Utilization of plant health clinic innovation for sustainable crop production in embu County, eastern Kenya

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Abstract

Plant health clinic (PHC) is a new approach in Kenya that provides a low cost method to provide plant health advisory services to smallholder farmers. The approach is based on field diagnosis on crop health issues which includes plant disease, insect pest, weed and soil health. It aimed to diagnose, manage the crop health issues for increased yield and sustainable livelihood. The plant clinics are run by the extension staff from the Ministry of Agriculture and the Kenya Agricultural Research Institute (KARI). The study revealed that farmers have varying problem and in the three agroecological where the clinics are situated. The crops grown are similar and are affected by similar diseases. However, nitrogen and phosphorous deficiencies were more rampared in the upper midland (UM1) as compared to the UM2 and 3. Since the plant clinic approach is conducted at the farm level it may act as a quick avenue to track any new pest in a area.

Key words: plant health clinic, plant ‘doctor’ nitrogen, phosphorous.

Introduction

Agriculture is the backbone of the Kenyan economy that contributes to 26% of the GDP annually and another 25% indirectly. The sector provides 70% of the informal employment in the rural areas. It also accounts for 65% of Kenya’s total exports. The agricultural sector is not only the driver of Kenya’s economy but also the means of livelihood for the majority of Kenyan people (GoK, 2010). Productivity in this sector has been declining due to; inadequate access to production inputs, low crop yields, and unfavourable markets among others. It is in this context that the National Agro forestry Research Project (NAFRP) indicated that the sector should be the main target of concentration in combating poverty (NAFRP, 1999). There are various factors that contributes to low yields that include; low soil fertility, poor crop husbandry, limited use of improved seeds, pests and diseases, monoculture, reduced crop diversity, lack of crop rotation and reduced tillage. It also includes use of herbicides that have boosted yields, though increasing pests and diseases. According to Coakley et al., 1999 the problem of pests and diseases has also been exacerbated by change of climate resulting in high temperatures that favours their survival. Adejumo (2005), Schroth et al (2000), Okori et al (2004) and Huis (1989) indicated that crop yields productivity has been continuously going down due to diseases and insect pests. Rao (2004), Schroth et al (2000) and Allotely and Oweyo (2000) indicated that grain legumes are more susceptible to pests and diseases. According to Oerke et al (1994) pests and diseases cause considerable loss of crop yields resulting to 42%, (insects) 15% (pathogens) and 13% (weed) of pre-harvest losses. Due to the climate change the survival of the pathogen that may results to increased inoculums are high which leads to infection of the subsequent crop (Boland, at al., 2004). According to (Bentley, 2009) farmers in the developing countries do not access timely and adequate advice on the issues of crop health. A case of Kenya, the extension services that was initially being rendered by the extension staffs to individual small scale holder was reduced by the Government resulting to a gap in the extension innovations (Davis, 2006). As sighted by (Boa, 2007) farmers demand exceed what can be offered by the extension staff in a more reliable and consistence. Plant health clinic is described as form of health care where farmers’ recommendations are based on field diagnosis and available information (Negguse et al.,2011). This initiative by the Global Plant Clinic (GPC) alliance led by CABI has responded to the need of small scale farmer through the introduction on plant health clinic for management of pest and
disease. According to Danielsen and Kelly, (2010) the approach provides a low cost method that enable plant health advisory services to smallholder farmers. Plant clinics have been introduced in other areas such as Africa, Latin America as well as Asia (Boa, (2009); Danielsen and Matisko (2010). In Kenya the approach was introduced in 2010 and in 2011 it began in Embu County with an aim of determining the contribution of the plant health clinic in management of pest and disease for sustainable livelihood.

Specific objectives

- Establish if plant nutrients involvement in the plant health clinic and the crop of interest and the gender
- Establish gender involvement in the plant health clinic and the crop of interest
- Establish the crop health challenges in different Agro-ecological zones of Embu County

Methodology

Plant health clinic was initiated in Embu County in September 2010 with the first clinic set at Embu market (coffee dairy land use system) followed by Kibugu (coffee, tea, dairy land use system) and the third one at Kithimu (Marginal coffee and maize land use system). The personnel that carry out the activity (MOA and KARI) were first trained on the approach. Data collected from different clinic sites cover the period between September 2011-Dec 2012. Depending on the site the plant clinics are run on weekly basis at a specified day, place and time. The sites were chosen in areas convenient for majority of the farmers as they visit the market. The publicity of the clinics dates were done through the chiefs’ barazas. Farmers carries infected plants material or they may identify the problem through the photo sheet provided at the clinic. Visual diagnosis is done and the recommendation done on a prescription by the staffs. Data was collected in a predefined sheet that included the farmers details (Name of the farmer, location, village, sub-location, email/telephone and district) crop type, crop variety, age of the crop, disease description and diagnosis. Issues brought to the clinic and were difficult to identify were referred to the laboratory for further identification and diagnosis and the farmer given the recommendation once the problem is identified.

Data analysis

The data was cleaned truncated into periods from inception of the clinics to the end, coded and analysed using SPSS software version 17.

Results

The results (Table 1) indicated various problems brought to the plant clinic ranging from diseases, insect pest nematodes and plant nutrients. Among the deficiencies realised were Nitrogen and Phosphorous that rated among the highest challenges. Among the food crops *Fusarium wilt* (Panama disease) of banana was a major challenge followed by maize streak virus in maize (MSV). Coffee berry disease in coffee was a major problem in coffee as commercial crop in the region. This was an indication that although farmers continued with their normal farming routine they are faced with varying challenges that required intervention. The cases reported in the three plant clinic site showed phosphorous and nitrogen as most limiting soil elements.

The results in Figure 1 showed differences on disease, insect pest and plant nutrition across the agroecological zones. Zone three represented by Nembure (UM3) had fewer problems as compared to UM1 (Kibugu) and UM2 (Embu market). UM1 uniquely showed the highest deficiency in Nitrogen.

Figures 2 and 3 shows problems affecting banana and maize which are a major food crops in the region. The *Fusarium wilt*, nematodes and banana weevil are the major challenges for bananas. Maize streak virus, stalk bores and Nitrogen deficiency are the major challenges in maize as the food crops.

<p>| Table 1: Diagnosis made in various plant clinics |  |</p>
<table>
<thead>
<tr>
<th>Problems diagnosed</th>
<th>Frequency</th>
<th>Valid (%)</th>
<th>Cumulative (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panama (<em>Fusarium wilt</em>)</td>
<td>131</td>
<td>9.7</td>
<td>31.6</td>
</tr>
<tr>
<td>Coffee berry disease</td>
<td>26</td>
<td>2.2</td>
<td>5.8</td>
</tr>
<tr>
<td>Bacterial wilt</td>
<td>62</td>
<td>5.1</td>
<td>16.7</td>
</tr>
<tr>
<td>Boll worm</td>
<td>26</td>
<td>2.2</td>
<td>18.9</td>
</tr>
<tr>
<td>Maize streak virus</td>
<td>56</td>
<td>4.6</td>
<td>23.5</td>
</tr>
<tr>
<td>Phosphorus deficiency</td>
<td>58</td>
<td>1.9</td>
<td>25.4</td>
</tr>
<tr>
<td>Potassium deficiency</td>
<td>19</td>
<td>1.6</td>
<td>27.0</td>
</tr>
<tr>
<td>Banana weevil</td>
<td>33</td>
<td>2.7</td>
<td>29.7</td>
</tr>
<tr>
<td>Cigar end rot</td>
<td>9</td>
<td>0.7</td>
<td>30.5</td>
</tr>
<tr>
<td>Maize stalk borer</td>
<td>35</td>
<td>2.9</td>
<td>33.4</td>
</tr>
<tr>
<td>Coffee borers</td>
<td>28</td>
<td>2.3</td>
<td>37.7</td>
</tr>
<tr>
<td>White flies</td>
<td>29</td>
<td>2.4</td>
<td>40.1</td>
</tr>
<tr>
<td>Nitrogen deficiency</td>
<td>105</td>
<td>5.8</td>
<td>45.9</td>
</tr>
<tr>
<td>Nematodes</td>
<td>73</td>
<td>6.0</td>
<td>52.0</td>
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<tr>
<td>Thrips</td>
<td>38</td>
<td>3.1</td>
<td>55.1</td>
</tr>
<tr>
<td>Stem borers</td>
<td>37</td>
<td>3.1</td>
<td>58.2</td>
</tr>
<tr>
<td>Leaf rust/minor/spot</td>
<td>43</td>
<td>3.6</td>
<td>61.8</td>
</tr>
<tr>
<td>Powdery mildew</td>
<td>18</td>
<td>1.5</td>
<td>63.2</td>
</tr>
<tr>
<td>Mango Weevils</td>
<td>42</td>
<td>3.5</td>
<td>66.7</td>
</tr>
<tr>
<td>Aphids</td>
<td>69</td>
<td>5.7</td>
<td>72.4</td>
</tr>
<tr>
<td>Borers</td>
<td>17</td>
<td>1.4</td>
<td>73.8</td>
</tr>
<tr>
<td>Smut</td>
<td>11</td>
<td>0.9</td>
<td>74.8</td>
</tr>
<tr>
<td>Others</td>
<td>221</td>
<td>18.3</td>
<td>93.0</td>
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<tr>
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<td>2.9</td>
<td>95.9</td>
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<tr>
<td>missing values</td>
<td>49</td>
<td>4.1</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>1,208</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>

*Figure 1*: Diseases in different sites

*Figure 2*: Problems affecting bananas
Figure 3: Problems affecting maize

Results in Figure 4 indicated higher percentages of the respondents were from Embuce (UM2 (47%). Embuki UM3 with 42% and Nembure with 11%, respectively.

Figure 4: Respondent in different AEZ

Figure 5: Gender and the crops taken to clinic
Results in Figure 5 showed there were more males who visited the plant clinic but associated with specific crops. Bananas, coffee and horticultural crop attracted more males than women. This may be the reason that more males were attracted to these crops being the decision makers in the families.

Discussions

Bananas and coffee are among the income generating crops in the region. However, they are affected *Fusarium wilt* and coffee berry disease respectively. The disease spread across the three agro-ecological of the study area which agree with Ploetz, (2006) that *Fusarium wilt* is an important disease in many parts of the world. This give a challenge to the researchers that more research study should be emphasized. Maize steak virus also cut across all the maize growing areas in the County in the three agro-ecological zones. This agree with what was reported by Thottappilly *et al.* (1993); Bosque-Perez *et al.*, (1998) and Martin *et al.*, (1999) that the disease cause significant yield loss even in Kenya. Kyetere *et al.*, 1999, Alegbejo, *et al*. 2002 have also reported yield loss of 100%. The disease is reported to manifest in wide range of elevation from sea level to 2000 m (Efron *et al.*, 1989).

Most of the respondent were from Embu market clinic (Embuue um 2) which may be attributed by the fact that the town is cosmopolitan town having higher population than the rest of the small town. Embu market also boarders with Kirinyaga County where there are lot of horticultural farming resulting to more farming challenges. Kibugu (Embuki um1) also had higher number of responded which may be due to its vicinity with Kirinyaga in the upper side of Embu. More males visited the plant clinic than females but the crops associated with them are high value crops in terms of income generation. Men having the affinity of decision making on control and asset of the household may have implied their strong attraction of the PHC to acquire skills that can enhance household income. Secondly men are freer to move than women who are tied down with household core.

The high incidence of phosphoruous deficiency in the Kibugu (UM1) may have resulted from the formation of iron and aluminum phosphate minerals that result from the reduced solubility of phosphorous in strongly acidic soil. Phosphorous fixation may also result in acid soils due to continuous cropping without any replenishment as found by Chien *et al.* (1990); Sanchez, (2002). Richard *et al.*, 2013 pointed out that about 80% of the African soils have inadequate amount of phosphorous which is an essential element for crop production. Phosphorus deficiency has also been found to be a production constraints in East Africa as found out by (Zapata *et al.*, 2004; and Onwonga *et al.*, 2008). Phosphorous deficiency could be brought about by low occurrence of p-containing mineral (Nyandat, 1981; Bunemann, 2003).

Nitrogen deficiency was found to be higher in the upper zone (UM1) than in UM 2 and 3. This can be attributed to various acid management practices done by farmers which may have resulted to decline soil organic matter. As reported by Liu *et al.* (2004) that acid soils limits the growth of microbial growth.

Conclusion

Up-scaling of the technologies through plant health clinic approach is an effective innovation which can be adopted for sustainable pest and disease management due to a wide number of challenges diagnosed. Since the approach is demand driven farmers there is need to introduce the same to other Counties. It consumes little since the farmers may combine the task of going to the market as well. Since the plant clinic approach is at the farm level it act as a quick avenue to track any new pest in a region.

Recommendations

From the data colleted at the clinic sites there are incidences where the officers are not able to identify the problem requiring them to take the sample to the laboratory. The labs need to be equipped to receive the referrals. There is also need to have regular training of the officers to keep in pace with the new challenges as well as good collaboration with the chemical manufacturer in order to know the new chemical in the market. A platform can be crated where the stakeholders meet regularly to review the progress and the benefits of the approach. More research is required on the management of the various...
challenges brought to the clinics particularly on food crops like management of *Fusarium* wilt on bananas, maize streak virus in maize. Other crop are arrowroots whose not much of the research is done yet the crop is in demand in the current market.

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