Sporleder 2008; Kroschel et al., 2013). In Korea, it was reported invaded since 1968 and its distribution seemed restricted in the southern part of peninsula (Choe and Park, 1980), but is becoming a new issue in potato production (Maharjan and Jung, 2011). This paper reviewed the ecological aspects of the potato tuber moth to figure out the knowledge gaps for further research.

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MATERIALS AND METHODS

Review on the PTM was done consulting different available research papers published in journals, national and international seminars, workshop proceedings, annual reports and students’ dissertation and other relevant literature. This paper mainly reviewed on ecological characteristics of PTM with their host range and distribution.

RESULTS AND DISCUSSION

1. Taxonomy

There are three species of the PTM; Tecia solanivora, which is found in Central and Northwest South America, Symmes-trischema tangolias (Turner), found in South America, Southeast Australia, and Philippines and Phthorimaea operculella, is important because of its economic importance and wider distribution in the world. Medina et al. (2010) have provided the molecular technique to identify the geographical variation in Phthorimaea operculella population. In USA two distinct populations of PTM exist where one mostly associated to the western United States and the other one associated to the eastern United States.

P. operculella was first described by Zeller in the year 1873 as Gelechia operculella. Taxonomic position of P. operculella given by Nayar et al. (2000) is as follows:

Kingdom: Animalia
Phylum: Arthropoda
Class: Insecta
Subclass: Pterygota
Infraclass: Oligoneoptera
Order: Lepidoptera
Family: Gelechiidae
Genus: Phthorimaea
Species: operculella
Common name: Potato tuber moth

2. Host range

There are many related wild hosts and 60 plant species are mentioned by Das and Raman (1994). Although PTM is primarily a pest of potato (Solanum tuberosum L.), it can also be found in other solanaceous plants such as eggplant (Solanum melongena L.), tomato (Solanum lycopersicum L.), black nightshade (S. nigrum L.), silver leaf nightshade (S. elaeagnifolium Cav.), chili pepper (Capsicum frutescens L.), tobacco (Nicotiana tabacum L.), cape gooseberry (Physallis peruviana L.), field ground cherry (Physalis mollis D.), prickly nightshade (S. torvum Sw.), jimson weed (Datura stramonium L.), P. angulata L. and Brugmansia suaveolens Bersch (Gubbaiah and Thontadarya, 1977; Trivedi and Rajagopal, 1992). Cunningham (1969) also included the genera Physalis, Fabina, Hyoscyamus, Lycium and Nicandra as hosts of P. operculella. Although PTM can be found in all crops and weeds listed above, field studies have shown that it only reproduces when feeding on potato, tomato and eggplant (Broodryk, 1971; Meisner et al., 1974; Das and Raman, 1994). Likewise in the laboratory, PTM was found to feed on tomato, eggplant, and tobacco (Gubbaiah and Thontadarya, 1975). PTM preferred Solanum tuberosum more and infestation was found high while S. melongena and S. lycopersicum are least infested on leaf among the five different species of Solanaceous plants (Neupane, 1977).

3. Geographic distribution

It is believed that the P. operculella have been originated in South America (Radcliffe, 1982; Briese, 1986). Now it is a cosmopolitan pest, especially in warm temperate and tropical regions where host plants are grown through the series of invasion events (Fig. 1). The pest has been reported from the tropical and subtropical countries of South Central and North America, Africa, Australia, and Asia (Flint, 1986; Kroschel and Koch, 1994). In United States, it has also been reported from California, Arizona, Florida, Texas, Maryland, Virginia (Radcliffe, 1982). The species has been involuntarily introduced into Georgia (Markosyan, 1992) and the Ukraine and there is a threat of its spreading to neighbouring states (Sikura and Shendaraskaya, 1983). It has also been recorded from the East Africa (Parker and Hunt, 1989). It was also spread over the Columbia Basin of Oregon and Washington (Rondon et al., 2008). The pest has also been reported from New Zealand (Cameron et al., 2002), Australia (Symington, 2003) and southwestern Europe (Povolny and Hula, 2004).

In Nepal, pest distribution and severity is reported from various eastern, western and central hill and plain districts (Joshi, 2004; Giri et al., 2014). The pest was reported for the first time in 1965 in the Kathmandu valley (NARC, 1966) and was also reported for the consecutive year (NARC, 1967). The pest is extending and spreading across Nepal and have been reported from Kavrepalanchowk, Chitwan, Kaski, Parbat, Dang, Salyan, Kathmandu, Lalitpur, Bhaktapur, Sindhupalchek, Makawanpur, Bara, Dhanusha, Ramechhap, Dolkha, Myagdi, Lamjung, Dailekh (Joshi, 2004; NPRP, 2008; Giri et al. 2014) and...