BIBLIOGRAPHY

COMPALAS, MARILOU ANTONIO. MAY 2011. Effect of Cooking Oils-Egg Yolk Formulation Against Bean Rust *(Uromycesappendiculatus)* of Bokod Bush Bean (*Phaseolus vulgaris).*Benguet State University, La Trinidad, Benguet.

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ABSTRACT

Different cooking oils-egg yolk formulation, joy dishwashing liquid and fungicide were evaluated from January 2011 to March 2011 to determine if they can reduce rust severity of snap beans, and their effects on yield.

Results showed that on the number of days from planting to flowering, application of the different treatment did not significantly affect the flower production of bean plants. On the other hand plants sprayed with the fungicide kumulus were the earliest to form flowers while the latest were the untreated plants. The same observation was noted on the number of days from flowering to pod formation and no significant differenceswas noted.

The application of kumulus and the different cooking oils-egg yolk formulation, joy dishwashing liquid slightly reduced rust infection while the untreated gave the highest,66 days after planting.

In terms of total yield, plants sprayed with kumulus produced the highest yield of 0.37 tons/ha while the lowest total yield of 0.28 tons/ha was produced from the untreated plants.

In the marketable pods there was no significant differences observed. The highest marketable yield was obtained from plants sprayed with kumulus while the untreated gave the lowest marketable pods. The same observation was noted in the non-marketable pods.

INTRODUCTION

Legumes are used to improve soil fertility through nitrogen fixation and are valuable components of many crop rotation and cropping system. In addition, incorporation of leguminous cover crops into the soil changes the microflora balance in the rhizosphere resulting in the control of specific pathogens (Dickson, 1956). It also improves the physical state and balance of chemical nutrients in the soil. Snap beans are widely cultivated and grow best in areas with temperatures between 15 to 21^0C and can tolerate temperatures up to 25^0C (Kudan, 1991). According to Ferrer (1981) snap bean is grown in Benguet, Mountain Province and Ifugao. It is also cultivated in Urdaneta, Pangasinan. The expected yield of pole snap beans under highland condition particularly in Benguet ranges from 17 to 23 tons/ha.

Snap bean scientifically known as *Phaseolus vulgaris* is one of the vegetable legumes grown in many parts of the Cordillera Region. It is not only grown for its economic value but also for its nutrients as it is a good source of proteins, vitamins and others that are important for human health (Celoy, 1999). According to Gonzales (1983) it partly contributes to the solution of the malnutrition problem because the protein content of snap bean is almost comparable to meat, fish and egg .Aside from protein, beans also provide Vitamins A and B, calcium, phosphorus, iron, fat, carbohydrates and other nutrients.

Legumes have the potential to utilize atmospheric nitrogen through symbiotic relationship with certain soil bacteria. The bacteria reduce atmospheric nitrogen to ammonia (NH_3) by sugars and other compounds produced by their legume hosts as a source of energy. The amount of nitrogen (N_2) fixed by legume association is highly variable, depending on the legume, cultivar, bacteria species and strain, and growing conditions, especially the pH and soil.

One of the constraints in legume production in the Philippines is the occurrence of bean rust (*Uromyces appendiculatus*). It is a serious leaf disease severe infection of rust of string bean, snap bean, mung bean and soybean which result to leaf drop and reduction of pod quality (PCARRD, 1975).

The fungi causing the disease belong to *Uridenales*. It is an obligate parasite and colonizes the host cheaply by intercellular mycelium with intercellular *haustoria*. The uredospore is developed late in the season. The optimum temperature for uredospore germination ranges from 16 to 24 degrees Celsius (Butler and Jones, 1961).

Fungicides which are presently used to control the disease are not only very expensive but also harmful to human's health and the environment. Reduction of fungicide use is necessary and they can be attained by employing alternative measures such as use of microbial agent and other safer methods like the use of cooking oil. Management of disease through biological agent makes use of an approach wherein the life cycle of the pathogens is considered in order to manipulate them to the host advantage (Mukerji and Garg, 1988).

The trends in disease management now a days are operated towards biological control which recognizes less health hazards and environmental pollution. With the use of plant extracts and other forms such as cooking oil, it is hoped that problem about the disease will be significantly reduced. It will also reduce fungicide spray application.

The use of cooking oil if found effective will result to production of bean pods free of fungicide. It will also help reduce the expenses of farm growers on inputs particularly on fungicides, and lessen the water and air contamination.

Oils pose few risks to people or to most desirable species, including beneficial natural enemies of insect pests. This allows oils to integrate well with biological controls. Toxicity is minimal, at least compared to alternative pesticides, and oils quickly dissipate through evaporation, leaving little residue. Oils also are easy to apply with existing spray.

The study aims to determine if cooking oil mixtures can reduce rust severity of snap beans.

This study was conducted at the Balili Expirement Farm, Benguet State University, La Trinidad, Benguet from January 2011 to March 2011.

REVIEW OF LITERATURE

The Host

Snap beans (*Phaseolus vulgaris*) belong to the family Leguminoceae. It is dwarf or climbing plant. The leaflets that are ovate usually are compost of 3- pointed leaflets with smooth boarders. The flowers are flat ended to sub-cylindrical upright or curved. They may be white, yellow, bluish and purple. The inflorescence usually develops a long period of time. The seeds are varied in size, shape and the color may be white, puff, pink, red, blue, black depending in varietal growth (Perez, 1983).

Bean Rust

It was observed that during the early vegetative stage, the bean plants are resistant to the attack of rust. However, as the plant matures, the leaves become more susceptible to rust. The application of fertilizer with high nitrogen content makes the plant more susceptible to rust (Cabilatazan, 1980).

According to Ware (1975), snap bean varieties in the United States and the commonly grown varieties in the Philippines are susceptible to rust. The disease as reported by PCARRD (1975) occurs during rainy season and cool nights. The first symptoms that appear are small white speck on the underside of the leaves and on the pods are tiny, almost white spot. Within few days, the spot break open into the rust colored pustules, about pinhead in size. The rust develops somewhat late in the season and is concentrated on the leaves. A seriously infected bean field looks as though it has been burned. This disease can decrease the yield and may lead to total failure when left uncontrolled as cited by (Pocyoy, 1980).

Management Measures of Bean Rust

Biological Control

According to Baker et.al 1958 the inhibitory effect of the isolate *Bacillus subtilis* (APPL-1) on the development of rust pustules of bean rust, provided more than 95% reduction in the subsequent number of rust pustules when it was applied as liquid culture to plants in the glass house two to 120 hours before inoculation with urediniospore. Microscopic observation of *B. subtilis* treated leaves showed that urediniospore germination was greatly reduced and no normal urediniospores were produced. Some urediniospore developed abnormal cytoplasmic protusions. According to Mukerji (1988) application per week of *B. subtilis* reduced rust severity by 75% in 1982 and 1983 with three applications per week. In some trials, bacterial treatment was more effective than the weekly Mancozeb application.

Vallez (2002) in his experiment entitled Management of Bean Rust Using Animal Manure Extracts showed that rabbit manure extract, swine manure extract, cow manure extract, chicken manure extract and goat manure extract significantly reduced the rust infection on snap beans plant applied with swine manure extract gave a yield of 7.76 tons/ha.

Cultural Control

Uichanco (1959) suggested that burning of infected bean leaves just after harvesting to destroy the rust and other leaf inhibiting fungi that cause the disease. Plowing under the remnants of green beans after harvest and crop rotation have also been claimed to control rust effectively. Another is by planting the beans apart to avoid crowding, a condition that favors growth of the fungus (Leonard and Martin, 1970)

Chokyogen (1996) suggested that the most logical solution then is to develop resistant varieties. This can be by evaluating snap bean varieties for possible resistance.

There has been considerable interest in the past few years in identifying the mechanisms by which bacterial and fungal antagonist suppress fungal plant pathogens. In the search for mechanisms of biological control, is not a simple process mediated by a single microbial metabolite. The capacity of an organism, to simply produce a fungicidal compound in and itself is not always sufficient to explain biological control activity, particularly antibiotics, siderophore and enzymes (Nelson, 1990).

Use of Cooking Oil in Pest Management

Various oils have been used for centuries to control insect and mite pests. Oils remain an important tool to manage certain pest problems (e.g., scales, aphids, mites) on fruit trees, shade trees and woody ornamental plants. Several recently developed oils extend this usefulness to flowers, vegetables and other herbaceous plants. Oils also can control some plant diseases, such as powdery mildew. Oils used to protect plants have been called by many names, but perhaps horticultural oils best describes them. Oils have different effects on pest insects. The most important is that they block the air holes (spiracles) through which insects breathe, causing them to die from asphyxiation. In some cases, oils also may act as poisons, interacting with the fatty acids of the insect and interfering with normal metabolism. Oils also may disrupt how an insect feeds, a feature that is particularly important in the transmission of some plant viruses by aphids.

Oils also are easy to apply with existing spray equipment and can be mixed with many other pesticides to extend their performance. The main limitation of spray oils is their small but real potential to cause plant injury (phytotoxicity) in some situations.

The primary reason oils were developed was because of their effectiveness on otherwise hard-to-control pest problems on fruit trees. They were used as a dormant-season application (before bud swelling and bud break) to kill mites and insects, such as scales and aphids, that spent the winter on the plant. Dormant oil applications also control certain overwintered shade tree pests. Recently, improvements in refining have produced oils with increased safety to plants and thus expanded their potential use. Summer or foliar treatments are now possible for a variety of pests during the growing season. Oils also can be mixed with other insecticides, providing a broader spectrum and greater persistence of control. Spider mites, whiteflies and young stages of scales are common pests that can be controlled by oils during the growing season. Oils are sometimes applied to prevent transmission of viruses. Many viruses spread by aphids (nonpersistent viruses), as well as some that are mechanically transmitted by people, can be inhibited by oil applications. Oils used to inhibit virus transmission are sometimes called "stylet oils," a reference to the piercing and sucking mouthparts (stylets) of aphids that transmit these viruses .Oils also are useful against powdery mildew. Diluted horticultural oils, often mixed with a small amount of baking soda, can be an effective control for this common plant disease. The neem oil products have been effective against several types of powdery mildew and rust (Baxendale, J.S and Cranshaw, R.V 2010).

Chemical Control

Several fungicides have been suggested for an effective control of bean rust. Deanon and Knott (1996) stated that the disease is controlled effectively by application of sulfur sprays such as Kolo-100 or color carbonate applied at 7-10 days interval and continued as long as the plants need protection.

Tarr (1972) stated that 1, 4 oxathions, a systemic fungicide, is particularly effective against basidiomycetes rust and smuts. Plantvax, the sulphose derivative of vitavax, shows some promise against wheat rust. Seed or soil application can give control of *Puccinia striformis* for one month after sowing. Mebenil is active against a wide range of basidiomycetes including certain rusts, smuts *Exobassidium vexans* and Rhizoctonia. The amount of 2.5 to 2.7 kg/ha is used to control rust.

Marsh (1977) stated that the application of systemic fungicides to seeds can result in some protection of the cotyledons and first leaves of some vegetables from attack of airborne fungi. Demonstration showed that the infection of the unifoliate and trifoliate leaves of beans by *Uromyces phaseoli* was largely prevented by dusting the seeds with carboxin or oxicarboxin.

According to Pocyoy (1980) in her experiment entitled Curative Control of Bean Rust Using EL 222 and EL 288 Naurimol showed that all the fungicides used with their respective rate were effective against bean rust.

Infection reading varied greatly between treated plants and untreated plants. This implies that the untreated plants were continually infected while the treated plants protected with fungicides had reduced infection.

Although the fungicides gave varying control, the best result was obtained from EL 228 and EL 222.The treated plants had low foliage infection indices and no incidence of tip burns.

MATERIALS AND METHODS

Field Preparation

An area of 90 sq.m was thoroughly prepared and was divided into three blocks. Each block composed of 6 plots with a dimension of 1 x 5m. The experiment utilized the Randomize Complete Block Design (RCBD) with three replicates. The experiment set-up has the following treatments and are presented below.

Treatments (Cooking oils)	Rate of Application
T_0-Control	_
T_1-Kumulus	5 g kumulus + four liters water
T_2-Joy dishwashing liquid	7.5 ml joy + four liters water
T_3-Canola Oil	35.50 ml of yolk mixture and oil + four liters water
T_4-Sunflower Oil	35.50 ml of yolk mixture and oil + four liters water
T_5 –Olive Oil	35.50 ml of yolk mixture and oil + four liters water

Sowing of Seeds

This was done by planting two seeds per hill in a double row plot having a distance 30 cm between hills and rows. After sowing, watering and weeding was done as the need arises. Figure 1 shows the experimental set-up 52 days after planting.

Figure 1. Experimental set-up at Balili Experiment Station 52 days after planting

Preparation of Oil Mixture and Application

Preparation of spray solution of cooking oil and yolk (COY) mixture was done by mixing 60 ml of oil with one egg yolk plus one hundred ml of sterile distilled water and then mixed thoroughly using vortex mixer. An amount of 35.50 ml mixture was mixed with four liter water then sprayed with bean plants with rust. The spray interval was seven days. The control plants will not be treated with any.

Data Gathered

1. Number of days from planting to appearance of flower and pods. This was taken by counting the number of days from sowing until the plants started to develop flowers and pods.

2. Weekly rust severity. This was done through weekly rating with 15 sample plant in each treatment. All plants were for using identification. The arbitrary rating scale of rating rust severity by Pocyoy 1980 was used.

Rating Scale	Description
1	No rust pustules
2	1 to 10% rust pustules per leaf
3	11 to 25% of leaf area covered with rust pustules
4	26 to 50% of leaf area covered with rust pustules
5	51 to 100% of leaf area covered with rust pustules

3. Final disease severity. This was recorded before the last harvest. There were 15 sample plants rated in each treatment.

4. Crop yield (tons/ha)

a. Marketable pods. Pods are free from diseases and insect damage.

b. Non-marketable pods. Pods that are not fitted for market (pods damage by insects and pathogen)

RESULTS AND DISCUSSION

Number of Days from Planting to Flowering

The application of the different treatments did not significantly affect the flower production of bean plants as shown in Table 1. It took 35 days for the plants sprayed with kumulus to flower and 36 days for plants sprayed with the different cooking oils. Flowers appeared after 38 and 37 days in the untreated plants and those sprayed with joy dishwashing liquid.

Number of Days from Flowering to Pod Formation

There was no significant difference obtained on the number of days from flowering to pod formation (Table 1). Plants applied with fungicide were the earliest to

Table 1. Number of days from planting to flowering and pod setting of Bokod bush bean variety

TREATMENT	DAYS FROM PLANTING TO	
	FLOWERING	POD SETTING
Control	38[a]	8[a]
Kumulus	35[a]	5[a]
Dishwashing liquid	37[a]	7[a]
Canola oil	36[a]	6[a]
Sunflower oil	36[a]	6[a]
Olive oil	36[a]	6[a]
CV (%)	39.48%	29.19%

Means with common letters are not significantly different at 5% level DMRT.

form pods five days after flowering and six days by plants applied with different cooking oils. Those applied with joy dishwashing liquid form their pods after seven days while plants in the control were the latest to form pods after eight days.

Weekly Rust Severity Rating

Initial rust rating on bean leaves recorded before the first spray application was slight as shown in Table 2. However, those plants in the control had higher rust severity infection.

The rating obtained after the first spray application of different oils and the kumulus varied significantly but higher infection (2.40) was noted on the control plants. Rust infection in all the treatments slightly increased.

Table 2. Average of rust severity of Bokod bush bean variety for six weeks

TREATMENT	MEAN RUST SEVERITY					
	30DAP	38DAP	45DAP	52DAP	59DAP	66DAP
Untreated	173[a]	2.40[a]	2.45[a]	3.62[a]	4.33[a]	4.56[a]
Kumulus	1.42[b]	2.18[b]	2.40[a]	2.93[b]	4.11[b]	4.36[b]
Joy dishwashing liquid	1.42[b]	2.18[b]	2.38[a]	3.27[ab]	4.11[b]	4.38[b]
Canola oil	1.40[b]	2.25[b]	2.53[a]	3.20[ab]	4.13[b]	4.42[b]
Sunflower oil	1.42[b]	2.13[b]	2.44[a]	3.18[ab]	4.20[ab]	4.42[b]
Olive oil	1.42[b]	2.17[b]	2.38[a]	3.31[ab]	4.11[b]	4.44[ab]
CV (%)	1.42	2.96%	6.84%	8.22%	2.13%	1.42%

Means with common letters are significantly different at 5% level DMRT

On the third week, plants sprayed with dishwashing liquid and olive oil gave the lowest rust infection with means of 2.38, while the control showed the highest mean rust of 2.45. Further observation shows rust infection slightly increased in the other treatments.

On the fourth week, rust infection continued to increase on the different treatments but with varying severity. The lowest mean rust severity was incurred in plants sprayed with the kumulus having a severity of 2.93 and differed significantly with the other treatments. During the fifth rating, still the control had the highest rust severity of 4.33 while plants sprayed with the kumulus, joy dishwashing liquid and olive oil had the lowest severity rating of 4.11 followed by those sprayed with canola and sunflower oils with a rust severity of 4.13 and 4.20.

Finally, during the final rating, Table 2 shows that the application of canola oil and sunflower oil to manage rust of bush bean was similar. Plants sprayed with kumulus had the lowest rust rating of 4.36 followed by plants sprayed with joy dishwashing liquid with mean rust severity of 4.38, olive oil and canola oil with rust rating of 4.42 compared to the control which is 4.56 (Figure 2).

According to Grossman (1990), oils are considered as one of the oldest natural pesticides as documented by a Roman scholar in the 1st century. This is probably the reason why bean plants sprayed with oils have lower rust infection as seen in the lower rating.

Statistical analysis showed a significant difference of rust severity in plants sprayed with different oils, dishwashing liquid and fungicide.

Untreated

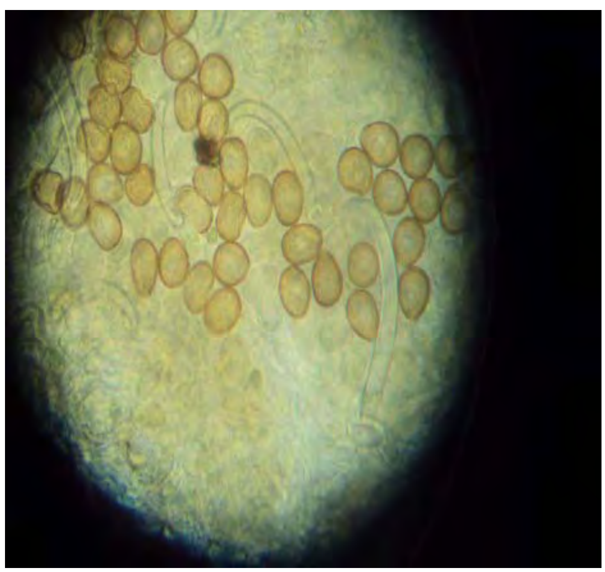
Fungicide(Kumulus)

Joy dishwashing liquid

Canola oil

Sunflower oil

Olive oil



Uredospores(40x) from rusted beans

Figure 2. Rust pustules of Bokod bush bean from different treatments

Total Yield

Yield obtained from plants sprayed with different oils and fungicide kumulus produce similar yield. Numerically, plants sprayed with kumulus gave a yield of 0.37 tons/ha followed by 0.36, 0.33 and 0.30 from plants applied with olive oil, canola oil and sunflower oil. The lowest yield of 0.29 and0.28 tons/ha was obtained from plants sprayed with joy dishwashing liquid and that of the control.

Table 3. Average weight of total yield marketable and non-marketable pods

TREATMENT	TOTALYIELD (tons/ha)	MARKETABLE PODS (tons/ha)	NON-MARKETABLE PODS (tons/ha)
Control	0.28[a]	0.21[a]	0.09[a]
Kumulus	0.37[a]	0.33[a]	0.04[a]
Dishwashing liquid (joy)	0.29[a]	0.23[a]	0.07[a]
Canola oil	0.33[a]	0.27[a]	0.05[a]
Sunflower oil	0.30 [a]	0.25[a]	0.06[a]
Olive oil	0.36 [a]	0.27[a]	0.05[a]
CV (%)	108.58%	29.19%	39.48%

Means with common letters are not significantly different at 5% level DMRT.

Marketable Pods

Significant difference was observed on the marketable pods of bush bean plant. The highest marketable pods with a mean of 0.33 tons/ha was obtained from those plants sprayed with kumulus while the lowest mean marketable pods of 0.21 tons/ha was recorded from plants in the control.

Non-marketable Pods

Few non-marketable pods were recorded. The highest mean non-marketable pods was 0.09 tons/ha and came from the control plants while the lowest non-marketable pods was recorded from plants sprayed with the fungicide kumulus with a mean of 0.04 tons/ha. This was followed by plants sprayed with canola oil and sunflower oil with a mean of 0.05 tons/ha.

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

This study was conducted at Balili, La Trinidad, Benguet from January to March 2011 to determine if cooking oil mixture can reduce rust severity of snap bean.

Plant sprayed with the fungicide, different cooking oils and dishwashing liquid showed lower rust severity compared to the untreated.

In terms of total yield plants sprayed with fungicide produced the highest yield of 0.37 tons/ha. This was followed by the plants sprayed with olive and canola oils. The lowest total yield of 0.28 tons/ha was came from the plants in the control.

In the marketable pods, there was no significant difference observed. However the highest was obtained from plants sprayed with kumulus, while the control showed the lowest marketable pods. The same observation was noted in the non-marketable pods.

Conclusion

Based on the results of the study, fungicide is the most effective to suppress rust infection that resulted to better yield performance than the control.

The effect of cooking oil spray against rust started to show up 59 days transplanting that lasted up to 66 days.

Recommendation

Cooking oils can be used to minimize rust disease rather than using fungicide for organically grown beans especially for small scale production.

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APPENDICES

Appendix Table 1. Number of days from planting to flowering

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
Control	38	38	38	114	38.00
Kumulus (Fungicide)	35	35	35	105	35.00
Joy dishwashing liquid	37	37	37	111	37.00
Canola oil	36	36	36	108	36.00
Sunflower oil	36	36	36	108	36.00
Olive oil	36	36	36	108	36.00
TOTAL	218	218	218	654	36.33

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARE	COMPUTED F	TABULAR F 0.05	0.01
Treatment	5	0	0	0^{ns}	3.33	5.64
Block	2	16	320			
Errot	10	0	0			
TOTAL	17					

^{ns} - Not significant

Coefficient of Variation = 108.58%

Appendix Table 2. Number of days from flowering to pod setting

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
Control	8	8	8	24	8
Kumulus (Fungicide)	5	5	5	15	5
Joy dishwashing liquid	7	7	7	21	7
Canola oil	6	6	6	18	6
Sunflower oil	6	6	6	18	6
Olive oil	6	6	6	18	6
TOTAL	38	38	38	114	6.33

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARE	COMPUTED F	TABULAR F 0.05	0.01
Treatment	5	0	0	0^{ns}	3.33	5.64
Block	2	16	320			
Errot	10	0	0			
TOTAL	17					

*- Not significant Coefficient of Variation = 29.19%

Appendix Table 3. Disease severity (initial rating before the first spray application)

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
Control	1.67	1.73	1.80	5.20	1.73
Kumulus (Fungicide)	1.47	1.27	1.53	4.27	1.42
Joy dishwashing liquid	1.53	1.40	1.33	4.26	1.42
Canola oil	1.40	1.47	1.33	4.20	1.40
Sunflower oil	1.33	1.53	1.40	4.26	1.42
Olive oil	1.27	1.40	1.60	4.27	1.42
TOTAL	8.67	8.80	1.89	26.46	1.40

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARE	COMPUTED F	TABULAR F	
					0.05	0.01
Treatment	5	0.2508	0.0502	3.50*	3.33	5.64
Block	2	0.0086	0.0043			
Errot	10	0.1432	0.0143			
TOTAL	17	0.4026				

* - Significant

Coefficient of Variation = 8.14%

Appendix Table 4. Disease severity (second rating)

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
Control	2.40	2.53	2.27	7.20	2.40
Kumulus (Fungicide)	2.20	2.13	2.20	6.53	2.18
Joy dishwashing liquid	2.13	2.27	2.13	6.53	2.18
Canola oil	2.27	2.27	2.20	6.74	2.25
Sunflower oil	2.20	2.13	2.07	6.40	2.13
Olive oil	2.23	2.20	2.07	6.50	2.17
TOTAL	13.43	13.63	12.94	39.90	2.17

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARE	COMPUTED F	TABULAR F 0.05	0.01
Treatment	5	0	0.0283	6.56**	3.33	5.64
Block	2	16	0.0166			
Errot	10	0	0.0043			
TOTAL	17	0.2178				

** - Highly significant

Coefficient of Variation = 2.96%

Appendix Table 5. Disease severity (third rating)

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
Control	2.47	2.07	2.80	7.34	2.45
Kumulus (Fungicide)	2.27	2.40	2.53	7.20	2.40
Joy dishwashing liquid	2.33	2.47	2.33	7.13	2.38
Canola oil	2.40	2.53	2.67	7.60	2.53
Sunflower oil	2.40	2.53	2.40	7.33	2.44
Olive oil	2.33	2.33	2.47	7.13	2.38
TOTAL	14.20	143	15.20	14.73	2.43

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN OF SQUARE	COMPUTED F	TABULAR F 0.05	0.01
Treatment	5	0.0532	0.0106	0.38^{ns}	3.33	5.64
Block	2	0.0985	0.0423			
Errot	10	0.2764	0.0276			
TOTAL	17	0.4281				

^{ns} - Not significant

Coefficient of Variation = 6.84%

Appendix Table 6. Disease severity (fourth rating)

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
Control	3.47	3.73	3.67	10.87	3.62
Kumulus (Fungicide)	3.33	3.13	3.07	9.53	3.18
Joy dishwashing liquid	3.33	3.20	3.27	9.80	3.27
Canola oil	3.20	3.13	3.27	9.60	3.20
Sunflower oil	2.27	3.33	3.20	8.80	2.93
Olive oil	3.40	3.20	9.93	9.93	3.31
TOTAL	19.00	19.85	19.68	50.53	3.25

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F 0.05	0.01
Treatment	5	0.7542	0.1508	2.11^{ns}	3.33	5.64
Block	2	0.0674	0.0337			
Errot	10	0.7140	0.0714			
TOTAL	17	1.5337				

^{ns} - Not significant

Coefficient of Variation = 8.22%

Appendix Table 7. Disease severity (fifth rating)

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
Control	4.27	4.40	4.33	13.00	4.33
Kumulus (Fungicide)	4.07	4.07	4.20	12.34	4.11
Joy dishwashing liquid	4.13	4.13	4.07	12.33	4.11
Canola oil	4.00	4.20	4.20	12.40	4.13
Sunflower oil	4.20	4.27	4.13	12.60	4.20
Olive oil	4.07	4.00	4.27	12.34	4.11
TOTAL	24.74	25.07	25.20	75.01	4.17

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F 0.05	0.01
Treatment	5	0.1167	0.0233	2.90^{ns}	3.33	5.64
Block	2	0.0187	0.0094			
Errot	10	0.0791	0.0079			
TOTAL	17	0.2146				

^{ns} - Not significant

Coefficient of Variation = 2.13%

Appendix Table 8. Disease severity (sixth rating)

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
Control	4.47	4.67	4.53	13.67	4.56
Kumulus (Fungicide)	4.40	4.40	4.27	13.07	4.36
Joy dishwashing liquid	4.33	4.47	4.33	13.13	4.38
Canola oil	4.40	4.40	4.47	13.27	4.42
Sunflower oil	4.47	4.40	4.33	13.27	4.42
Olive oil	4.47	4.40	4.40	13.33	4.42
TOTAL	26.54	2.88	26.33	78.74	4.33

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F 0.05	0.01
Treatment	5	0.0739	0.0148	3.73^{ns}	3.33	5.64
Block	2	0.0257	0.0128			
Errot	10	0.00393	0.0039			
TOTAL	17	0.1389				

^{ns} - Not significant

Coefficient of Variation = 108.58%

Appendix Table 9. Total yield (tons/ha)

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
Control	0.13	0.40	0.32	0.85	0.28
Kumulus (Fungicide)	0.28	0.27	0.55	0.10	0.37
Joy dishwashing liquid	0.29	0.26	0.32	0.87	0.29
Canola oil	0.36	0.28	0.34	0.98	0.33
Sunflower oil	0.33	0.30	0.27	0.90	0.30
Olive oil	0.36	0.29	0.43	1.08	0.36
TOTAL	1.75	1.80	2.23	4.78	0.32

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F	
					0.05	0.01
Treatment	5	0.383	0.192	0.8699^{ns}	3.33	5.64
Block	2	1.153	0.231			
Errot	10	2.203	0.220			
TOTAL	17	3.739				

^{ns} - Not significant

Coefficient of Variation = 108.58%

Appendix Table 10. Marketable pods (tons/ha)

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
Control	0.23	0.16	0.25	0.64	0.21
Kumulus (Fungicide)	0.26	0.24	0.49	0.99	0.33
Joy dishwashing liquid	0.11	0.32	0.26	0.69	0.23
Canola oil	0.29	0.23	0.30	0.82	0.27
Sunflower oil	0.26	0.25	0.23	0.74	0.25
Olive oil	0.30	0.20	0.31	0.81	0.27
TOTAL	1.45	1.40	1.84	4.69	0.26

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F 0.05	TABULAR F 0.01
Treatment	5	0.019	0.010	1.6718^{ns}	3.33	5.64
Block	2	0.025	0.005			
Errot	10	0.058	0.006			
TOTAL	17	0.102				

^{ns} - Not significant

Coefficient of Variation = 29.19%

Appendix Table 11. Non-marketable pods (tons/ha)

TREATMENT	REPLICATION			TOTAL	MEAN
	I	II	III		
Control	0.07	0.09	0.12	0.28	0.09
Kumulus (Fungicide)	0.02	0.03	0.06	0.11	0.04
Joy dishwashing liquid	0.06	0.10	0.06	0.22	0.07
Canola oil	0.07	0.05	0.04	0.16	0.05
Sunflower oil	0.08	0.05	0.04	0.17	0.06
Olive oil	0.02	0.08	0.06	0.16	0.05
TOTAL	0.32	0.50	0.38	1.10	0.06

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	COMPUTED F	TABULAR F	
					0.05	0.01
Treatment	5	0.001	0.000	0.4962^{ns}	3.33	5.64
Block	2	0.006	0.001			
Errot	10	0.006	0.001			
TOTAL	17	0.012				

^{ns} - Not significant

Coefficient of Variation = 39.48%

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