- BUREAU OF AGRICULTURE AND FISHERIES STANDARDS -
TECHNICAL BULLETIN
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Title	**Terminal Report: Efficacy Testing of Formula One 0.5% Soluble Liquid (SL) against Aphids *(Aphis fabae)*, Thrips *(Megalurothrips usitatus)*, and Beet Armyworm *(Spodoptera exigua)* of Pole Sitao**
Introduction	Pole sitao is an important crop in Asian countries like Malaysia, Thailand, Indonesia and the Philippines. It is also considered one of the most important vegetables in certain parts of Taiwan and China. In the Philippines, pole sitao is the most popularly produced vegetable among edible legumes because the pods, young shoots as well and beans are available throughout the year, and one of the cash crops of most farmers. The succulent young pods only need light cooking. The young leaves, shoots, and sprouted seedlings can also be utilized as vegetables. The Bureau of Agricultural Statistics (2010) showed that the country's total land area planted for pole beans is 14,681 hectares with a total volume of production of 119,453.02 metric tons. Pole sitao is a good source of protein, vitamin A, vitamin C, folate, magnesium, manganese, thiamin, riboflavin, iron, phosphorus, and potassium (FNRI-DOST, 1997). Some medical reviews in 2022 state that pole beans may be low in calories, but they contain important nutrients that provide several health benefits. The legumes are full of antioxidants that fight free radicals in the body. It is full of fiber, which is an important nutrient, and improves the health of the heart by lowering bad cholesterol levels. With the alarming decrease in production from 2004 to 2009, a joint project of Benguet State University (BSU) and the University of the Philippines, Los Banos (UPLB), College of Agriculture, Crop Science Cluster, developed a breeding team to produce varieties of pole snap beans in different locations and elevations. It was indeed a successful project that resulted in slowly increasing production of pole snap beans (BSU, 2019). Infestation of insects is the main problem in growing pole sitao. The foremost is the small creatures (around 1/16" – 1/8") that feed by sucking the sap from plants by aphids. In small numbers, aphids are not a problem, but under favorable circumstances, they can multiply rapidly and create large colonies. In severe cases, they remove so much sap from growing shoots that they become stunted and misshapen. Infested plants have the characteristics such as leaf curling and distortion, leaf yellowing and wilting, honeydew, and black sooty mold. In severe cases, aphids can not only wipe out some of your vegetable plants, but they are very bad at spreading other diseases. The aphids are small, green to black are most prevalent during dry season or summer but sometimes they appear anytime. They do not eat leaves but pierce the leaves and stem, sucking the

	juices from the plants and resulting in yellowing during infestation. Honeydew secreted by aphids could affect the plant, thus this increases and invites ant population (Banks & Macaulay, 1967). Thrips infestation begins in the flowers, and pods become twisted, and deformed with reddish-brown marks and this lowers the quality of the harvest (Duff, et al. 2015). This insect also causes a loss in yield of the crop if not controlled properly. Another insect, which was not the target pest by *Matrine* but found infesting pole beans, is the armyworm. They feed on a wide variety of vegetable crops. They are night-flying moths and the damage to foliage was clearly noticed by feeding on the leaves. This is quite difficult to control directly. Aphids, thrips, and beet armyworms can be controlled by synthetic insecticides, however, the use of these hazardous products is not recommended since the harvests of pods are done every other day. The product, Formula One (0.5% Matrine SL), is a registered product under the Pesticide Administration Regulations of the People's Republic of China. Registration certificate number is LS98579. The product was extracted from a part of a plant named *Sophora flavescens.* It is a bio-insecticide for the control of insect pests. It was tested in some crops in China like crucifers, tea trees, and some horticultural crops. It was reported that the product is of low toxicity by oral and dermal routes and non-irritating to the eye and not a dermal irritant. The product is an organic insecticide for the control of many vegetable pests in China, but not in the Philippines. This study introduced the efficacy of Formula One to fill the gap of biological controls of insects on vegetables. The only limitation is the campaign to other vegetable growers to use bio-control measures for healthy harvest and a safe environment. The use of Formula One in controlling destructive insect pests of pole sitao is of urgent need, specifically, aphids, thrips, and beet armyworms.
Objective	The general objective of efficacy trials was to generate efficacy data of Formula One 0.5 SL to support product registration with DA-BAFS. Specifically, the trials aimed to: 1. determine the efficacy of Formula One 0.5 SL against aphids, thrips, and beet armyworm; and, 2. determine the most effective dose/s of Formula One 0.5 SL against aphids, thrips, and beet armyworm.
Methodology	1. **Efficacy Trial Period and Location** The efficacy trials were conducted in New Visayas, Sto. Tomas, Davao del Norte *(Location 1)*, and South Panabo, Panabo City, Davao del Norte (*Location 2*) from September 2022 to December 2022.

2. **Target Crop and Pests**
   The target crop was pole sitao, a popularly produced vegetable among edible legumes because the pods, young shoots, as well as beans are available throughout the year. The following target pests were as follows:

   a) **Aphids *(Aphis fabae)*** – Black bean aphids are usually visible on plants because of their contrasting color. Aphids feed by sucking plant juices, so infested growth is often yellowed and curled. In addition, aphids can transmit several diseases.
   b) **Thrips *(Megalurothrips usitatus)*** – The most common damage symptom in green beans is found on the pods. Scarring on the pods causes twisting and curling to varying degrees as well as mildly rough patches on the skin. Silvering of the leaf tissue is rarely of economic importance but can indicate the presence of thrips. Adult bean thrips have dark, grayish-black bodies with white wing bands. The legs have light and dark bands and both genders have fringed wings that they fold over their backs when at rest. When bean thrips eggs hatch, first and second instar larvae feed heavily on leaves, growing tips, and immature pulses before they fall to the ground and go through a two-stage population. Winged adults emerge and the cycle starts again.
   c) **Beet Armyworm *(Spodoptera exigua)*** – The beet armyworms are light-green to black larvae with four pairs of abdominal prolegs and a dark head. There are many fine, white wavy lines along the back and a broader stripe along each side. There is usually a distinctive dark spot on each side just above the second pair of true legs. This insect is a widespread agricultural pest that originated in southeast Asia but has since spread globally. Beet armyworm feeding on young tender growth can be very damaging to small transplants. Often a fine webbing is produced by smaller larvae near these feeding sites. Older plants can become rapidly defoliated.

3. **Efficacy Trial Design and Layout**
   There were 10 sampling units per treatment plot in each replicate as shown in Figure 1. The trials were laid out randomly with three replications.

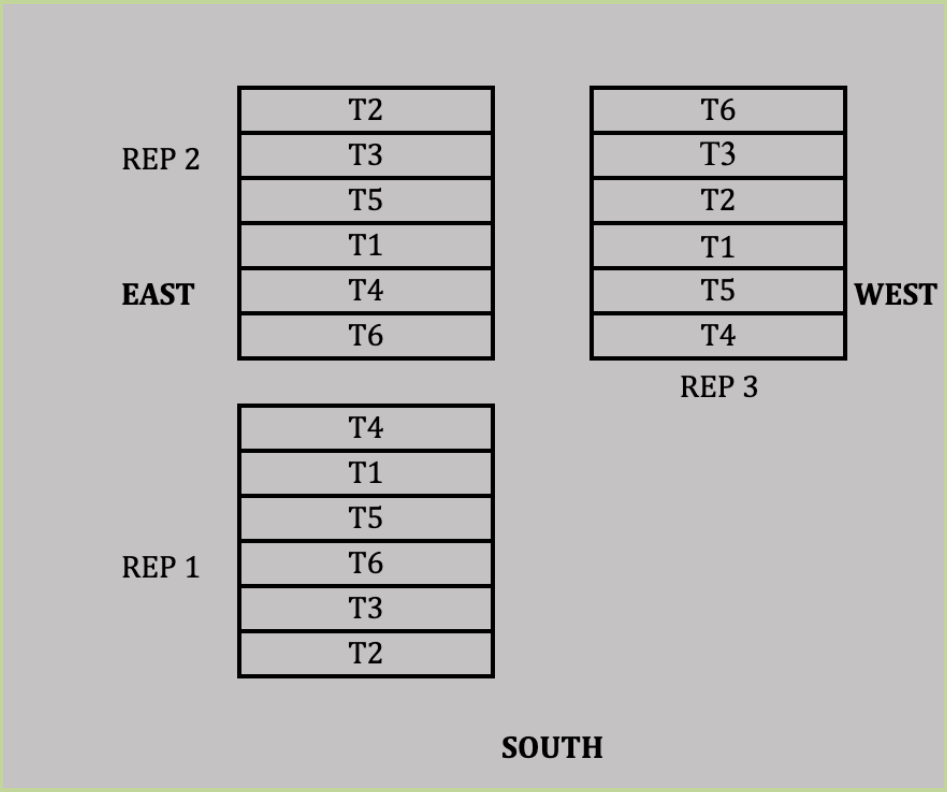

Figure 1. Efficacy Trial Layout, applied to sites 1 and 2.

Plots measured 1m x 10m providing three replicates per treatment with a total of 30sq.m per treatment. In each plot, pole bean seeds were planted at a distance of 30cm per row and 30cm between hills, or a total of 90 hills per row. There were three rows per plot or a total of 270 hills per treatment.

4. **Treatment Protocols**

The dosages and frequency of treatment application are shown in Table 1. The treatment sequences were in chronological order to avoid treatment contamination.

Table 1. Dosages and Frequency

Treatment	Dosages (L/ha)	Frequency
1	Untreated	Every 7 days, from vegetative (15 DAP**) to fruiting stage (62 DAP) 9 cycles
2	0.5	
3	1.0	
4	1.5	
5	2.0	
6	1.0*	

*Note: *Non-organic Insecticide (Bio-optimax)*
***Days after Planting*

5. **Cultural Management Practices**
An area of about 300 sqm was thoroughly prepared and divided into three blocks and treatments were laid out randomly in each block. Plots measure 1m x 10m and each treatment was assigned in three plots where the middle plot was used in periodic data gathering. Two seeds per hill were planted 30cm apart. There was no replanting done because the seeds have almost 90% germination. There were three rows per treatment and the two outer plots served as buffers to avoid drift from other treatments during application. At the fruiting stage of pole beans where growth was more than 150cm in height, black plastic mounted in two bamboo poles was used as a buffer. This was carried by two men and transferred from one place to another.

Initially, chicken manure was incorporated into the plots one week before planting. This was the source of initial nitrogen for the plant for their germination. Ten days after planting, about 30 to 40 grams of 14-14-14 was applied per hill and this was repeated 30 days after. No other fertilization was done. At planting, the soil moisture was enough for the growth of the plant, however, after 15 days, watering of the plant was done, and the rest was rainfed. Excessive moisture was available due to frequent rain and the soil remained wet until the last harvesting of pods. Treatment application, 15 days after planting, the first application of Formula One was done and repeated every seven days until the 9th application was done. No other insecticide was used in the area. Moreover, no fungicide was applied to pole sitao. Harvesting was done every three-day interval.

6. **Sampling**
There were 10 sample plants each treatment per replicate from the inner row where data collection was gathered. Once target pests are detected or observed, percent infestation gathered at three and seven days after each treatment application similar prior to each treatment application.

7. **Analysis of results**
The data gathered were subject to analysis by comparing the difference of mean of treatments against untreated control. The standard percent comparison is set in the PNS/BAFS 182:2016.

Data to be Gathered

A. Aphids

1. **Percent Infestation.** Count and record the number of colonies in the three youngest trifoliate leaves of a stalk of each of 10 randomly tagged sample plants per plot. Efficacy was expressed in terms of the mean number of aphid colonies per plant as well as the percentage aphid infested plants. This was determined using the formula below:

$$\%\ Infestation = \frac{\text{total number of infested plants}}{\text{total number of plant samples}} X100$$

B. Thrips

2. **Percent Infestation** Count and record the number from three selected trifoliate leaves representing the upper, middle, and lower foliage of each of 10 randomly tagged sample plants per plant. The was determined using the formula below:

$$\%\ Infestation = \frac{\text{total number of infested plants}}{\text{total number of plant samples}} X100$$

C. Beet Armyworm

3. **Percent Infestation.** During the conduct of the trials, beet armyworms were destructive causing damage to test crops, including feeding on leaves and leaving holes. The gathering of data was done on foliage infestation.

$$\%\ Infestation = \frac{\text{total number of infested plants}}{\text{total number of plant samples}} X100$$

Results & Discussion

1. **Percent reduction of aphids infestation.** The treatment and its average percent reduction of aphids infestation per site, which passed the standard efficacy set by the Philippine National Standard (PNS) for Organic Bio-Control Agents (PNS/BAFS 182:2016), is the 1.0 L/ha with 51.10% and 59.90% for Sites 1 and 2, respectively.

2. **Percent reduction of thrips infestation.**
   The treatments and average percent reduction of thrips infestation, which passed the standard efficacy set by the PNS/BAFS 182:2016, are shown in Table 2:

Table 2. Percent reduction of thrips infestation

Treatment	Site 1	Site 2
1.5 L/ha	55.82	50.90
2.0 L/ha	52.78	54.60

3. **Percent reduction of beet armyworm infestation.**

The treatments and average percent reduction of beet armyworm infestation, which passed the standard efficacy set by the PNS/BAFS 182:2016, are only for Site 1, as shown in Table 3:

Table 3. Percent reduction of beet armyworm infestation

Treatment	Site 1
0.5 L/ha	57.84
1.0 L/ha	73.35
1.5 L/ha	74.51
2.0 L/ha	76.35

Conclusion and Recommendation

Conclusion and recommendation

The product **Formula One 0.5 SL** was able to meet the percent efficacy standards set by the PNS/BAFS 182:2016 at ≥50 percent, and as required by the Department Circular (DC) 5, Series of 2020 (*Guidelines on the Registration of Organic Bio-Control Agents Producers and Products*), as amended by DC No. 1, Series of 2021, but only against *aphids* and *thrips*. Thus, the product is recommended to apply for product registration in DA-BAFS.

However, for *beet armyworm*, the company shall conduct a retrial of the product for a second location to comply with the requirements set by the PNS/BAFS 182:2016, and DC 5, Series of 2020, as amended by DC No. 1, Series of 2021.

Practical implication

The efficacy results suggest that the product can be used to control the infestation of insect pests of pole sitao with the following dosage as shown in Table 4:

Table 4. Insect pest, dosage, and frequency of application.

Insect Pest	Dosage and Frequency of application
Aphids	1.0 L/ha, 7 days interval
Thrips	1.5 to 2.0 L/ha, 7 days interval

Researchers and Company Profile

SERGIA P. MILAGROSA, PhD
DA-BAFS Certified Researcher
DA Special Order No. 065 series 2022

ENASIA IMPORT EXPORT CORPORATION
Unit 907, #321 Dasmarinas St. Binondo, Manila

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Annex

-Photo Documentation

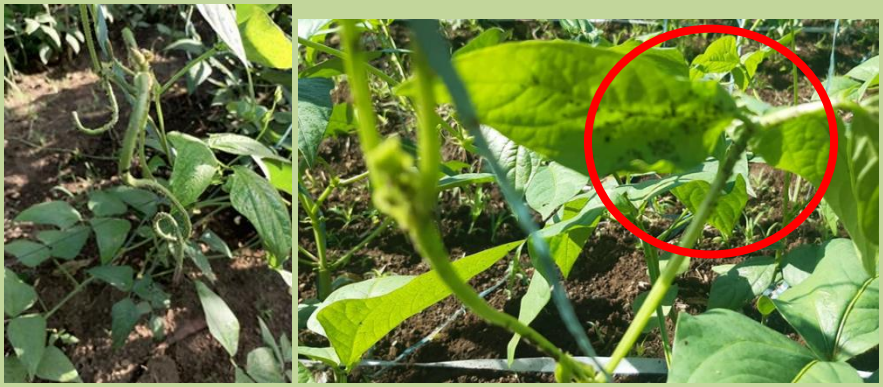

Figure 2. Aphid infestation

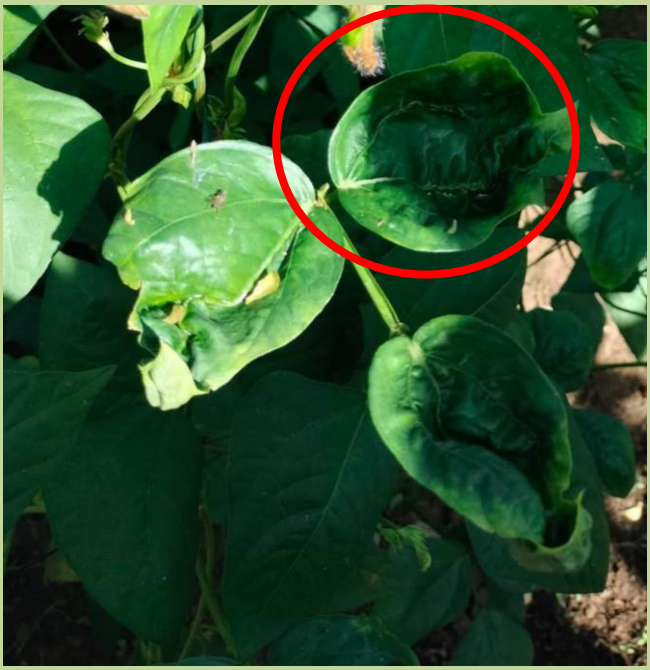

Figure 3. Thrips infestation

Figure 4. Beet Armyworm infestation