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Field Evaluation of Some Botanical Extracts against the Pea aphid *Acrythosiphon pisum* (Homoptera: Aphididae) on Field pea *Pisum* *sativum* L

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Abstract

Green pea aphids (*Acrythosiphon pisum*) are among the most important pests challenging Field pea production. Although there are some insecticides, cost and environmental hazard necessitates the development of safe and effective management options. With this intent Aqua's extract of Chilli, Garlic, Ginger and Mexican marigold were evaluated for their insecticidal property. ANOVA for after spray aphid count depicted that there was significant difference ($P < 0.005$) between treatments. The maximum number of aphids/plant (7) was recorded from untreated check while the minimum (0) was from Chilli, Ginger and Mexican marigold treated plots. Similarly, grain yield ANOVA has revealed significant differences ($P < 0.05$) between treatments; the highest grain yield (2511.3kg/ha) and the lowest (1846kg/ha) was obtained from Mexican marigold and chili treated plots, respectively. This result depicted that Mexican marigold was the most effective botanical insecticide against pea aphids. Therefore, foliar sprays of Mexican marigold is recommended at a rate of 4 kg/ha.

Keywords: Field pea; Botanical insecticide; *Acrythosiphon pisum*; aqua's extract, Mexican marigold

1. Introduction

Of Field pea or "dry pea" (*Pisum sativum* L.) is an annual cool-season food legume that grows worldwide [1]. Field pea is the third most important pulse crop after Faba bean and chickpea in Ethiopia in both area coverage and total production [2]. It provides a quality vegetable protein in the diets of Ethiopians and also plays important role in soil fertility restoration and controlling disease epidemics as a suitable rotation and break crop where cereal mono-cropping is predominant in areas like Bale and Arsi highlands, Ethiopia [3]. Currently, the area of production and yield per unit area of field pea in Ethiopia is increasing, in 2009/2010 the area covered with field pea were 226,533 ha and the annual production were about 235,872.10 ton with the average annual productivity of 1.041 t/ha [4]. However, in Ethiopia its productivity far below its potential, this is attributed to several yield limiting factors; the inherent low yielding potential of the indigenous cultivars [5], diseases like powdery mildew (*Erysiphe polygoni*), downy mildew (*Pernospora pisi*) and Ascochyta blight (*Mycosphaerella pinodes*) and green pea aphids (*Acrythosiphon pisum*) are the major constraints [6].

Green pea aphid reduces both weight and caloric content of young pea plants by as much as 64 and 113%, respectively, depending on the number of feeding aphids [7]. Yield losses due to aphids were estimated to about 22-48% in Ethiopia [8] and [9]. Therefore, development of safe management strategies against the pest is crucial. In recent years, interest in using botanicals has gained attention but research on botanical control of insect pests in Ethiopia so far has concentrated on storage pest management and information on their potential against field pests are scanty [10]. Therefore, the information from this and some other similar experiments can serve as baseline information for future studies.

2. Materials and Methods

2.1 Experimental Site Description

The experiment was conducted for two years; 2011/12 and 2012/13 during bona (August-January) cropping season at Sinana Agricultural Research Center (SARC) on-station site. SARC is located at 463 km far from the central city, Finfiine to the southeast. It is situated at 07° 07' N latitude and 40° 10' E longitude with an elevation of 2400 m.a.s.l. and the area

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receives 750-1000 mm mean annual rain fall and have mean annual temperature of 9-21 °C [11].

2.2 Treatments and Design

The experiment was laid out in RCB Design with three replications consisting of six treatments. The plot size was 2m x 1.2m with spacing of 0.2m, 1m and 2m between row, plot and replications, respectively. Four botanicals extract, synthetic insecticide (Ethiothoate@1.5l/ha) as standard check and untreated control were evaluated using local field pea landrace. The treatments were applied when the aphid population was reached Economic Threshold Level viz. 35% plants infested [12]. All other management practices were done as per the agronomic recommendation.

2.3 Botanical Plant Materials and Method of Extraction

The plant materials used in this experiment were fresh fruits of Chillis (*Capsicum annum L.*), fresh bulbs of Garlic (*Allium sativum L.*), fresh rhizomes of Ginger (*Zingiber officinale L.*) and fresh leaves Mexican marigold (*Tagetes minuta L.*). The growth stage of botanicals was varied based the characteristic nature of the plants. Matured chilli, garlic and ginger fruits, bulbs and rhizomes, respectively and fresh leaves of Mexican marigold at flowering stage were used. The botanicals were evaluated at a rate of 2.5 kg/ha, 10 kg/ha, 10 kg/ha and 4 kg/ha of Chilli, Garlic, Ginger and Mexican marigold, respectively based on pungency nature of the botanicals. The botanicals were extracted following the standard procedure for botanicals wet extraction; i.e. 10g of each botanical were ground using mortar and pestle, thoroughly stirred using rotary shaker and

soaked in 100 ml of water for 24 hours [13]. Then, after 24 hours the extracts were sieved using double fold of filter paper and additional water was added to make up the extract 100 ml. Observations was made for parameters aphids/plant (before and after botanicals spray), pods/plant, seeds/pod, tillers/plant, biomass (Kg), Thousand Kernel Weight and grain yield (kg/ha).

2.4 Data Management and Statistical Analysis

Independent variables for field experiment data under different treatments was analyzed using SAS Procedure [14]. The data collected were subjected for analysis using SAS statistical package. To detect the smallest significant difference exist between treatments List Significant Difference (LSD) technique was employed.

3. Results

The botanicals tested were found to be as effective as the standard check (Ethiothoate @1.5 l/ha) as compared to the untreated check. In this study, the aphid populations on the untreated plots were affected by the botanicals sprayed on neighboring plots due to the volatile/repellant property of the botanical materials. As a result, for some parameters ANOVA showed that there were not statistically justifiable difference ($P \geq 0.05$) across treatments. However, for parameters like after spray aphid count, after spray percent aphid infestation and grain yield (Kg/ha) there were statistically significant difference ($P \leq 0.05$) between treatments (Fig. 1, Fig. 2 and Table 1).

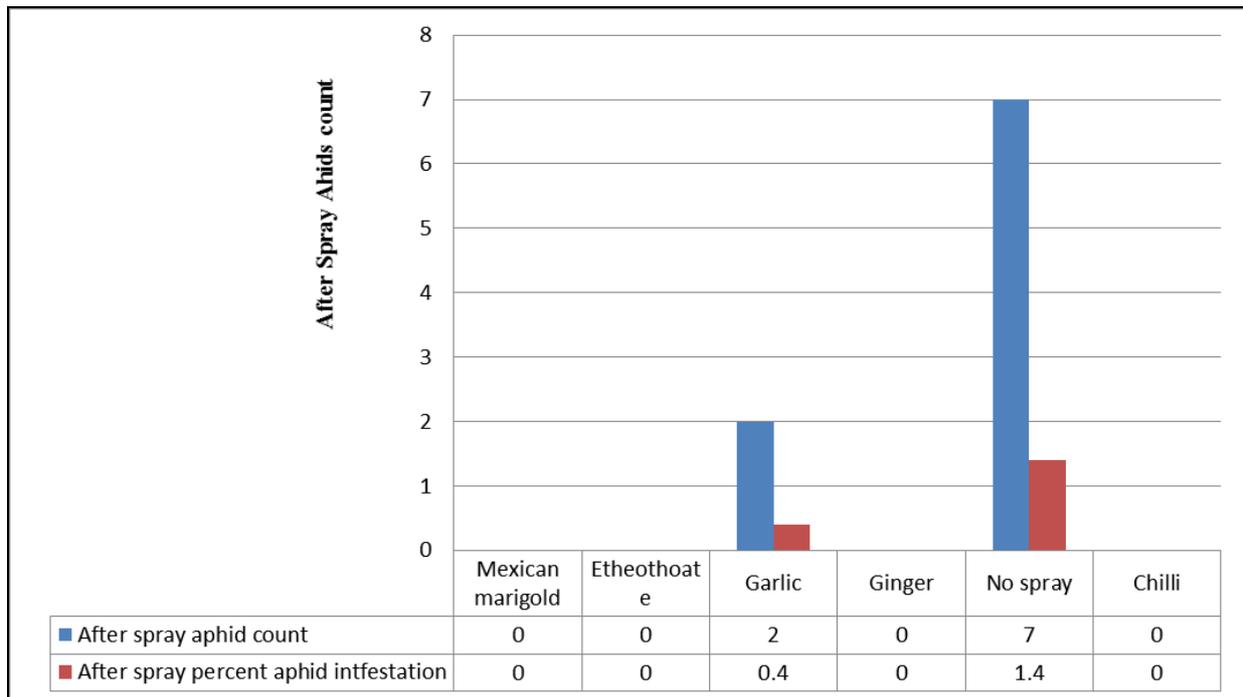


Fig 1: After spray aphid per plant count and percent aphid infestation

The maximum number of aphid per plant after spray (7) was recorded from untreated check which is followed by Garlic sprayed plot (2) and zero (0) aphids per plant were recorded from the rest of the treatments. ANOVA for after spray percent aphid infestation has showed that statistically significant differences ($P \leq 0.05$) were existed between treatments. The maximum percent of aphid infestation (1.4%) after spray was recorded from untreated control and followed by Garlic (0.4%) while the lowest (0%) were recorded from the rest of the

treatments (figure 1 and Table 1). Analysis of variance for grain yield depicted that there was significant difference ($P < 0.05$) between treatments (Table 1). The highest grain yield of 2511.3 kg/ha was harvested from Mexican marigold sprayed plot which is followed by the synthetic insecticide (Ethiothoate @ 1.5 l/ha) sprayed plot (2432.3 kg/ha). Whereas the lowest grain yield of 1846 kg/ha was harvested from chili sprayed plot; this is mainly due to the burning effect of chili on the crop as of its effect on the pea aphid’s population (Table1).

Table 1: Effect of botanical extract on aphid count, percent aphid infestation, yield and yield components of field pea

Treatment	Parameters							
	*Acb	Aib	Aca	Aia	pd/plnt	Sd/pd	TSW	Yield (kg/ha)
Mexican marigold	102.33	20.47	0(0.00)	0(0.00)	25.43	4.3	210.27	2511.30
Etheothoate	101.67	20.33	0(0.00)	0(0.00)	23.94	3.73	204.13	2432.30
Garlic	101.00	20.2	2(1.38)	0.4(0.62)	28.61	3.47	211.40	2379.70
Ginger	101.67	20.33	0(0.00)	0(0.00)	27.86	3.33	201.27	2373.30
No spray	100.67	20.13	7(2.62)	1.4(1.17)	25.24	3.5	206.00	2248.30
Chilli	99.67	19.93	0(0.00)	0(0.00)	22.25	3.57	210.73	1846.00
CV (%)	2	2	32.38	32.38	30.98	20.88	4.47	6.39
LSD _{0.05}	NS	NS	0.39	0.17	NS	NS	NS	261.59

* Figures in the bracket are square root transformed data, Acb-Aphid count before spray, Aib-Aphid infestation before spray, Aca-Aphid count after spray, Aia-Aphid infestation after spray, pd/plnt-pod/plant, sd/pd-seed/pod and TSW-Thousand Seed Weight

4. Discussion

Field pea (*Pisum sativum* L.) is among the majorly produced and consumed highland pulse crops next to Faba bean in the highlands of Bale, Ethiopia. Recently, due to wheat mono-cropping based challenges occurring frequently in the area, farmers are inserting field pea in their cropping system which has increased the production area of the crop; although its production constraints are also increasing prominently. Among which, green pea aphids (*Acyrthosiphon pisum*) are found to be the fore most important pest of this crop. Currently there are some insecticides on the market for the management of this pest. But, due to its high cost, hazard to the environment, less availability in the local markets and some other problems development of easier management method is important. For this matter, aqua's extract of four botanical materials (Chilli, Garlic, Ginger and Mexican marigold) were evaluated for their insecticidal property against this pest. The result showed that the aqua's extracts of each botanical have shown their strong potential to have an insecticidal property against the intended pest. However, in case of Chilli and Ginger, although they have a good insecticidal property, they were found to have burning effect on the crop as well; As a result they cannot be recommended as botanical insecticide. On the other hand, regardless of its strong insecticidal property, it could not be possible to recommend Garlic as botanical insecticide due to its very high market value. Similarly, Mexican marigold was found to have a good insecticidal property through its high killing and repellence activity against the target pest. Unlike other botanicals evaluated, Mexican marigold was found to have no negative effect on the crop, easily accessible as a road side weed without any cost and found to be effective insecticide.

Different studies have conducted across the world regarding the insecticidal property of Botanical materials and their effect on insect pests. Birbira (*Milletia ferrugenia*) was found effective and reported as an effective botanical insecticide [15]. Likewise, [16] reported from their experiment findings that *Tageta minuta*'s crude extract has caused cumulative mortality of Faba bean aphids on the field condition. Similarly, from another experiment it was reported that 10% Birbira suspension caused 90% sweet potato butterfly larval mortality in the field condition [17] and also the leaf and seed extract of Birbira caused mortality on sweet potato butterfly larvae [18]. Several similar studies conducted across the globe have showed the efficacy of botanicals and their result agrees with current result. Different scholars have reported that *Tagetus minuta* have a highly reasonable level of effectiveness against

insect pests [19, 20]. These studies have shown that whole plant extract of *T. minuta* contains active ingredient phototoxin alaphaterthieenyl which have a highly insecticidal activity [21].

5. Conclusion

Out of the four botanical materials evaluated, Mexican marigold (*Tagetus minuta* L.) was found to be the most effective, the cheapest and easily available botanical. As a result it is recommended for use as botanical insecticide either as a potential substitute for synthetic insecticides or it alone can serve as insecticide for the management of green pea aphids on field pea. This botanical is found to be effective and recommended at a rate of 4 kg/ha of fresh leaves as foliar spray of the extract. However, its easy handling and users friendly formulation is the future direction to be considered for easy adoption of Mexican marigold by end users of this output.

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