Evaluation of crop protection measures against wild boar (*Sus scrofa*) damage on Chinese potato (*Solonostemon rotundifolius* (Poir) Morton) in Kerala

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ABSTRACT: Crop depredation by wild boar had alarmingly increased in recent years due to their abruptly increased population. A study was carried out from 2013 to 2015 under All-India Network Project on Vertebrate Pest Management (AINP-VPM) at Kerala Agricultural University (KAU) to evaluate the effectiveness of physical barriers and an olfactory repellent (BoRep) against wild boar damage in Chinese potato, *Solonostemon rotundifolius* (Poir) Morton. Among different management measures, olfactory repellent (Bo Rep) and physical barrier with nylon net around the field in a particular fashion were found to be the most effective methods which resulted in nocrop damage and higher yield. The yield varied from 1192.65 kg to 1478 kg/plot in fields protected with olfactory repellent and 1160.43 kg to 1383.17 kg in field protected with physical barrier with nylon net as against 792.28 kg to 1105.5 kg in unprotected field. An increase in tuber yield to the tune of 22.96 to 29.9 per cent and 20.04 to 23.11 percent was observed in plot protected with olfactory repellent and nylon net, respectively over unprotected plot.

Keywords: Wild boar, Chinese potato, management, olfactory repellent, physical barrier

INTRODUCTION

Biotic factors are one of the reasons for the perceptible decline in agricultural production. Among the biotic factors, the threat posed by vertebrate pests to agricultural crops had alarmingly increased in recent years due to many reasons. Reduced habitat, changes in cropping pattern, encroachment of forest areas, lack of predators, decline in the natural forest food are some of the reasons that led to the frightening state of wild animal human conflict. A good number of vertebrate pests representing various tax alike elephants (*Elephas maximus indicus*), wild boars (*Sus scrofa*), peafowl (*Pavo cristatus*), monkeys (*Macaca radiata*), porcupines (*Histrix indica*) are causing economic damage to crops in Kerala (Jaison, 1998). Wild boar is one of the most important vertebrate pests and has attained the status of a major pest in many districts of Kerala. The damage due to wild boar is more prevalent in fields which are close to the forest and nearer to the foraging domain of wild animals (Sinu and Nagarajan, 2015). About 90 per cent of wild boar’s diet include plants and it also feed opportunistically on a large number of animal species. Over 400 species of plants were recorded in the diet of wild boar among which 40 species were crop plants (Chauhan and Rajpurohit, 1993). Wild boar caused damage to agricultural crops to the tune of 36 per cent by directly feeding on plant parts and also by mechanical disturbance to crops (Rao et al., 2015).

As Kerala has a diverse cropping system, wild boar attacks on many crops including rice, coconut, tuber crops, plantain and vegetables. *Coleus, Solonostemon rotundifolius* (Poir) Morton commonly known as Chinese potato is an important minor tuber crop and attaining the status of a high value vegetable which is grown intensively in paddy fields in many parts of Kerala (George, 2008). Though the crop is free from major insect pest and diseases, wild boar is a constrain in successful crop production as it attack the crop during tuber developing stage and feed on tuber. The mechanical disturbance to the crop at the time of tuber formation aggravate damage by preventing tuber setting. Farmers are adopting traditional management measures and do field patrolling during night hours to protect the crop from wild boar.

As wild boar population and their geographical range continues to expand and the threat posed to native flora and fauna is increasing, stringent measures to mitigate the attack on agricultural crops have to be initiated.
Management measures that are socially acceptable, eco friendly, cost effective and legally sound can only be practiced to mitigate the damage caused by wild boar as they are protected under schedule III of Wild life (Protection) Act. 1972. In view of the enormous damage being caused by wild boar, the present study was under taken to evaluate different physical measures and olfactory repellents to mitigate wild boar attack on Chinese potato, one of the important tuber crops grown in Kerala.

MATERIALS AND METHODS

Field experiments were conducted in Keralassery, Palakkad, Kerala from 2013 to 2015. The stem cuttings of Chinese potato var. local of size of 15 cm were planted in the month of June on ridges (60cm/90cm
width) at a spacing of 30 cm. There were five treatments as detailed below with four replications in a randomized block design.

**T1** - Physical barrier with nylon net. The net was tied around the field at four feet (120 cm) height and trailed on the ground up to three feet (90 cm) distance and fixed firmly on the ground with pegs.

**T2** - Physical barrier with nylon rope tied around the crop in two rows with first row at a height of 30 cm above ground level and second row 30 cm above the first row.

**T3** - Physical barrier with GI wire around the crop in two rows as in nylon rope.

**T4** - Olfactory repellent (BoRep) - Fifty gram of the repellent was taken in muslin cloth and tied and hung on the rope at 10-15 cm above ground level crop height at a distance of 2 m around the crop field.

**T5** - Unprotected/untreated plot.

The extent of crop damage by wild boar was recorded at weekly interval from tuber formation stage up to harvesting. Wild boar damage was assessed in terms of area of crop damaged and expressed as percent area damaged. The crop was harvested after five to six months of planting and yield per plot was recorded. The data was subjected to statistical analysis.

### RESULTS AND DISCUSSION

Year wise yield data of Chinese potato revealed that during the year 2013 all the treatments were significantly effective and performed better in reducing the attack of wild boar on the crop compared to control (Table 1). Field protected with physical barriers with nylon net around the crop and olfactory repellent (Bo Rep) were equally effective in preventing the entry of wild boar into the crop field which reflected in higher yield and no damage to crop compared to other treatments. The highest yield of 1435.15 kg was recorded in plot protected with olfactory repellents (Bo Rep) followed by field protected with nylon net around the crop (1382.60 kg) compared to 18.29 percent crop damage and a yield of 1105.50 kg in unprotected plot. The next best treatment was fencing with GI wire which recorded a crop damage of 9.18 percent and yield of 1309.26 kg followed by fencing with nylon rope, however there was no significant differences in yield between them. In plot fenced with nylon rope, crop damage was 12.69 percent and yielded 1251.65 kg as against 18.29 percent damage in unprotected field. The unprotected field recorded lowest

<table>
<thead>
<tr>
<th>Treatment</th>
<th>2013 Area damaged (%)</th>
<th>Mean yield (kg/plot)</th>
<th>Yield increase over control (%)</th>
<th>2014 Area damaged (%)</th>
<th>Mean yield (kg/plot)</th>
<th>Yield increase over control (%)</th>
<th>2015 Area damaged (%)</th>
<th>Mean yield (kg/plot)</th>
<th>Yield increase over control (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>T1-Nylon net around the field</td>
<td>0.00</td>
<td>1382.60</td>
<td>20.04</td>
<td>0.00</td>
<td>1160.43</td>
<td>23.11</td>
<td>0.00</td>
<td>1383.17</td>
<td>21.89</td>
</tr>
<tr>
<td>T2-Nylon rope around the field</td>
<td>12.69</td>
<td>1251.65</td>
<td>11.68</td>
<td>13.24</td>
<td>961.38</td>
<td>7.19</td>
<td>13.72</td>
<td>1183.92</td>
<td>8.74</td>
</tr>
<tr>
<td>T3-G. I. wire around the field</td>
<td>9.18</td>
<td>1309.26</td>
<td>15.56</td>
<td>10.61</td>
<td>1080.21</td>
<td>17.39</td>
<td>15.52</td>
<td>1307.95</td>
<td>17.40</td>
</tr>
<tr>
<td>T4-Olfactory repellent (BoRep)</td>
<td>0.00</td>
<td>1435.15</td>
<td>22.96</td>
<td>0.00</td>
<td>1192.65</td>
<td>25.19</td>
<td>0.00</td>
<td>1478.04</td>
<td>29.90</td>
</tr>
<tr>
<td>T5-Control/Unprotected plot</td>
<td>18.29</td>
<td>1105.50</td>
<td>16.51</td>
<td>892.28</td>
<td>17.74</td>
<td>1080.40</td>
<td>17.82</td>
<td>178.27</td>
<td></td>
</tr>
<tr>
<td>CD (P = 0.05)</td>
<td>2.05</td>
<td>106.57</td>
<td>2.51</td>
<td>240.19</td>
<td>2.15</td>
<td>178.27</td>
<td>8.89</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 1. Effectiveness of different management measures against wild boar on crop damage and yield of Chinese potato (kg/plot) during 2013-2015.
yield of 1105.50 kg due to the frequent intrusion and crop damage by wild boar. The percent increase in yield was highest in plots protected with olfactory repellent (22.96%) followed by nylon net (20.04%), GI wire (15.56%) and nylon rope (11.68%) as compared to unprotected plot (Table 1).

During the year 2014 all the treatments except fencing with nylon rope were significantly superior in reducing wild boar attack compared to unprotected plot (Table 1). Intermittent rain during the tuber formation stage of the crop adversely affected yield of the crop in 2014. The area damaged by wild boar varied from 0 to 16.51 per cent and the highest crop damage was recorded in unprotected plot. The plot protected with olfactory repellent (Bo Rep) and nylon net and were absolutely free from wild boar attack and recorded a yield of 1192.65 kg and 1160.43 kg respectively. It was followed by GI (1080.21 kg) and nylon rope (961.38 kg) as against 792.5 kg in unprotected plot. The percent increase in yield was highest in plot protected with olfactory repellent (29.9%) followed by nylon net (23.11%), GI wire (17.39%) and nylon rope (7.19%) as compared to unprotected plot.

Similar trend in yield and crop damage was observed in 2015 also. All the treatments except fencing with nylon rope were significantly superior over control in terms of higher yield. The field protected with olfactory repellent and fenced with nylon net were completely free from wild boar attack and recorded the highest yield of 1478.04 kg and 1383.17 kg of tubers respectively. It was followed by field protected with GI wire (1307.95 kg), and nylon rope (1183.92 kg). The percent increase in yield was highest in plot protected with olfactory repellent (25.19%) followed by nylon net (21.89%), GI wire (17.4%) and nylon rope (7.19%) as compared to control plots. The highest crop damage was recorded in unprotected plot (17.74) followed by GI wire (15.52), nylon rope (13.72) as against zero damage in fields protected with olfactory repellent and nylon net.

The efficacy of different physical barriers in protecting field crop from wild boar was well documented in many places. Rao et al. (2015) reported effectiveness of physical measures like barbed wire fence around maize crop and increase in yield to the tune of 40 per cent over unprotected control. Fencing with white colored plastic sheet around rubber plantations was a practice followed in Central Kerala to protect the crop from wild boar (Gopakumar et al., 2012). In our study physical barrier of nylon net around the crop offered complete protection against wild boar. When wild boar attempt to enter nylon net protected crop field, it became entangled in the net trailed on the ground. This made the wild boar panic and the distress call by the entangled boar would prevent other wild boars in the group from entering the field. In treatment with other physical barriers like GI wire and nylon rope, when wild boar came in contact with these barriers, the scared boars had moved away from the crop field. Some extent of damage in these plots were due to intrusion of wild boars through the free space available either on the ground level or in between the GI wires or nylon rope.

Strong smelling insecticides, kerosene or waste oil were reported to be effective repellents against wild boar and some small animals like porcupines, black-naped hare and mouse (Veeramani et al., 2004). However, the effectiveness of these remained for few days to one week only. The protection obtained due to olfactory repellent in the present study could be attributed to the offensive odour emanated from the olfactory repellents applied in the field which masked the smell of crop and thereby repelled the wild boar. As sight and hearing is poorly developed in wild boar and host selection is primarily on the basis of odour originating from the food source, olfactory repellent could be the best alternative for wild boar management. The effect of olfactory repellent (BoRep) remained for one month and effectively warded off the animal from crop during tuber formation and maturing stages. Results are in conformity with Rao et al., (2013, 2015) who reported the effectiveness of some traditional measures to repel wild boar with smell and were scientifically evaluated and validated under field conditions.

Chinese potato being a high value vegetable, yield loss even to a marginal level cannot be afforded. Adoption of eco-friendly management measures against wild boar are vital for attaining higher yield. The results of the study concluded that physical barrier of nylon net tying around the crop in a particular fashion and olfactory repellent (Bo Rep) effectively managed wild boar damage and protected Chinese potato resulting in higher yield. Physical barriers like GI wire and nylon rope offered little protection and there was intrusion of wild boar towards the end of the crop season only as against frequent entry in unprotected field. As these measures were cost effective it could be used for avoiding wild boar problem in agricultural crops especially tuber crop cultivation.
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MS Received : 21 August 2017
MS Accepted : 28 November 2017