BIBLIOGRAPHY

DAO-ANES, ANABELLE L. APRIL 2012. Efficacy of Selected Bio-Insecticides for the Control of Insect Pests of Garden Pea.Benguet State University, La Trinidad, Benguet.

Adviser: Eulogio V. Cardona, Jr, Ph.D

ABSTRACT

The study was conducted at the Research Station, Benguet State University, La Trinidad, Benguet from October 2011 to February 2012. The objectives of the research were to determine should the bio-insecticides chili, garlic, yellow ginger, onion, sunflower and piper betley are phytotoxic in garden pea crop and assess its insecticidal activity for the control of aphids and leaf miner. Secondly, to determine the rates of the bio-insecticides effective for the control of insect pests of garden pea and to determine should they have a repellent activity against adult whiteflies.

The efficacy of the bio-insecticides was conducted under field condition using a small plot of 1 square m^2 per treatment while the repellent activity was conducted under greenhouse condition. Prior the extraction, the bio-insecticides were soaked on wine captioned as (A) and vinegar captioned as (B) for at least 10 days to enhance extraction. The ordinary juicer was used for the extraction of the bio-insecticides. The 1.0 liter capacity hand sprayer was used during treatment application. The effects of the bio-insecticides were observed in terms of phytotoxicity on the garden pea crop, its effect on the population of aphids and the degree of leaf miner damage. The repellent activity of the bio-insecticides was likewise determined under greenhouse condition.

This was carried out by treating the potted plants with the bio-insecticides and after which were enclosed with cube shaped mesh cloth and released with cultured adult white fly numbering to 200.

The bio-insecticides chili, garlic, onion and yellow ginger were phytotoxic at the dilution ratio of 1:2 and 1:4 but were none phytotoxic at the dilution ratio of 1:6 and 1:8. Piper betley and sunflower were none-phytotoxic at the dilution ratio of 1:2 until 1:8. None of the bio-insecticide treatments offered excellent control of aphids and the suppression of leaf miner damage. However, among the treatments, the treatment of chili has shown the least count of aphids and leaf miner damage comparable with the standard Selecron.

Bio-insecticides chili and garlic offered excellent repellent activity against adult whiteflies. Both bio-insecticides soaked on wine and vinegar is as equally effective against whiteflies with the dilution ratio of 1:6 and 1:8.

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INTRODUCTION

Garden pea (*Pisumsativum* L.) belongs to the leguminaceae family. It is a semi-temperate crop that requires a cool climate for growth and development. Garden pea is a hardy, annual, and tendril-climbing plant grown mainly for its whole edible pods. The mature seeds contain a high percentage of carbohydrates and important minerals like vitamin A, starch and protein, particularly in developing countries where there is a shortage of livestock and fish products. Garden pea is likewise use in maintaining, conserving the fertility and productivity of the soil. Nodules which contain nitrifying bacteria are produced on the root. These nodules fixes nitrogen abundant and available for vigorous growth of plants, decomposing and releasing fixed phosphate and potassium compounds and increasing the activity of rhizosphere in plants facilitating the absorption of elements required for plant nutrition.

Aphids, whiteflies and leaf miners are some of the damaging insects of garden pea. The common practices of farmers in controlling these insect pests are by the use of insecticides because the effect is quick and readily available in the market. Insecticides are an integral part of the production system. Moreover, the continuous and excessive use of insecticides had led to the development of resistance of the insect pests, rendering the insecticides in effective. Likewise human health is affected due to frequent exposure to high toxicity and residual persistence on consumable crop parts. Improper or indiscriminate use of insecticides had also resulted to environmental hazards such as soil and water pollution.

In response to this alarming problems associated with the excessive use of insecticides in controlling insect pests, a better control must be sought.

The study aims to discover an alternative control that are environment friendly and are non-toxic. One possible alternative is the use of botanical insecticides. Botanical insecticides are safe and do not result in the accumulation of hazardous residues in food commodities.

The objectives of the study were to determine the bio-insecticidal activity of chili, garlic, yellow ginger, onion, sunflower and piper betleyagainst insect pests of garden pea, to identify the rates of the bio-insecticides effective for the control of insect pests of garden pea, to determine should the bio-insecticides are phytotoxic and to determine should they have a repellant activity against adult whiteflies.

The study was conducted at the ResearchStation, Benguet State University, La Trinidad, Benguet from October 2011 to February 2012.

REVIEW OF LITERATURE

Insect Pests of Garden Pea

There are some common pests that affect pea leaves and pea pods and these insects include aphids, whiteflies, cutworms, pod borers, snails and slugs. The major insect pests of garden pea in the Midwest are loppers, alfalfa caterpillars, stink bugs, ground beetles, aphids and whiteflies (Deshpande and Adsulen, 1998).

Insect Pests Nature of Damage

Whitefly (*Bemesiatabacci*Genn.). It is a tiny, snow-white insect pest that resembles a moth. Both adult and nymphs stages feed by sucking plant juices. Heavy feeding by these pests can give plants a mottled dew excreted by these insect glazes both upper and lower leaf surfaces, permitting the development of black sooty mold fungus. Besides being unattractive, sooty mold interferes with photosynthesis, which retards plant growth and often causes leaf drop (Hunter *et al*., 1998).

They suck phloem sap. Large populations can cause leaves to turn yellow, appear dry, or fall off plants. Like aphids, whiteflies excrete honeydew, so leaves maybe sticky or covered with black sooty mold. Feeding by the immature whitefly, can cause plant distortion, discoloration, or silvering of leaves and may cause serious losses in some vegetable crops. Some whiteflies transmit viruses to certain vegetable crops (Bellows *et al*., 2002).

Aphids (*Aphis gosypii* Glover). Aphids have piercing-sucking mouthparts and cause damage by sucking the plant juices. They are commonly found on stems, undersides of leaves and on flower buds in colonies of individuals. However, their ability

to transmit plant virus diseases may be more harmful than any direct feeding damage. Aphids seem to be especially troublesome on plants that are in shaded areas. Their feeding causes the leaves to curl or crinkle and flower buds may become hardened causing the flowers to be distorted. Aphids excrete large amount of honeydew which is a sugary liquid composed of unused plant sap and waste products. This provides an excellent medium for the growth of a black fungus called "sooty mold". Besides being unattractive, sooty mold interferes with photosynthesis and somewhat retards the growth of the plant. Sooty mold usually weathers away following control of the insect infestation (Maurice, 2010).

Description of the Insect Pests

Whitefly (*Bemesiatabacci*Genn.).Borror in 1976 stated that whiteflies are minute insects, rarely over 2 to 3 mm in length, which resemble tiny moths. The adults of both sexes are winged, and the wings are covered with a white dust or a waxy powder. The adults are usually active whitish insects that feed on leaves. The first instars are sessile and look like scales; the scale like covering is a waxy secretion of the insect and has a rather characteristic appearance.

Aphids (*Aphis gosypii* Glover). Aphids are tiny true bugs with piercing-sucking mouthparts designed to suck juices from plants. They are usually wingless and pear-shaped. Aphids vary in color according to species and host plants. They are also known as plant lice in Britain and the Commonwealth as greenflies, black flies or whiteflies. They are small sap sucking insects, and members of the superfamily Aphidoidea. Aphids are among the most destructive insect pests on cultivated plants in temperate regions (Blackman and Eastrop, 1994).

Bio-insecticides

Garlic (*Allium cepa*Linn). Locally known as “bawang”, is the white gold of Ilocos Region. It is one of the most important cash crops in the Philippines especially in the province of Ilocos Norte and Ilocos Sur. Garlic is used for relish in salads and for enhancing the flavor of soups, stews and to some extent, for pickles. The leaves are used for food as vegetables. Edible bulb is composed of several segments called cloves that are rich in sugar and pungent oil from strong flavor and odor come. These are also used for medicinal preparations and sold in powdered or juice forms. It has been used medicinally as a stimulant (Hernandez, 1971).

Onion (*Allium cepa* Linnaeus). Also known as bulb onion, and common onion, is the most widely cultivated species of the genus Allium. It is a bulbous plant cultivated worldwide as a vegetable. The rounded edible of this plant, composed of fleshy, tight, concentric leaf bases having a pungent odor and taste. Onions are pungent because they contain a sulfur-rich volatile oil, peeling or slicing them can bring tears to person’s eyes, they vary in size, shape, color and pungency. Though low standard nutrients, they are valued for their flavor. Onions have claimed to cure colds, earaches, and laryngitis and have been used to treat animal bites, powder burns, and warts; like their close relative garlic (Brewster, 1994).

Yellow Ginger (*Hedychiumgardneranum* Roscoe). It is also called as wild ginger or kopi, is a flowering plant native to India, which is now commonly found in warm environment throughout the world. It is a tropical plant and prefers warm and moist environments, growing best in its rainforests or similar climates. It can grow in full sunlight, but prefers partial to full shade created by a dense foliage canopy. It is a

perennial flower, which blooms during late fall and early winter. Flowers vary from cream to yellow in color, and are very fragrant. The plant has long and waxy, blade-shape leaves of green. At maturity yellow ginger can reach a height of between 6 to 7 feet (Barton, 1999).

Chili (*Capsicum annum* L.). Chili is the fruit of plants from the genus *Capsicum*, members of the nightshade family, *Solanaceae*. Chili originated in the Americas. After the Columbian exchange, many cultivars of chili spread across the world, used in both food and medicine (Wikipedia, 2011).

Sunflower (*Helianthus annus* L.).Sunflower is an annual plant native to the Americas that possesses a large inflorescence (flowering head). The sunflower got its name from its huge, fiery blooms, whose shape and image is often used to depict the sun. It has a rough, hairy stem, broad, coarsely toothed, rough leaves and circular heads of flowers. The head consists of 1,000-2,000 individual bases. Sunflower leaves can be used as cattle feed, while the stems contain a fiber which may be used in paper production. They most commonly grow to heights between 1.5 and 3.5 m (5-12) ft (Wood, 2002).

MATERIALS AND METHODOLOGY

The materials used in the study were garden pea seeds, grab hoe, chicken manure, sticks, sacks, knife, juicer, onion, garlic, yellow ginger, chili, sunflower, piper betel and digital camera.

Methodology

A. Field Efficacy of Bio-Insecticides against Insect Pests of Garden Pea

The host garden pea was raised in the open field at the BSU Research Station. Because of limited space at the research area coupled by the large number of treatments as required by the research, the area allotted per treatment was generally reduced equivalent to 1 square meter with the dimension of 1 meter in width and 1 meter in length. The distances between plants were maintained at 30 cm between rows and 30 cm between hills with a total of 8 plants per plot (Figure 1). Except the application of insecticides, all other agronomic cultural requirements of the plants were provided. Application of the treatments started 3 weeks after seeding when plants were 6 inches in height. The treatments include the extract of several bio-insecticides namely: garlic, chili, onion, yellow ginger, piper betley, sunflower and the standard Selecron (Figure 2). Prior the extraction using a juicer (Figure 3), the bio-insecticides were grouped into 2 with one group soaked in a wine (fermented strawberry)or captioned as (A) while the other on vinegar (fermented sugar) or captioned as (B).

Figure 1.Garden pea plants in the field for the efficacy of the extracts on aphids and leaf-miner

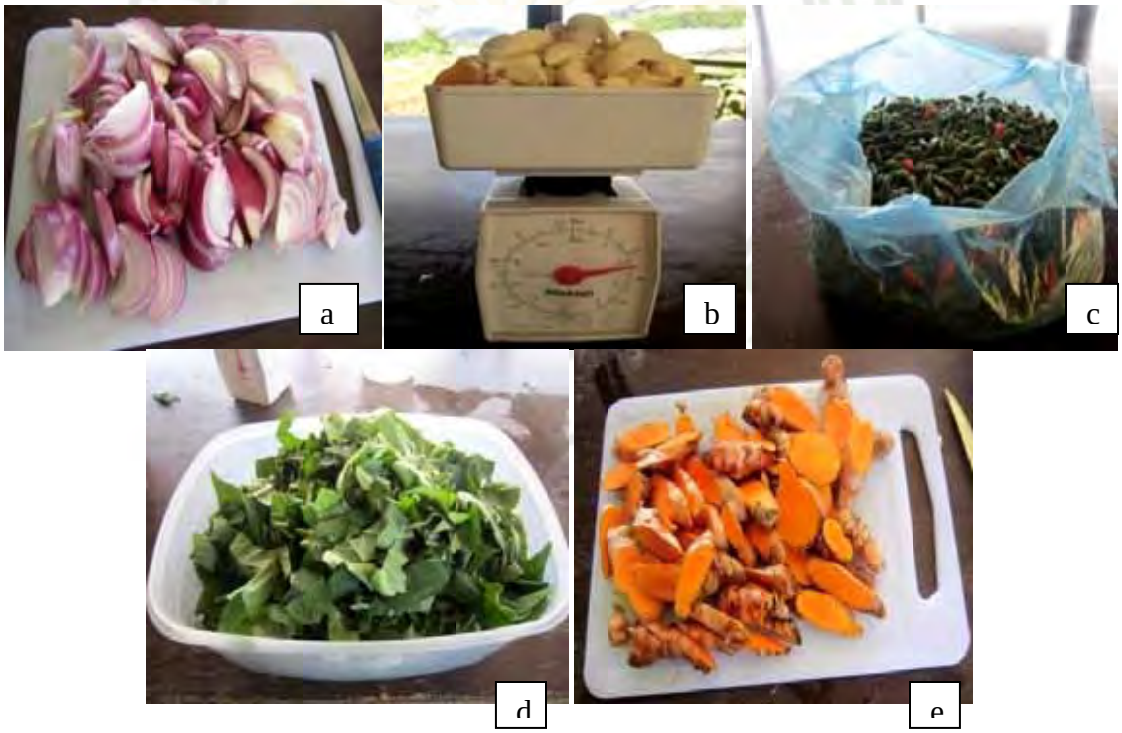

Figure 2. Bio-insecticides a. onion,b. garlic, c. chili, d. sunflower ande. yellow ginger

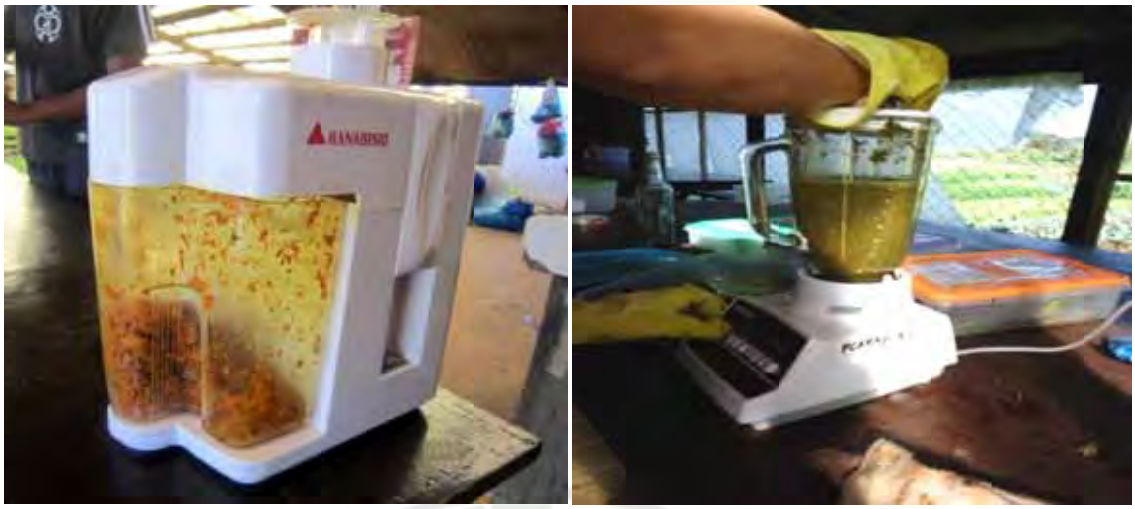

Figure 3. Juicer used for the extraction of bio-insecticides

Figure 4. Spraying of the treatments on garden pea plants in the field

The dilution ratio for the two sets of bio-insecticides was 1:2, 1:4, 1: 6 and 1:8 (Table 1). The phytotoxicity of the treatments was determined using the 1-9 FPA rating scale index at 2 days after the scheduled application of treatments (Figure 5). The details of the phytotoxicity rating scale index were as follows: 1-no crop injury; 3-1 to 10% crop injury; 5-11 to 20% crop injury; 7-21 to 30% crop injury; 9->30% crop injury.

Table 1.Plant extract and dilution ratio

DILUTION RATIO	PLANT EXTRACTS					
	Garlic	Chili	Onion	Sunflower	Yellow Ginger	Piper Betley
1:2	/	/	/	/	/	/
1:4	/	/	/	/	/	/
1:6	/	/	/	/	/	/
1:8	/	/	/	/	/	/

The efficacy of the treatments against aphids was determined through population count by counting them individually using all the 8 plants per replication as the samples. Due to the difficulty of assessing the population of leaf miners since they mine the leaves, as an alternative, the insect damaged was assessed using the 1-9 FPA damage rating scale index. The details of leaf miner feeding damage are as follows: 1- no damage, 3-1-to 25% leaf damage, 5-26 to 50 damage, 7-51 to 70% damage and 9-71 to 100% damage.

B. A Study on the Repellent Activity of Bio-Insecticides against Whitefly of Garden Pea under Greenhouse Condition

The host garden pea plants of the test whitefly were propagated on a 6 inches diameter clay pots inside the open sided greenhouse (Figure 5) at the BSU, La Trinidad, Benguet. In order to come up with vigorous plants ideal for the development of whiteflies, the soil medium used was enriched with nutrient elements by the incorporation of 1/3 compost chicken dung for every 2/3 unit of clay soils. The growing plants were protected from diseases by the weekly application of fungicide Dithane M-50. Insecticides were not applied but in order to prevent plants from possible early

infestation by whiteflies, the potted garden pea plants were enclosed with cube shaped mesh cloth (Figure 5).

Figure 5.Potted garden pea plants enclosed with cube shape mesh cloth

A cube shaped cage made of fine mesh cloth was established and used to enclose the 2 weeks old potted garden pea plants for the trial. The size dimension of the cage was 2 x 2 x 1.5 meters. One potted garden pea plants represented one treatment. Since there were 8 treatments and each is replicated 3 times, the number of garden pea plants enclosed within the cage was 24. There were 2 cages made each to represent the treatments of different extraction procedures captioned as A for the extraction using the wine and captioned B for the extraction using the vinegar.

As the cages were used to enclose the potted garden pea, the said potted garden peas were first treated with the treatments before they were placed inside the cages. The dilution ratio of 1:8 was used being the rate screened effective and non phytotoxicunder field condition. The 1.0 liter capacity atomizer was used in applying the treatments. An

hour after treatment, cultured adult whitefly on potted cabbages was gently placed inside the cages. The garden pea plants stem near the root was cut after placing within the cage. This is to enhance the wilting of the host plants for the whiteflies to leave the plants and have their choices among the treated potted garden pea plants.

One day after treatment of the potted garden pea plants, the number of adult whitefly present on the plants were examined and record their number. The counts of the adult whitefly were done 3 times for 3 successive days after treatment. In addition, phytotoxicity of the treatments by following the 1 to 9 FPA rating scale index was likewise taken, a rating scale index similar with the rating scale done under field condition. This was done 2 days after treatment.

RESULTS AND DISCUSSION

A. Field Efficacy of Bio-Insecticides against Insect Pests of Garden Pea

A.1 Efficacy of Wine Soaked Bio-Insecticides

Efficacy against aphids.The efficacy of bio-insecticides against aphids is presented in data Table 2. None of the treatments of bio-insecticides have offered exceptional control of aphids (Figure 6) even from the dilution ratio of 1:2 and 1:4 which were proven to be phytotoxic. Among the treatments, so far only the treatment of chili in all the dilution ratio of 1:2, 1:4, 1:6 and 1:8 were obvious to have a population of aphids that are numerically lower comparable with the standard Selecron.

Table 2. Population of aphids/ garden pea plant as affected by the application of bio-insecticides

TREATMENT WINE SOAKED BIO-INSECTICIDES	DILUTION RATIO 1:2	1:4	1:6	1:8
T_1-Garlic	34.08^{ab}	38:00^{ab}	37.58^{a}	38.08^{ab}
T_2-Chili	32.58^{b}	36.67^{ab}	37.00^{a}	36.83^{ab}
T_3-Onion	36.17^{ab}	39.17ab	38.17^{a}	41.58^{ab}
T_4-Yellow Ginger	42.25^{a}	36.95^{ab}	37.25^{a}	41.50^{ab}
T_5-Piper Betle	35.33^{ab}	42.50^{a}	40.17^{a}	40.42^{ab}
T_6-Sunflower	39.08^{ab}	40.00^{ab}	42.83^{a}	42.00^{a}
T_7-Selecron	30.50^{b}	31.67^{b}	35.17^{a}	36.08^{ab}
T_8-Untreated	37.50^{ab}	39.25^{ab}	40.83^{a}	39.25^{ab}

Means within each vertical column followed by same letter are not significantly different at 0.05 DMRT

Figure 6. Nymphs and Adult aphids feeding by sucking on the leaves

Efficacy against leaf miner.The efficacy of bio-insecticides against leaf miner is presented in data Table 3. Like the efficacy of the bio-insecticides presented above, none have offered exceptional control of leaf miners(Figure 7)where all the treatments were significantly damaged together with the untreated in all the dilution ratio of 1:2, 1:4, 1:6 and 1:8. On the other hand so far, only the treatment of chili was obvious to be numerically least damaged (1:6 and 1:8 dilution ratio) comparable with the standard Selecron.

Table 3. Degree of leaf miner damage (1-9 rating scale)/ garden pea plant as affected by the application of bio- insecticides

TREATMENT WINE SOAKED BIO-INSECTICIDES	DILUTION RATIO			
	1:2	1:4	1:6	1:8
T_1-Garlic	5.00^{ab}	5.00 ^{a}	4.83^{bc}	5.00^{ab}
T_2-Chili	5.00^{ab}	5.00 ^{a}	4.83^{bc}	4.83^{ab}
T_3-Onion	4.83^{ab}	5.33 ^{a}	5.17^{ab}	5.00^{ab}
T_4-Yellow Ginger	5.17^{ab}	5.50 ^{a}	5.67^{a}	5.17^{ab}
T_5-Piper Betle	4.83^{ab}	4.83 ^{a}	4.50^{c}	4.83^{ab}
T_6-Sunflower	5.00^{ab}	5.50 ^{a}	5.33^{ab}	5.67^{a}
T_7-Selecron	4.50^{b}	4.67 ^{a}	4.33^{c}	4.67^{b}
T_8-Untreated	5.50^{a}	5.33 ^{a}	5.50^{a}	5.67^{a}

Means within each vertical column followed by same letter are not significantly different at 0.05 DMRT. Leaf miner feeding damage: 1- no damage, 3-1-to 25% leaf damage, 5-26 to 50 damage, 7-51 to 70% damage and 9-71 to 100%

Figure 7. Leafminer damage on the garden pea leaves

Phytotoxicity of garlic, chili, onion, yellow ginger, piper betle and sunflower.The data on the phytotoxicity of the bio-insecticides is presented in Table 4. All the bio-insecticides with the dilution ratio of 1:2 and 1:4 namely: garlic, chili, onion, and yellow ginger are phytotoxic. However, the phytotoxicity of the bio-insecticides is gone with the dilution ratio of 1:6 and 1:8. For unknown reason, the bio-insecticides piper betley and sunflower are not phytotoxic. (Figure 8).

Table 4. Degree of phytotoxicity (1-9 rating scale)/ garden pea plant as affected by the application of bio- insecticides

TREATMENT WINE SOAKED BIO-INSECTICIDES	DILUTION RATIO			
	1:2	1:4	1:6	1:8
T_1-Garlic	3.00^{ab}	2.33^{ab}	1.0^{a}	1.0^{a}
T_2-Chili	4.33^{a}	3.00^{a}	1.0^{a}	1.0^{a}
T_3-Onion	1.67^{b}	1.67^{ab}	1.0^{a}	1.0^{a}
T_4-Yellow Ginger	2.33^{ab}	1.67^{ab}	1.0^{a}	1.0^{a}
T_5-Piper Betle	1.00^{b}	1.00^{b}	1.0^{a}	1.0^{a}
T_6-Sunflower	1.00^{b}	1.00^{b}	1.0^{a}	1.0^{a}
T_7-Selecron	1.00^{b}	1.00^{b}	1.0^{a}	1.0^{a}
T_8-Untreated	1.00^{b}	1.00^{b}	1.0^{a}	1.0^{a}

Means followed by a common letter are not significantly different at a 5% level by DMRT

Figure 8.Phytotoxicity effect of the test bio insecticides on garden pea

A.2 Vinegar Soaked Bio-Insecticides

Efficacy of bio-insecticides against aphids.The efficacy of the bio-insecticides against aphids is presented in data Table 5. None of the treatments of bio-insecticides showed exceptional control of aphids. This claim was evidenced by the counts on the treatments that are comparable with the untreated. Among the treatments, so far only the treatment of bio-insecticide onion was obvious to have a numerically lower population of aphids comparable with the standard Selecron.

Table 5. Population of aphids/ garden pea plant as affected by the application of bio-insecticides

TREATMENT VINEGAR SOAKED BIO-INSECTICIDES	DILUTION RATIO			
	1:2	1:4	1:6	1:8
T_1-Garlic	37.08[a]	38.50 [a]	36.42 [a]	41.00 [a]
T_2-Chili	36.33[a]	37.92 [a]	38.08 [a]	40.58 [a]
T_3-Onion	38.00[a]	38.83 [a]	36.00 [a]	37.67 [a]
T_4-Yellow Ginger	36.50[a]	36.00 [a]	36.25 [a]	38.83 [a]
T_5-Piper Betle	38.33[a]	47.17 [a]	39.97 [a]	39.75 [a]
T_6-Sunflower	42.67[a]	41.67 [a]	38.50 [a]	40.25 [a]
T_7-Selecron	35.83[a]	36.00 [a]	35.00 [a]	34.91 [a]
T_8-Untreated	42.33[a]	41.08 [a]	39.92 [a]	41.67 [a]

Means within each vertical column followed by same letter are not significantly different at 0.05 DMRT.

Efficacy against leaf miner.The data on the efficacy of bio-insecticides against leaf miner is presented in Table 6. None of the treatments have shown exceptional control of the insect since the feeding damage was generally comparable with the untreated. Among the treatments, so far the treatment of bio-insecticide chili in all the dilution ratio of 1:2, 1:4, 1:6 and 1:8 was obvious to have a lower feeding damage relatively comparable with the standard Selecron.

Table 6. Degree of leaf miner damage (1-9 rating scale)/ garden pea plant as affected by the application of bio-insecticides

TREATMENT VINEGAR SOAKED BIO-INSECTICIDES	DILUTION RATIO			
	1:2	1:4	1:6	1:8
T_1-Garlic	5.00^{ab}	4.83^{abc}	4.50^{b}	4.50^{c}
T_2-Chili	4.67^{b}	4.67^{bc}	4.83^{ab}	4.67b^{c}
T_3-Onion	5.17^{ab}	5.33^{abc}	5.33^{a}	5.00^{abc}
T_4-Yellow Ginger	5.33^{ab}	5.00^{abc}	4.83^{ab}	4.83^{abc}
T_5-Piper Betle	5.50^{a}	5.00^{abc}	5.50^{a}	5.00^{abc}
T_6-Sunflower	5.17^{ab}	5.50^{ab}	5.50^{a}	5.67^{a}
T_7-Selecron	4.67^{b}	4.50^{c}	4.83^{ab}	5.00^{abc}
T_8-Untreated	5.33^{ab}	5.67^{a}	5.70^{ab}	4.67^{abc}

Means within each vertical column followed by same letter are not significantly different at 0.05 DMRT. Leaf miner feeding damage: 1- no damage, 3-1-to 25% leaf damage, 5-26 to 50 damage, 7-51 to 70% damage and 9-71 to 100% damage

Phytotoxicitygarlic, chili, onion, yellow ginger, piper betle and sunflower. The phytotoxicity effect of bio-insecticides is presented in data Table 7. Like in the above trial, the bio-insecticides namely: garlic, chili, onion, yellow ginger and piper betleyare phytotoxic from the dilution ratio of 1:2 and 1:4. The bio-insecticides are less phytotoxic on the dilution ratio of 1:6 for garlic and chili and all are non phytotoxic on the dilution ratio of 1:8. From the dilution ratio of 1:2 until 1:8, only the bio-insecticide sunflower was non phytotoxic like the standard Selecron.

Table 7. Degree of phytotoxicity (1-9 rating scale)/ garden pea plant as affected by the application of bio-insecticides

TREATMENT VINEGAR SOAKED BIO-INSECTICIDES	DILUTION RATIO 1:2	1:4	1:6	1:8
T_1-Garlic	3.00^{ab}	3.00^{a}	1.67^{a}	1.00^{a}
T_2-Chili	3.67^{a}	3.00^{a}	2.33^{a}	1.00^{a}
T_3-Onion	2.33^{abc}	2.33^{cb}	1.00^{a}	1.00^{a}
T_4-Yellow Ginger	1.67^{bc}	1.67^{abc}	1.00^{a}	1.00^{a}
T_5-Piper Betle	1.67^{c}	1.00^{c}	1.00^{a}	1.00^{a}
T_6-Sunflower	1.00^{c}	1.00^{c}	1.00^{a}	1.00^{a}
T_7-Selecron	1.00^{c}	1.00^{c}	1.00^{a}	1.00^{a}
T_8-Untreated	1.00^{c}	1.00^{c}	1.00^{a}	1.00^{a}

Means within each vertical column followed by same letter are not significantly different at 0.05 DMRT. The details of the phytotoxicity rating scale index are as follows: 1-no crop injury; 3-1 to 10% crop injury; 5-11 to 20% crop injury; 7-21 to 30% crop injury; 9->30% crop injury

B. Repellant Activity of Bio-Insecticides against Whiteflies

The counts of adult whiteflies are presented in data Table 8. It is clear presented the significant difference of the treatments base on the results of the ANOVA. There were 7 bio-insecticides tested but among the treatments it was clearly shown that the treatments of chili and garlic have the lowest counts of adult whiteflies significantly lower than the untreated. These two bio-insecticides were tested with the dilution ration of 1:6 and 1:8 but both of them appear to show excellent repellent activity against adult whiteflies. In between chili and garlic there was no significant repellent activity

difference against adult whiteflies. Synthetic Selecron was used as the basis for comparison yet the treatments of chili and garlic appeared to show a better repellent activity against the insect. The rests of the treatments like onion, yellow ginger, sunflower and piper betley have not shown any sign for a repellent activity against adult whiteflies. This was because the counts of adult whiteflies on the said treatments were extremely high comparable with the untreated. For unknown reason the standard Selecron had not shown any degree of repellent activity against whiteflies.

Table 8. Population of whiteflies/ garden pea plant as affected by the application of bio-insecticides

TREATMENT	WINE (1:8)	WINE (1:6)	VINEGAR (1:8)	VINEGAR (1:6)
T_1-Chili	7.33^{a}	7.00^{a}	10.33^{a}	8.67^{a}
T_2- Garlic	11.33^{ab}	12.67^{ab}	9.67^{a}	9.67^{a}
T_3-Sunflower	26.00^{bc}	38.67^{bc}	33.00^{bc}	23.00^{ab}
T_4- Piper Betle	32.00^{c}	29.67^{ab}	25.33^{abc}	8.67^{b}
T_5- Onion	27.00^{bc}	32.33^{ab}	36.33^{bc}	31.00^{bc}
T_6 Yellow Ginger	27.67^{bc}	37.33^{bc}	37.33^{bc}	34.67^{bc}
T_7- Selecron	15.33^{abc}	20.33^{ab}	15.33^{ab}	21.33^{ab}
T_8- Untreated	52.00^{d}	61.67^{c}	45.33^{c}	47.00^{c}
Fc	7.287^{**}	4.144^{**}	3.888^{*}	5.105^{**}
Sig.	.001	.009	.012	.003

Means with the same letters are not significantly different at 5% by DMRT

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted at the Research Station, Benguet State University, La Trinidad, Benguet from October 2011 to February 2012 purposely to gather information which may serve as guide in determining the efficacy of bio-insecticides like chili, garlic, yellow ginger, onion, and sunflower against aphids and leaf miners and its repellent activity against adult whiteflies.

The efficacy of the bio-insecticides against the insect pests of garden pea plants was conducted under field condition using a small plot of 1 square m^2 per treatment while the repellent activity was conducted under greenhouse condition. The treatments were replicated 3 times and laid out in the field by following the randomized complete block with 3 replications. Prior the extraction, the bio-insecticides chili, garlic, yellow ginger, onion, sunflower and piper betley were first soaked on wine captioned as (A) and vinegar captioned as (B) for at least 10 days. This is to enhance extraction. Each of the bio-insecticides extract was applied with the dilution ratio of 1:2, 1:4, 1:6 and 1:8. The ordinary juicer was used for the extraction of the bio-insecticides. The 1.0 liter capacity hand sprayer was used during treatment application. An important information gathered after treatment was the bio-insecticide phytotoxicity effect, their effect on the population of aphids and the degree of leaf miner damage. The repellent activity of the bio-insecticides was likewise determined under greenhouse condition. This was carried out by treating the potted plants with the bio-insecticides. The treated potted garden pea plants were enclosed with cube shaped mesh cloth and released with cultured adult white fly numbering approximately 200.

The bio-insecticides chili, garlic, onion and yellow ginger were phytotoxic at the dilution ratio of 1:2 and 1:4 but were none phytotoxic at the dilution ratio of 1:6 and 1:8. Piper betley and sunflower were none-phytotoxic at the dilution ratio of 1:2 until 1:8. None of the bio-insecticide treatments offered excellent control of aphids and the suppression of leaf miner damage. However, among the treatments, the treatment of chili has shown the least count of aphids and leaf miner damage comparable with the standard Selecron.

Bio-insecticides chili and garlic offered excellent repellent activity against adult whiteflies. Both bio-insecticides soaked either on wine and vinegar at the dilution ratio of 1:6 and 1:8 are as equally effective against whiteflies.

Conclusions

Sunflower and piper betleysoaked on either wine and vinegar are none phytotoxic on the most concentrated dilution ratio of 1:2.

Chili, garlic, onion and yellow ginger soaked either on wine and vinegar are phytotoxic at the dilution ratio of 1:2, 1:4. The bio-insecticides are not phytotoxic on the dilution ratio of 1:6 and 1:8

None of the bio-insecticides either soaked on wine and vinegar offered excellent control of aphids and in suppressing leaf miners although the bio-insecticide chili offered a control relatively better than any of the bio-insecticides tested.

Chili and garlic soaked either on wine and on vinegar at both dilution ratio of 1:6 and 1:8 offered an excellent repellent activity against adult whitefly better than the standard Selecron.

Recommendation

Garlic and chili are recommended for the control of whiteflies. The rate recommended is the dilution ratio of 1 part extract and 6 parts water and 1 part extract and 8 parts water.

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APPENDICES

Appendix Table 1.Degree of phytotoxicity (1-9 rating scale)/ garden pea plant as affected by the application of bio- insecticides

TREATMENTS (Wine 1:2)	REPLICATION			TOTAL	MEAN
	I	II	III		
T_1-Garlic	3	3	3	9	3.00
T_2-Chili	3	1	5	13	4.33
T_3-Onion	3	1	5	9	3.00
T_4-Yellow Ginger	3	3	1	7	2.33
T_5-Piper Betley	1	1	3	5	1.67
T_6-Sunflower	1	1	1	3	1.00

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN SQUARES	COMPUTED F	Sig.	$t^{.05}$	$t^{.01}$
Treatment	5	20.4444	4.089	3.067^{ns}	.052	3.11	5.06
Error	12	16.000	1.333				
TOTAL	17	36.444					

^{ns}-Not significant

Appendix Table 2.Degree of phytotoxicity (1-9 rating scale)/ garden pea plant as affected by the application of bio- insecticides

TREATMENTS (Wine 1:4)	REPLICATION			TOTAL	MEAN
	I	II	III		
T_1-Garlic	1	3	3	7	2.33
T_2-Chili	3	3	3	9	3.00
T_3-Onion	1	3	1	5	1.67
T_4-Yellow Ginger	3	1	1	5	1.67
T_5-Piper Betley	1	1	1	5	1.00
T_6-Sunflower	1	1	1	3	1.00

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN SQUARES	COMPUTED F	Sig.	$t^{.05}$	$t^{.01}$
Treatment	5	9.111	1.822	2.733 ^{ns}	.071	3.11	5.06
Error	12	8.000	.667				
TOTAL	17	17.111					

^{ns}-Notsignificant

Appendix Table 3.Degree of phytotoxicity (1-9 rating scale)/ garden pea plant as affected by the application of bio- insecticides

TREATMENTS (Wine 1:6)	REPLICATION			TOTAL	MEAN
	I	II	III		
T_1-Garlic	1	1	1	3	1.00
T_2-Chili	1	1	1	3	1.00
T_3-Onion	1	1	1	3	1.00
T_4-Yellow Ginger	1	1	1	3	1.00
T_5-Piper Betley	1	1	1	3	1.00
T_6-Sunflower	1	1	1	3	1.00

Appendix Table 4.Degree of phytotoxicity (1-9 rating scale)/ garden pea plant as affected by the application of bio- insecticides

TREATMENTS (Wine 1:8)	REPLICATION			TOTAL	MEAN
	I	II	III		
T_1-Garlic	1	1	1	3	1.00
T_2-Chili	1	1	1	3	1.00
T_3-Onion	1	1	1	3	1.00
T_4-Yellow Ginger	1	1	1	3	1.00
T_5-Piper Betley	1	1	1	3	1.00
T_6-Sunflower	1	1	1	3	1.00

Appendix Table 5.Population of aphids/ garden pea plant as affected by the application of bio- insecticides

TREATMENTS (Wine 1:2)	REPLICATION			TOTAL	MEAN
	I	II	III		
T_1-Garlic	32	38.5	31.75	102.5	34.08
T_2-Chili	30.5	33	34.25	97.75	32.58
T_3-Onion	39.75	36.25	32.5	108.5	36.17
T_4-Yellow Ginger	40.75	51.75	34.5	126.75	42.25
T_5-Piper Betley	33	38.5	34.5	106	35.33
T_6-Sunflower	39.75	35.75	41.75	117.25	39.08
T_7-Selecron	29.75	31	30.75	91.5	30.5
Untreated	32.25	43.75	36.5	112.5	37.5

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUAREs	MEAN SQUARES	COMPUTED F	Sig.	$t^{.05}$	$t^{.01}$
Treatment	7	290.573	41.510	20.169 ^{ns}	.110	2.66	4.03
Error	16	322.708	20.169				
TOTAL	23	613.281					

^{ns}-Not significant

Appendix Table 6.Population of aphids/ garden pea plant as affected by the application of bio- insecticides

TREATMENTS (Wine 1:4)	REPLICATION			TOTAL	MEAN
	I	II	III		
T_1-Garlic	45.5	35.25	33.25	114	38.00
T_2-Chili	34.25	38.25	37.5	110	36.57
T_3-Onion	34.75	42.75	40	117.5	39.17
T_4-Yellow Ginger	29.11	44	37.75	110.86	36.95
T_5-Piper Betley	41.75	45	40.75	127.5	42.5
T_6-Sunflower	47.75	34.25	38	120	40.00
T_7-Selecron	34.75	32.25	28	95	31.67
Untreated	41.25	39.25	37.25	117.75	39.25

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUAREs	MEAN SQUARES	COMPUTED F	Sig.	$t^{.05}$	$t^{.01}$
Treatment	7	210.459	30.066	1.271^{ns}	.324	2.66	4.03
Error	16	378.558	23.660				
TOTAL	23	589.017					

^{ns}-Not significant

Appendix Table 7.Population of aphids/ garden pea plant as affected by the application of bio- insecticides

TREATMENTS (Wine 1:6)	REPLICATION			TOTAL	MEAN
	I	II	III		
T_1-Garlic	34	38.75	40	112.75	37.58
T_2-Chili	36.5	39.25	35.25	111	37.00
T_3-Onion	33.75	42.25	38.5	114.5	38.17
T_4-Yellow Ginger	37.75	38.75	35.25	117.75	37.25
T_5-Piper Betley	38.5	42.75	39.25	120.5	40.17
T_6-Sunflower	52.25	36.75	39.5	28.5	142.83
T_7-Selecron	34.25	37.25	34	105.5	35.17
Untreated	45.5	38.75	38.25	122.5	40.83

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUAREs	MEAN SQUARES	COMPUTED F	Sig.	$t^{.05}$	$t^{.01}$
Treatment	7	128.250	18.321	1.138^{ns}	.389	2.66	4.03
Error	16	257.625	16.102				
TOTAL	23	385.875					

^{ns}-not significant

Appendix Table 8.Population of aphids/ garden pea plant as affected by the application of bio- insecticides

TREATMENTS (Wine 1:8)	REPLICATION			TOTAL	MEAN
	I	II	III		
T_1-Garlic	40	36.75	37.5	114.25	38.08
T_2-Chili	38	37.5	35	110.5	36.83
T_3-Onion	44.25	41.75	38.75	124.75	41.58
T_4-Yellow Ginger	41.5	42	41	124.5	41.5
T_5-Piper Betley	43.25	41.25	36.75	121.25	40.42
T_6-Sunflower	40	48	30	126	42.00
T_7-Selecron	37	36.75	33.75	107.5	35.83
Untreated	41.5	40.25	44	125.5	41.83

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUAREs	MEAN SQUARES	COMPUTED F	Sig.	$t^{.05}$	$t^{.01}$
Treatment	9	166.033	18.448	1.990^{ns}	.096	2.39	3.46
Error	20	185.417	9.271				
TOTAL	29	351.450					

^{ns}-not significant

Appendix Table 9. Degree of leaf miner damage (1-9 rating scale)/ garden pea plant as affected by the application of bio- insecticides

TREATMENTS (Wine 1:2)	REPLICATION			TOTAL	MEAN
	I	II	III		
T_1-Garlic	5	5	5	15	5.00
T_2-Chili	5	5	5	15	5.00
T_3-Onion	5	5	4.5	14.5	4.83
T_4-Yellow Ginger	5.5	5.5	4.5	15.5	5.17
T_5-Piper Betley	6	4	4.5	14.5	4.83
T_6-Sunflower	4.5	5	5.5	15	5.00
T_7-Selecron	4.5	4.5	4.5	13.5	4.5
Untreated	5.5	5.5	5.5	13.5	5.5

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUAREs	MEAN SQUARES	COMPUTED F	Sig.	$t^{.05}$	$t^{.01}$
Treatment	7	1.740	.249	1.136^{ns}	.389	2.66	4.03
Error	16	3.500	.219				
TOTAL	23	5.240					

^{ns}-Not significant

Appendix Table 10. Degree of leaf miner damage (1-9 rating scale)/ garden pea plant as affected by the application of bio- insecticides

TREATMENTS (Wine 1:4)	REPLICATION			TOTAL	MEAN
	I	II	III		
T_1-Garlic	4.5	5	5.5	15	5.00
T_2-Chili	4.5	5.5	5	15	5.00
T_3-Onion	5.5	5.5	5	16	5.33
T_4-Yellow Ginger	4.5	6.5	5.5	16.5	5.5
T_5-Piper Betley	4.5	5	5	14.5	4.83
T_6-Sunflower	5	6	5.5	16.5	5.5
T_7-Selecron	5	4.5	4.5	14	4.67
Untreated	5	5	6	16	5.33

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUAREs	MEAN SQUARES	COMPUTED F	Sig.	$t^{.05}$	$t^{.01}$
Treatment	7	2.073	.296	1.015^{ns}	.457	2.66	4.03
Error	16	4.667	.292				
TOTAL	23	6.740					

^{ns}-not significant

Appendix Table 11. Degree of leaf miner damage (1-9 rating scale)/ garden pea plant as affected by the application of bio- insecticides

TREATMENTS (Wine 1:6)	REPLICATION			TOTAL	MEAN
	I	II	III		
T_1-Garlic	5	4.5	5	14	4.83
T_2-Chili	4.5	5.5	4.5	14.5	4.83
T_3-Onion	5	5	5.5	15.5	5.17
T_4-Yellow Ginger	5.5	6	5.5	17	5.67
T_5-Piper Betley	4.5	4.5	4.5	13.5	4.5
T_6-Sunflower	5.5	5.5	5	16	5.33
T_7-Selecron	4.5	4.5	4	13	4.33
Untreated	5.5	5.5	5.5	16.5	5.5

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUAREs	MEAN SQUARES	COMPUTED F	Sig.	$t^{.05}$	$t^{.01}$
Treatment	7	4.740	.677	7.222**	.001	.66	4.03
Error	16	1.500					
TOTAL	23	6.240					

** -highly significant

Appendix Table 12. Degree of leaf miner damage (1-9 rating scale)/ garden pea plant as affected by the application of bio- insecticides

TREATMENTS (Wine 1:8)	REPLICATION			TOTAL	MEAN
	I	II	III		
T_1-Garlic	5	5.5	4.5	15	5.00
T_2-Chili	4.5	5.5	4.5	14.5	4.83
T_3-Onion	6	4.5	4.5	15	5.00
T_4-Yellow Ginger	5.5	5	5	15.5	5.17
T_5-Piper Betley	5	4	5.5	14.5	4.83
T_6-Sunflower	6	5.5	5.5	17	5.67
T_7-Selecron	5	4.5	4.5	14	4.67
Untreated	5.5	6	5.5	17	5.67

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUAREs	MEAN SQUARES	COMPUTED F	Sig.	$t^{.05}$	$t^{.01}$
Treatment	9	3.133	.348	1.441^{ns}	.237	2.39	3.46
Error	20	4.833	.242				
TOTAL	29	7.967					

^{ns}-not significant

Appendix Table 13.Degree of phytotoxicity (1-9 rating scale)/ garden pea plant as affected by the application of bio- insecticides

TREATMENTS (Wine 1:2)	REPLICATION			TOTAL	MEAN
	I	II	III		
T_1-Garlic	3	3	3	9	3.00
T_2-Chili	3	5	3	11	3.67
T_3-Onion	1	3	3	7	2.33
T_4-Yellow Ginger	1	3	1	5	1.67
T_5-Piper Betley	3	1	1	5	1.67
T_6-Sunflower	1	1	1	3	1.00
T_7-Selecron	3	1	1	3	1.00
Untreated	1	1	1	3	1.00

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUAREs	MEAN SQUARES	COMPUTED F	Sig.	$t^{.05}$	$t^{.01}$
Treatment	7	1.167	3.024	4.536**	006	2.66	4.03
Error	12	10.667	.667				
TOTAL	23	31.833					

** -highly significant

Appendix Table 14.Degree of phytotoxicity (1-9 rating scale)/ garden pea plant as affected by the application of bio- insecticides

TREATMENTS (Wine 1:4)	REPLICATION			TOTAL	MEAN
	I	II	III		
T_1-Garlic	3	3	3	9	3.00
T_2-Chili	3	3	3	9	3.00
T_3-Onion	3	1	3	7	2.33
T_4-Yellow Ginger	1	1	3	5	1.67
T_5-Piper Betley	1	1	1	3	1.00
T_6-Sunflower	1	1	1	3	1.00
T_7-Selecron	1	1	1	3	1.00
Untreated	1	1	1	3	1.00

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUAREs	MEAN SQUARES	COMPUTED F	Sig.	$t^{.05}$	$t^{.01}$
Treatment	7	17.167	2.453	7.357**	.000	2.66	4.03
Error	16	5.333	.333				
TOTAL	23	22.500					

** -highly significant

Appendix Table 15.Degree of phytotoxicity (1-9 rating scale)/ garden pea plant as affected by the application of bio- insecticides

TREATMENTS (Wine 1:6)	REPLICATION			TOTAL	MEAN
	I	II	III		
T_1-Garlic	1	3	1	5	1.67
T_2-Chili	5	1	1	7	2.33
T_3-Onion	1	1	1	3	1.00
T_4-Yellow Ginger	1	1	1	3	1.00
T_5-Piper Betley	1	1	1	3	1.00
T_6-Sunflower	1	1	1	3	1.00

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUAREs	MEAN SQUARES	COMPUTED F	Sig.	$t^{.05}$	$t^{.01}$
Treatment	7	5.167	.738	.886^{ns}	.539	2.66	4.03
Error	16	13.333	.833				
TOTAL	23	18.500					

^{ns}-notsignificant

Appendix Table 16.Degree of phytotoxicity (1-9 rating scale)/ garden pea plant as affected by the application of bio- insecticides

TREATMENTS (Wine 1:8)	REPLICATION			TOTAL	MEAN
	I	II	III		
T_1-Garlic	1	1	1	3	1.00
T_2-Chili	1	1	1	3	1.00
T_3-Onion	1	1	1	3	1.00
T_4-Yellow Ginger	1	1	1	3	1.00
T_5-Piper Betley	1	1	1	3	1.00
T_6-Sunflower	1	1	1	3	1.00

Appendix Table 17.Population of aphids/ garden pea plant as affected by the application of bio- insecticides

TREATMENTS (Wine 1:2)	REPLICATION			TOTAL	MEAN
	I	II	III		
T_1-Garlic	40.75	37.25	33.25	111.25	37.08
T_2-Chili	39.25	33.5	36.25	109	36.33
T_3-Onion	38	43.5	34	115.5	38.5
T_4-Yellow Ginger	34.5	42.75	32.25	109.5	36.5
T_5-Piper Betley	35.75	38.75	40.5	115	38.33
T_6-Sunflower	45.25	47.25	35.5	128	42.67
T_7-Selecron	36	40	31.5	107.5	35.83
Untreated	40	42.5	44.5	127	42.33

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUAREs	MEAN SQUARES	COMPUTED F	Sig.	$t^{.05}$	$t^{.01}$
Treatment	7	149.622	21.375	1.186^{ns}	.000	2.51	3.71
Error	16	288.250	18.016				
TOTAL	23	437.872					

^{ns}-Not significant

Appendix Table 18.Population of aphids/ garden pea plant as affected by the application of bio- insecticides

TREATMENTS (Wine 1:4)	REPLICATION			TOTAL	MEAN
	I	II	III		
T_1-Garlic	38	42.5	35	115.5	38.5
T_2-Chili	43.75	32.5	37.5	113.75	37.92
T_3-Onion	35.25	39	42.25	116.5	38.83
T_4-Yellow Ginger	33.25	38.5	36	108	36.00
T_5-Piper Betley	37.75	43.5	42.25	123.5	41.17
T_6-Sunflower	44.25	39.25	41.5	125	41.67
T_7-Selecron	35.75	39.25	33	108	36.00
Untreated	42	37	44.25	123.25	41.08

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUAREs	MEAN SQUARES	COMPUTED F	Sig.	$t^{.05}$	$t^{.01}$
Treatment	7	107.997	15.428	1.185^{ns}	.365	2.66	4.03
Error	16	208.375	13.023				
TOTAL	23	316.372					

^{ns}-not significant

Appendix Table 17.Population of aphids/ garden pea plant as affected by the application of bio- insecticides

TREATMENTS (Wine 1:6)	REPLICATION			TOTAL	MEAN
	I	II	III		
T_1-Garlic	35.75	40.5	33	109.25	36.42
T_2-Chili	33.25	38	43	114.25	38.08
T_3-Onion	30.5	35	42.5	108	36.00
T_4-Yellow Ginger	44.25	31.5	33	108.75	36.25
T_5-Piper Betley	40.75	47	31.25	119	39.67
T_6-Sunflower	42.5	31.5	41.50	115.5	38.5
T_7-Selecron	31.5	40	33.5	105	35.00
Untreated	43.25	37.25	39.25	119.75	39.92

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN SQUARES	COMPUTED F	Sig.	$t^{.05}$	$t^{.01}$
Treatment	7	69.323	9.903	$.314^{ns}$	.937	2.66	4.03
Error	16	504.917	31.557				
TOTAL	23	574.240					

^{ns}-not significant

Appendix Table 18.Population of aphids/ garden pea plant as affected by the application of bio- insecticides

TREATMENTS (Wine 1:8)	REPLICATION			TOTAL	MEAN
	I	II	III		
T_1-Garlic	43.5	39	40.5	123	41.00
T_2-Chili	37.75	40	44	121.75	40.58
T_3-Onion	36.5	45.75	30.75	113	37.67
T_4-Yellow Ginger	37.25	43.5	35.75	116.5	38.83
T_5-Piper Betley	40	40.75	38.5	119.25	39.75
T_6-Sunflower	39.25	44.25	37.25	120.75	40.25
T_7-Selecron	38.25	2.5	34	104.75	34.91
Untreated	40.75	45	39.25	125	41.67

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN SQUARES	COMPUTED F	Sig.	$t^{.05}$	$t^{.01}$
Treatment	9	121.008	13.445	$.969^{ns}$	.493	2.39	3.46
Error	20	277.542	13.877				
TOTAL	29	398.550					

^{ns}-not significant

Appendix Table 19. Degree of leaf miner damage (1-9 rating scale)/ garden pea plant as affected by the application of bio- insecticides

TREATMENTS (Wine 1:2)	REPLICATION			TOTAL	MEAN
	I	II	III		
T_1-Garlic	5	5	5	15	5.00
T_2-Chili	4.5	4.5	5	14	4.67
T_3-Onion	4.5	5.5	5.5	15.5	5.17
T_4-Yellow Ginger	5.5	5.5	5	16	5.33
T_5-Piper Betley	5.5	6	5	16.5	5.5
T_6-Sunflower	5	5.5	5	15.5	5.17
T_7-Selecron	4.5	5	4.5	14	4.67
Untreated	5.5	5.5	5	16	5.33

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN SQUARES	COMPUTED F	Sig.	$t^{.05}$	$t^{.01}$
Treatment	7	1.990	.284	2.274^{ns}	.082	2.66	4.03
Error	16	2.000	.125				
TOTAL	23	3.990					

^{ns}-Not significant

Appendix Table 19. Degree of leaf miner damage (1-9 rating scale)/ garden pea plant as affected by the application of bio- insecticides

TREATMENTS (Wine 1:4)	REPLICATION			TOTAL	MEAN
	I	II	III		
T_1-Garlic	4	5	5.5	14.5	4.83
T_2-Chili	4.5	5	4.5	14	4.67
T_3-Onion	5	5.5	5.5	16	5.33
T_4-Yellow Ginger	5	5	5	15	5.00
T_5-Piper Betley	6	4.5	4.5	15	5.00
T_6-Sunflower	5.5	5.5	5.5	16.5	5.5
T_7-Selecron	5.5	6	5.5	17	5.67
Untreated	4.5	4.5	4.5	13.5	4.5

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN SQUARES	COMPUTED F	Sig.	$t^{.05}$	$t^{.01}$
Treatment	7	3.490	.499	2.519^{ns}	.060	2.66	4.03
Error	16	3.167	.198				
TOTAL	23	6.656					

^{ns}-not significant

Appendix Table 21. Degree of leaf miner damage (1-9 rating scale)/ garden pea plant as affected by the application of bio- insecticides

TREATMENTS (Wine 1:6)	REPLICATION			TOTAL	MEAN
	I	II	III		
T_1-Garlic	4.5	4.5	4.5	13.5	4.5
T_2-Chili	4.5	5.0	5.0	14.5	4.83
T_3-Onion	5.5	5.5	5.0	16	5.33
T_4-Yellow Ginger	5	4.5	5	14.5	4.83
T_5-Piper Betley	5.5	5.5	5.5	16.5	5.5
T_6-Sunflower	5	6	5	16.5	5.5
T_7-Selecron	5.5	4.5	4.5	4.5	4.83
Untreated					

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN SQUARES	COMPUTED F	Sig.	$t^{.05}$	$t^{.01}$
Treatment	7	2.458	.351	2.810*	.041	2.66	4.03
Error	16	2.000	.125				
TOTAL	23	4.458					

*- significant

Appendix Table 22. Degree of leaf miner damage (1-9 rating scale)/ garden pea plant as affected by the application of bio- insecticides

TREATMENTS (Wine 1:8)	REPLICATION			TOTAL	MEAN
	I	II	III		
T_1-Garlic	4.5	4.5	4.5	13.5	4.5
T_2-Chili	4.5	5	5	14.5	4.83
T_3-Onion	5.5	4.5	5	16	5.33
T_4-Yellow Ginger	5	4.5	5	14.5	4.83
T_5-Piper Betley	5.5	5.5	5.5	16.5	5.5
T_6-Sunflower	5	6	5	16.5	5.5
T_7-Selecron	5.5	4.5	4.5	14.5	4.83
Untreated	5	5	5.5	15.5	5.17

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN SQUARES	COMPUTED F	Sig.	$t^{.05}$	$t^{.01}$
Treatment	9	4.200	.467	2.000^{ns}	.094	2.39	3.46
Error	20	4.667	.233				
TOTAL	29	8.867					

^{ns}- Not significant

Appendix Table 23.Population of whiteflies/ garden pea plant as affected by the application of bio- insecticides

TREATMENTS (Wine 1:6)	REPLICATION			TOTAL	MEAN
	I	II	III		
T_1-Garlic	21	8	9	38	12.67[a]
T_2-Chili	4	13		21	7.00[a]
T_3-Onion	58	27	12	97	32.33[ab]
T_4-Yellow Ginger	44	40	28	112	37.33[bc]
T_5-Piper Betley	46	22	21	89	29.67[ab]
T_6-Sunflower	52	31	33	116	38.67[bc]
T_7-Selecron	18	25	18	61	20.33[b]
Untreated	91	44	50	185	61.67[c]

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARE	MEAN SQUARES	COMPUTED F	Sig.	$t^{.05}$	$t^{.01}$
Treatment	7	6180.292	882.899	4.144**	.009	.213	.042
Error	16	3408.667					
TOTAL	23	9588.958					

**highly significant

Appendix Table 24.Population of whiteflies/ garden pea plant as affected by the application of bio- insecticides

TREATMENTS (Wine 1:8)	REPLICATION			TOTAL	MEAN
	I	II	III		
T_1-Garlic	14	5	15	34	11.33[ab]
T_2-Chili	5	9	8	22	7.33[a]
T_3-Onion	8	35	38	81	27.00[bc]
T_4-Yellow Ginger	27	27	29	83	27.67[bc]
T_5-Piper Betley	43	27	26	96	32.00[c]
T_6-Sunflower	27	13	38	78	26.00[bc]
T_7-Selecron	15	14	17	46	15.33[abc]
Untreated	62	43	51	156	52.00 [d]

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	COMPUTED F	Sig.
Treatment	7	4146.667	592.381	7.287**	.001
Error	16	1300.667	81.292		
TOTAL	23	5447.333			

**highly significant

Appendix Table 25.Population of whiteflies/ garden pea plant as affected by the application of bio- insecticides

TREATMENTS (Vinegar 1:6)	REPLICATION			TOTAL	MEAN
	I	II	III		
T_1-Garlic	7	12	10	29	9.67[a]
T_2-Chili	12	8	6	26	8.67[a]
T_3-Onion	31	41	21	93	31.00[bc]
T_4-Yellow Ginger	56	18	30	104	34.67[bc]
T_5-Piper Betley	36	22	28	86	28.67[b]
T_6-Sunflower	30	15	24	69	23.00[ab]
T_7-Selecron	12	29	23	64	21.33[ab]
Untreated	80	42	41	141	47.00[c]

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	COMPUTED F	Sig.
Treatment	7	3519.833	502.833	5.105**	.003
Error	16	1576.000	98.500		
TOTAL	23	5095.833			

**highly significant

Appendix Table 26.Population of whiteflies/ garden pea plant as affected by the application of bio- insecticides

TREATMENTS (Vinegar 1:8)	REPLICATION			TOTAL	MEAN
	I	II	III		
T_1-Garlic	9	11	9	29	9.67[a]
T_2-Chili	6	19	6	31	10.33[a]
T_3-Onion	59	36	14	109	36.33[bc]
T_4-Yellow Ginger	48	21	43	112	37.33[bc]
T_5-Piper Betley	24	34	18	76	25.33[abc]
T_6-Sunflower	35	18	46	99	33.00[bc]
T_7-Selecron	16	8	22	46	15.33[c]
Untreated	53	40	43	136	45.33[c]

ANALYSIS OF VARIANCE

SOURCE OF VARIANCE	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	COMPUTED F	Sig.
Treatment	7	3845.167	549.310	3.888*	.012
Error	16	2260.667	141.292		
TOTAL	23	6105.833			

*-significant Sig. <0.05