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Disease Pest Surveillance under E-Plant Clinic in Sindhuli District, Nepal

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ABSTRACT

The status on the existing disease pest status of summer crop was studied in Kapilakot of Sindhuli district. Data for pest surveillance were collected from nine regular e-Plant clinics conducted at every 15 days interval in Pipalbot, Kapilakot in 2017. Total of 222 queries were registered from 193 farmers attending the plant clinic. Plantwise Clinics Data Entry Template (V9.2B) was used for data entry and CABI's Final Validation Tool (V8) software for validation. Among 21 different crops recorded in e-Plant clinic, majority was maize followed by rice, tomato and chilly respectively. Coverage of e-Plant clinic was 7 km on an average and maximum up to 15km. Out of 51different causes of crop damage identified, 91.44% was the biotic cause whereas 8.56% was abiotic. Insect were the major biotic cause of crop damage followed by fungal disease. Maize stem borer was noted in 52.86% of all maize samples and was found to affect mostly intermediate stage of maize. Similarly, fruit fly was recorded in 79% of all cucurbitaceous samples. Rice was found to be mostly affected by rice blast and rice stem borer. Tomato leaf miner, red banded caterpillar in mango and cob rot of maize were identified as the emerging disease pest in Sindhuli.

Key Words: e-Plant clinic, Pest surveillance, Insect pest, Disease, Coverage, Emerging

Introduction

Globally, disease and pests cause substantial losses both in term of quality and quantity. Various studies indicate that about 35-40% pre and post-harvest losses are caused by pests in Nepal (FAO & PPD, 2004). Nepalese farmers are facing numerous problems during production, one of which is lack of regular access to advisory services for crop protection to disease pest which includes technical knowledge and skill (Adhikari et al., 2013). MoAD (2016) reported that according to agricultural census 2011, the ratio of agriculture service centre to farmer household was1:11,269. With limited access to agriculture extension services, Nepalese farmers have very poor knowledge and skill on plant health issues which results inthe use of pesticidesat inappropriate dose and frequency without any safety measures (Atreya, 2007).

To overcome some of the existing gaps of plant health extension the concept of plant health clinic has been evolved as a novel approach in providing regular, low-cost plant health services to farmers since 2003 (Bentley & Boa, 2004). Danielsen and Matsiko (2016) reported that the plant clinic approach represents a shift from a 'vertical' (single crop or single pest) to a 'horizontal' approach (any problem in any crop). Similar to the concept of clinic for human and animals, plant clinics, which are operated by local extension workers at farmers convenient place (Bentley, Boa, Danielsen, &Zakaria, 2007), provide primary health care for plants (Danielsen& Kelly, 2010). Plant clinic reduces the unnecessary application of chemical pesticides (Zinsstag, 2015), links research and extension and discovers new crop problems (Boa & Harling, 2008). Besides conventional plant clinic services, e-Plant clinic includes ICT to deliver improved advice, including targeted messaging, directly to farmers (CABI, 2016).

Plant clinic is one of the different methods of community based pest surveillance (CABI, 2011). Emerging diseases cause major damage or pose major threats (Anderson et al., 2004). As seen in Uganda, diagnostic services continue to suffer from weak technical capacity and uncertain funding, even where major plant diseases cause widespread damage. There is a need of 'plant health system', where extension, diagnostic services, research and input supply are better connected and worked more closely together (Danielsen et al., 2013). Community based pest surveillance through e-Plant clinic would avoid pest problems and lead to designing an effective control programme to improve the functioning of pest disease problem by providing overall status of disease pest of any area (CABI, 2016).Boa (2010), through a research involving gathering demand and innovative responses regarding plant healthcare for poor farmers around the world, found innovative responses arising from the clinics include 'Going Public', a new extension method and an improved surveillance of current and emerging plant diseases.

The regular e-Plant clinic conducted in maize block of Sindhulirecorded disease pest occurrence including detailed informative data on existing and emerging new pest species, assessed pest damage at different growth stage of crop, and monitored time of occurrence of particular type of pest. Thus, present study aimed at assessing existing disease pest status of summer crop in Kapilakot village, Sindhuli district of Nepal.

Methodology

Regular e-Plant clinic was conducted from April to August, 2017 at every 15 days interval under maize block at Pipalbot of Kapilakot,Marin rural municipality-6.The site of e-plant clinic is at an altitude of 500 meter above mean sea level.Geographically, it is located at 27.2611°-NLatitude,85.7654°-ELongitude (GPS).Most number of clinics was operated in summer season followed by rainy season. The major crops under cultivation in maize block during study period were maize and rice.

Plant clinic campaign was the source of empirical data for characterization of the pest surveillance where the crop sample brought by farmers visiting e-Plant clinic was diagnosed by plant doctor. The type of pest, time of occurrence and abundance of pests were recorded through e-Plant clinic. Similarly, the severity of problems, percentage loss of crops, types of symptoms, recommendation and farmers management techniques were also recorded. The Plantwise Data Collection android application was used for data entry at the time of e-Plant clinic campaign. Later the PlantwiseClinics Data Entry Template (Version 9.2B) software was used for data entry as well as analysis. The Plantwise Prescription and Record Sheet (V9.2) feature of the software was used as data entry of all clinics individually that was automatically compiled under data sheet of excel by another feature of the software. MS excel 2010 was used for data analysis for characterization of pest under e-Plant clinic conducted around maize block. Descriptive analysis such as frequency, range, percentage, mean and ranking were used whenever applicable.

Before subjecting the data to analysis, the data were validated using Final Validation Tool (V8) software developed by CABI. The software uses two categories (diagnosis and recommendation) for validity. The diagnosis feature validates the specificity, plausibility, distinctness and inclusiveness of key symptoms. On the other hand, validity of recommendation was confirmed by the comprehensiveness, effectiveness, safety, detail and quality of recommendation practices subjected under the recommendation column in the software.

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Results and Discussion

Number of plant clinics sessions and queries

Nine plant clinic sessions were run under clinic code NPSDO3. The maximum number of queries was 29 and minimum 18. The average number of queries and farmers per session was 25 and 21 respectively. Majority of female farmers (59.07%) visited e-Plant clinic (Figure. 1).

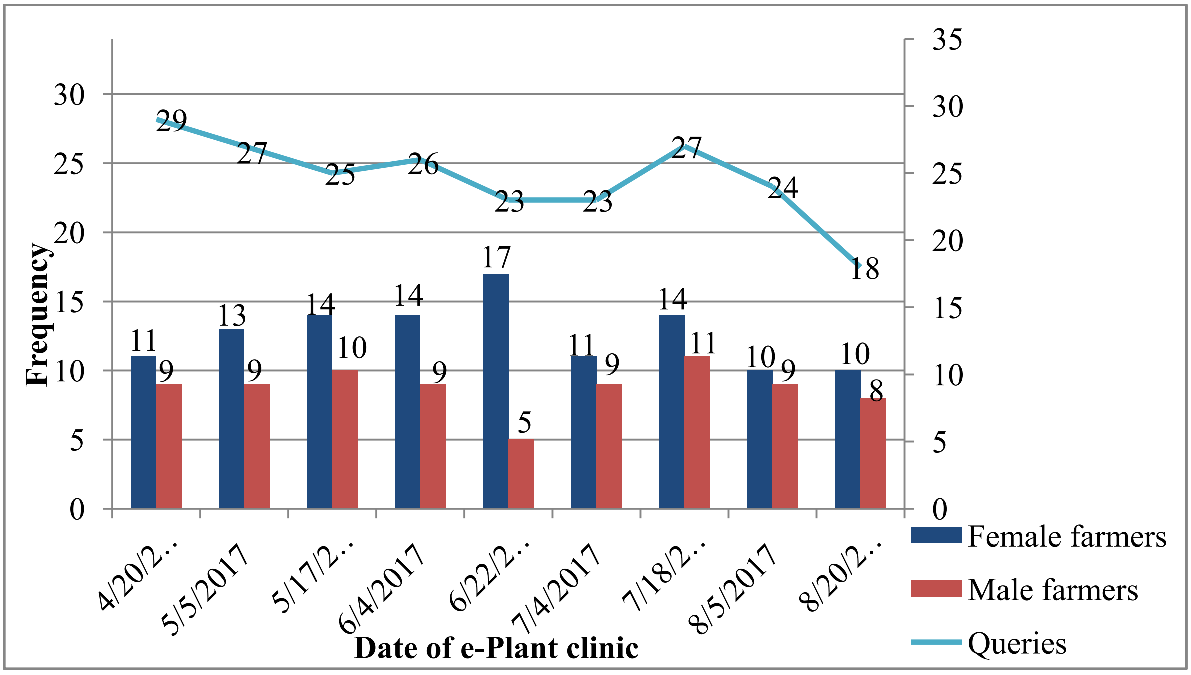

Figure.1. Total number of e-Plant clinic sessions and queries run at Kapilakot, 2017

Coverage of e-plant clinic at Kapilakot

Coverage of e-Plant clinic was 7 km on an average and maximum up to 15 km around Kapilakot area. Similarly, Adhikari et al. (2016) found distance as the limiting factor for farmers' participation in plant clinic.

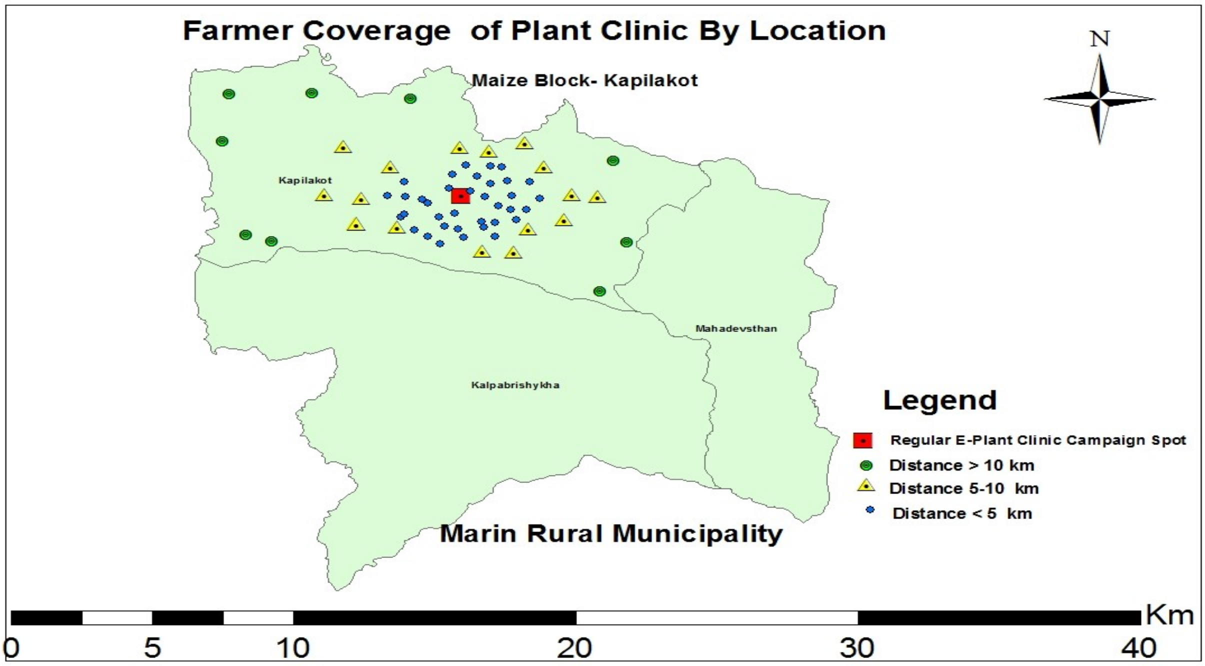

Figure. 2. Farmer's visit to e-Plant clinic atKapilakot, 2017

Characterization of pest surveillance under e-Plant clinic, 2017

Diversity of crops recorded in e-Plant clinic

Among 21 crops recorded in e-Plant clinic from April to August, 2017; majority was maize followed by rice, tomato and chilly. The study found that problem of disease pest was most common in maize, which accounted for 31.53% of total infested crop sample brought in e-Plant clinic. Rice was found to be the second most commonly infested crop brought in e-Plant clinic accounting for about 18.92% of total crop. Similarly, 5% of total sample brought in e-Plant clinic was tomato and chilly each (Figure. 3).

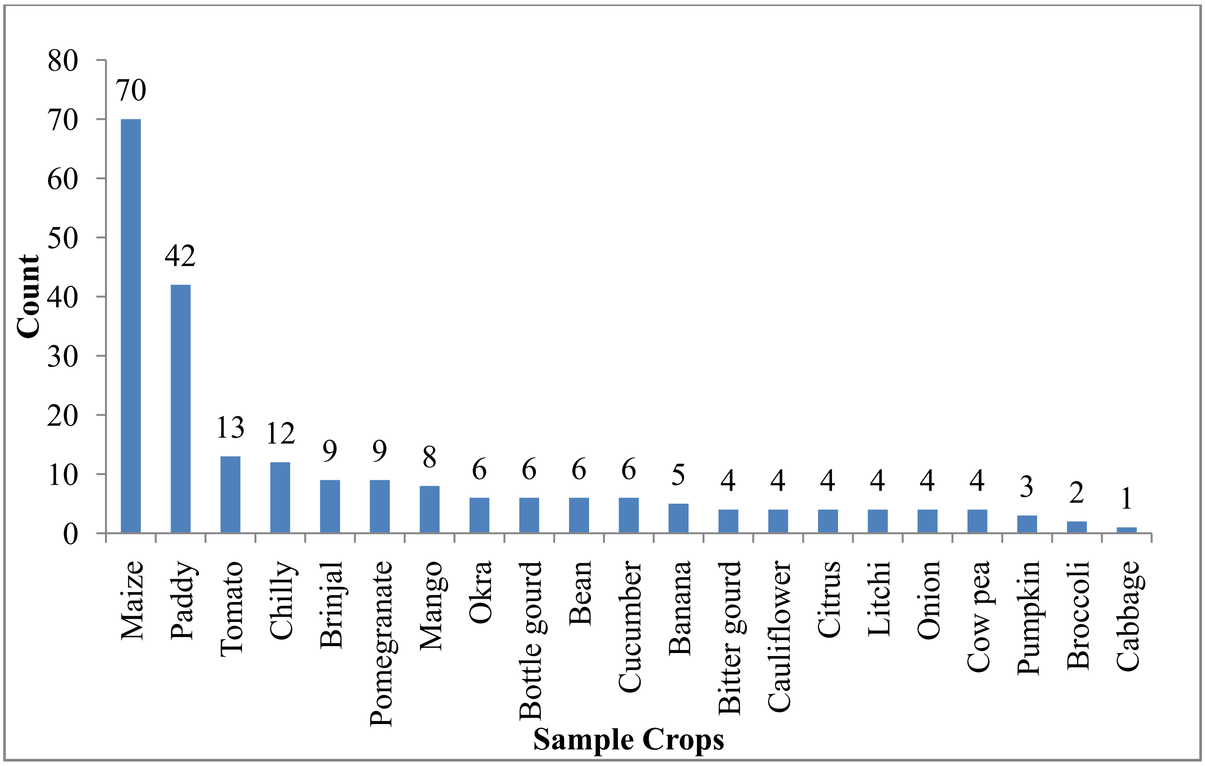

Figure. 3. Crops diversity recorded in e-Plant clinic

Cereals were found to be the most commonly damaged crop followed by vegetables.Half of the crops brought in the plant clinic were cereals, whereas only 14% of all damaged crops brought in the plant clinic were fruits (Figure. 4). Similarly, Adhikari et al. (2017) reported maximum queries on cerealsin plant clinics.

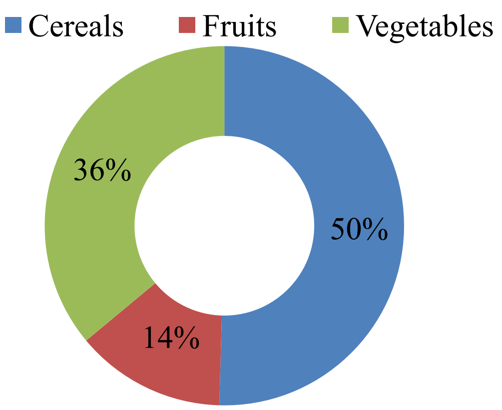

Figure. 4. Categorization of major crops recorded in e-Plant clinic at Kapilakot, 2017

Disease pest diagnosed in e-Plant clinic

Total of 51 different biotic and abiotic factors affecting crops were recorded in e-Plant clinic (Table 1).Similarly, among the crop samples maize stem borer was recorded in nearly 32% of cases followed by fruit fly (12.93%). A survey in western hills of Nepal also found insect to be the major problem in maize field (Bhandari et al., 2015). Among the insects, stem borer was reported to be the major threat of maize in the field condition. Study findings suggested fungal disease to be the major threat to rice production, with rice blast being the most severe one. Similarly, Pokhrel (1997) reported blast as the major production hazard in rice among the diseases. Among bacterial disease, Bacterial leaf blight was found to be a major disease in rice. Bacterial leaf blight is a major bacterial disease affecting rice in the mid-hills during rainy season starting from August (Adhikari, Leach,& Mew, 1996).

Table 1: Different type of disease pest diagnosis recorded in e-Plant clinic

Causative agent	Count	Causative agent	Count
Insects		**Fungal Disease**	
Maize stem borer	37	Rice blast	9
Fruit fly	15	Gray leaf spot	6
Rice stem borer	7	Anthracnose disease of chilli	5
Pomegranate butterfly	7	Downy mildew	4
Brinjal fruit and shoot borer	7	Root rot	3
White grub	7	Alternaria leaf spot	3
Mealy bug	6	Sheath blight	3
Cut worm	5	Rust	3
Aphids	5	Cob rot of maize	2
Banana stem weevil	5	Purple blotch of onion	2
Tomato leaf miner	5	Early leaf blight of tomato	2
Litchi mites	4	Brown rot	2
Rice leaf folder	4	Damping off	2
Brown plant hopper	4	Smut	2
Unidentified insect	3	Club root of crucifers	1
Maize aphid	3	**Viral diseases**	
Red pumpkin beetle	3	Chilly mosaic virus	4
Termite	2	Leaf curl virus	2

Red banded caterpillar	2	Yellow vein mosaic virus	2
Tomato fruit borer	2	**Little leaf of chilli**	**1**
Mango seed weevil	2	**Rootknot nematode**	**1**
Cowpea aphid	1	**Rat**	**1**
Bacterial Disease		**Abiotic causes**	**19**
Bacterial stalk rot	4		
Bacterial leaf blight of rice	3		

Biotic factor was major cause of crop damage, 91.44% of crops were damaged by biotic factor while abiotic factors accounted for only 8.56% of crop damage. As show in Figure5, insect (67%) were the major biotic cause of crop damage followed by fungal diseases (24.14%), virus (3.94%) and bacteria (3.45%), respectively. Similarly, Adhikari (2009) through plant clinic study reported high insect incidence as the major cause of crop damage in Kathmandu and Dhading districts.

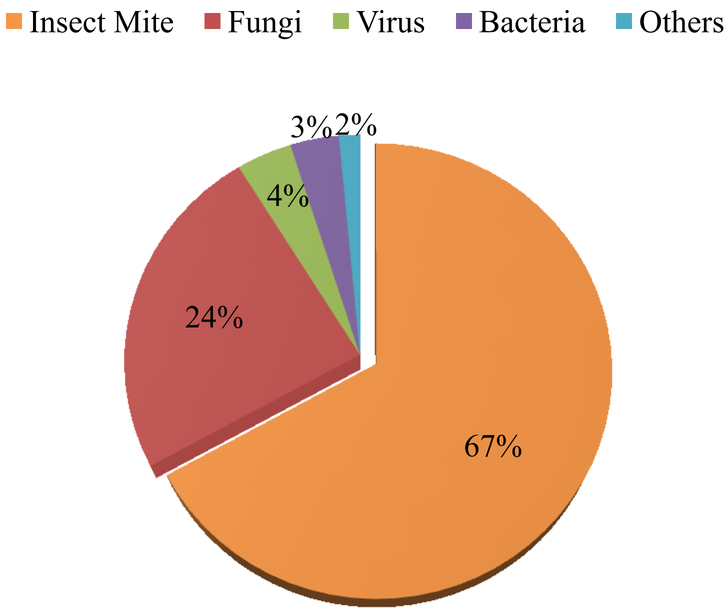

Figure. 5. Biotic causes of crop damage found in e-plant clinic

Among 8.56% of abiotic causes of crop damage, boron deficiency accounted for 31.58% followed by zinc deficiency (21.05%). Increasingly common occurrence of Zinc deficiency has been reported to adversely affect rice yields(CDD, 2015).

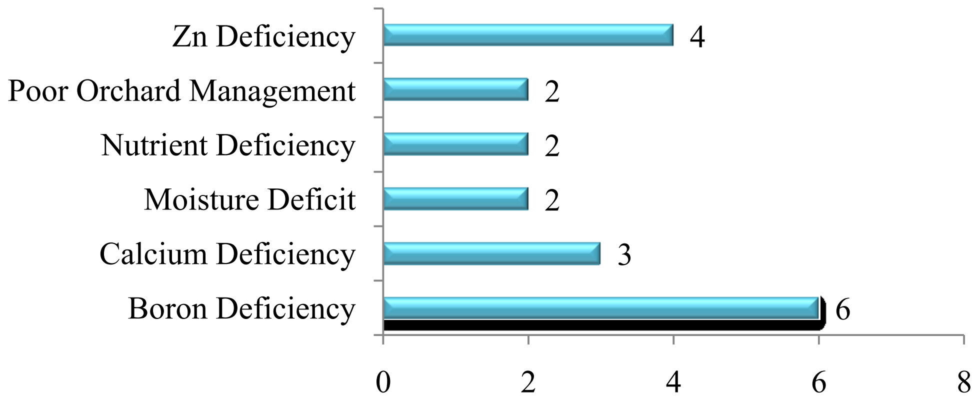

Figure. 6. Abiotic causes of crop damage found in e-Plant clinic

Major disease pestaffecting four major crops recorded in plant clinic are shown in Table 2. Major pest affecting maize around Kapilakot area was found to be maize stem borer (52.86%). Pingali (2001) reported stem borers as the most damaging group of insect in maize throughout the world. Moreover, occurrence of stem borers in problematic level was suggested by Paudyalet al. (2001) in central mid-hills in summer planting. Similarly, gray leaf spot (8.57%) was recorded to be the second most problematic cause of maize damage. Similar to this finding in the mid-hills of Sindhuli during rainy season, K.C et al. (2015) also reported gray leaf spot emerging as problematic fungal disease in the hills of Nepal during the rainy season.

Rice was found to be mostly affected by rice blast (21.43%) followed by rice stem borer. In Nepal, rice blast has been a continuous threat to rice production (Manandhar, 1987; Chaudhary, 1999). Tomato leaf miner (38.46%) was found as the most problematic cause of tomatodamage. Moreover, Anthracnose disease of chilly was the most problematic pest (41.67%), followed by chilly mosaic virus (33.3%).

Table 2: Top three disease pest of major four crops recorded in e-Plant clinic

Crops	Disease pest	Percentage
Maize	Maize stem borer	52.86%
	Gray leaf spot	8.57%
	Cutworm	7.14%

Paddy	Rice blast	21.43%
	Rice stem borer	16.67%
	Root rot	9.52%
Tomato	Tomato leaf miner	38.46 %
	Unidentified Tomato insect	23.08%
	Tomato fruit borer	15.38%
Chilly	Anthracnose	41.67%
	Chilly mosaic virus	33.33%
	Chilly leaf curl virus	16.67%

Characterization of maize disease pest according to development stage

Out of 70 affected maize samples brought in e-Plant clinic, majority of infestation (31) was found in intermediate stage followed by flowering (15) and fruiting (14) respectively (Table 3). The most prevalent pest of maize i.e. maize stem borer was also found maximum in intermediate stage (25 out of 31) of maize followed by fruiting stage. Kalule, Ogenga-Latigo, & Okoth (1994) reported that maize stem borer infested maize during the early growth stages (3-4 weeks after emergence). The study also found that cut worm affected mostly seedling stage of maize. Similarly, Paudyal et al. (2001)reported emergence stage of maize to be most affected by cutworm and white grub damage in central mid-hills of Nepal.

Table 3: Distribution of disease pest of maize according to development stage

Types of disease pests of maize	Stages of maize				
	Seedling	Intermediate	Flowering	Fruiting	Mature
Maize stem borer	-	25	4	6	2
Gray leaf spot	-	4	1	1	-
Cut worm	3	2	-	-	-
Bacterial stalk rot	-	-	4	-	-
Boron deficiency	-	-	1	1	1
Rust	-	-	1	2	-
Downy mildew	-	-	2	1	-
Aphid	-	-	2	1	-

Cob rot of maize	-	-	-	1	1
White grub	2	-	-	-	-
Smut	-	-	-	1	1
Total	5	31	15	14	5

Fruit fly Prevalence

Fruit fly was found the second major insect prevalent around the maize block. There were 15 queries recorded on fruit fly. Fruit fly was recorded in 79% of all cucurbitaceous samples. As shown in Figure 7, the crops mostly affected by fruit fly were bottle gourd (40%), followed by cucumber (33.33%) and bitter gourd (26.67%). Among the queries on fruit fly recorded in plant clinic of Nepal (September 2013 to July 2016) fruit fly were the most problematic in cucurbitaceous vegetables (Adhikari, 2016).

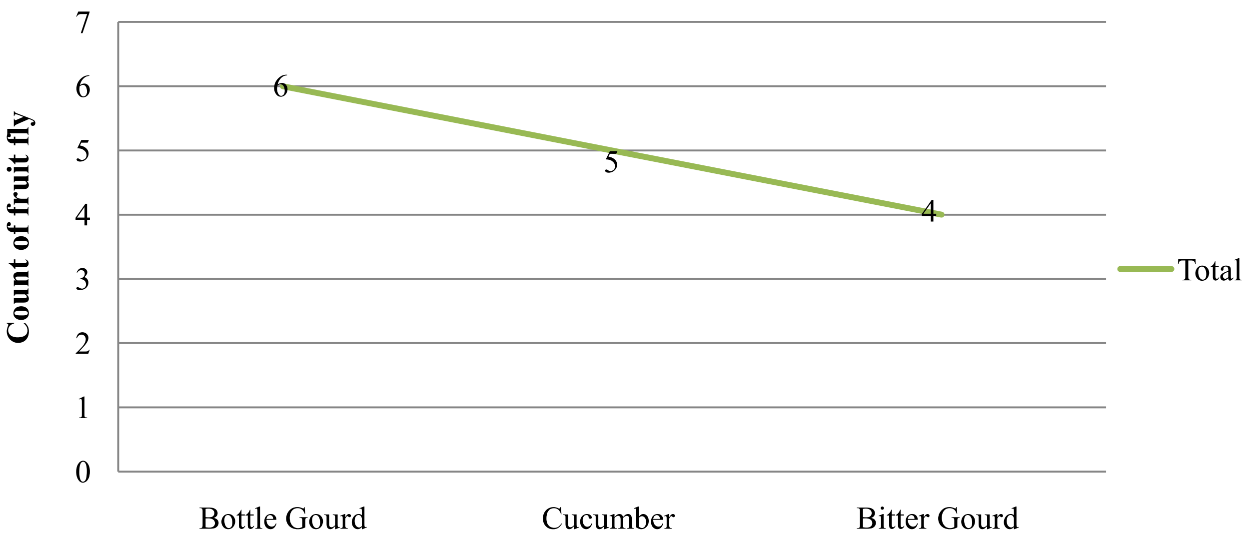

Figure. 7. Number of queries on fruit fly recorded in different crops in e-Plant clinic

Emerging disease pest

New disease pest were recorded in e-Plant clinic which included cob rot of maize, tomato leaf miner in tomato and red banded caterpillar in mango (Figure 8). Tomato leaf miner was recorded for the first time in Nepal from a commercial tomato farm of Kathmandu during May 2016, since then it has been spreading around vicinity of Kathmandu valley (Bajracharya et al., 2016).

Similar community based surveillance based on CABI's e-Plant clinic approach provided the first authenticated Cassava Brown Streak Disease (CBSD) identification in Congo (Adams et al., 2013). From this raw, substantial and quickly gathered data, a number of suspected CBSD cases were identified and followed-up with farmers to obtain plant samples for laboratory verification. This approach provided a valuable, 'real-time' picture of pest events in the area but also showed that the disease was not as common as feared ("Risk assessment and surveillence", 2014).

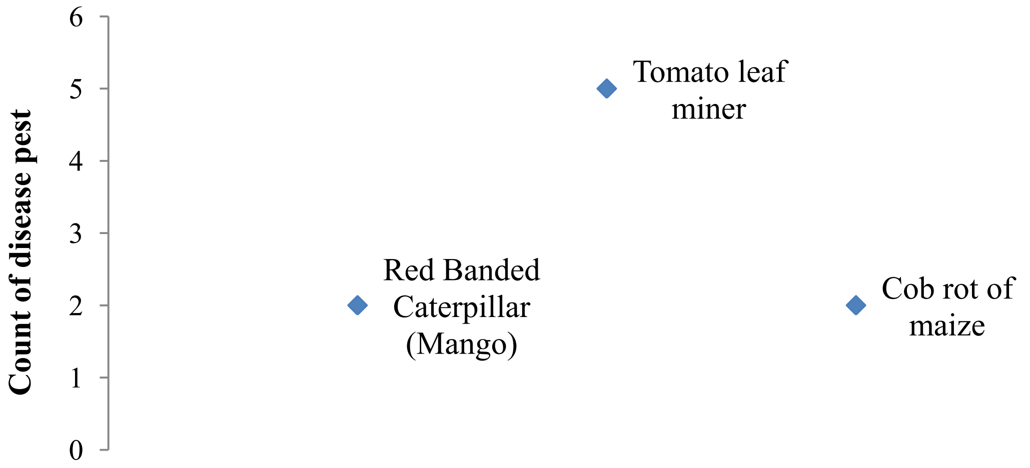

Figure. 8. Emerging disease pest recorded in e-Plant clinic at Kapilakot, 2017

Conclusion

Surveillance result revealed that most crops in Sindhuli were affected by biotic causes. Maize stem borer was the major pest of Maize in Kapilakot. It affected maize mainly in its intermediate stage. Similarly, fruit fly, rice blast and rice stem borer were found to be among the most problematic insect pest and disease around Kapilakot. The effectiveness of e-Plant clinic should be enhanced by increasing coverage and access to farmers. It is urged that regular e-Plant clinic service be developed as a reliable tool for pest surveillance to assess the pest status of an area. The etiology, conditions favoring the prevalence of certain disease pest and its effective management options should be studied further. Tomato leaf miner, red banded caterpillar and cob rot of maize are seen as emerging pests in the Kapilakot area. So, further studies should be conducted for conformation.

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