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ORAS, CAROLYN DANIWES. MAY 2011. Evaluation of Plant Extracts against *Cercospora* Leaf Spot (*Cercospora longissima*) on Lettuce. Ambiong Riverside, La Trinidad Benguet.

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ABSTRACT

The study was conducted at the Ambiong, Riverside La Trinidad Benguet from March to May 2011. The study aimed to determine the efficacy of botanical fungicides against *Cercospora* leaf spot of Iceberg lettuce.

Leaf spot symptoms on the Iceberg lettuce cultivar appeared as small yellowish spots with brown to black dots in the center. Larger spot form from the merging of adjacent small spots.

Results of the study showed that the plant extracts used in this experiment did not suppress *Cercospora* leaf spot infection on lettuce. The plants treated with plant extracts as botanical fungicides had infection of *Cercospora* leaf spot higher than the infection of untreated plants.

INTRODUCTION

Lettuce *(Lactuca sativa)* is a native to the Mediterranean Region, where it has been cultivated for several millennia. It probably spread into the rest of Europe during the Roman occupation. When it was introduced into the America's in the 15th Century, lettuce become popular in the new world and now the major salad crop and become important in most countries. Lettuce is unique among the major vegetables in that it is used almost exclusively as a fresh raw product. This can be grown as a field crop or else under the protection of glass or plastic (Snowdon, 1992).

Lettuce is a temperate annual or biennial plant of the daisy family Asteraceae or Compositae. It is most often grown as a leaf vegetable. In many countries, it is typically eaten cold, raw, in salads, sandwiches, hamburgers, tacos and in many other dishes. In some places, including china, lettuce is typically eaten cooked and use of the stem is as important as use of the leaf. It has a short stem initially, but when it gradually blooms, the stem and branches lengthens and produces many flower heads that look like those of dandelions, but smaller. This is referred to as bolting. When grown for food, lettuce is harvested before it bolts (Berg, 1998).

Lettuce is usually grown commonly in semi-temperate regions like Benguet. It can be planted anytime of the year, provided that there is abundant supply of water. It is best however to plant from September to February when climate is relatively cool (Knott and Deanon, 1967).

Lettuce growers in Benguet often observe and complain about destructive diseases of lettuce. These diseases inflict leaf spots that lead to economic losses due to low quality of the harvest or no harvest if severely infected.

As cited by Snowdon (1992) lettuce is a fast income generating agricultural produce, however, pests and disease and improper postharvest handing contributes to the great losses of

income to producers. It is a highly perishable crop that can be damaged easily due to disease infections and adverse environmental conditions. Being a high value commercial crop, losses through pathogen infections should be minimized. Moreover, Fry (1982) mentioned that more than 40% of the produced is considered as loss due to over trimming, color changes and nutrition depletion. Climate is known to be capable of causing large reduction in yield by directly affecting the plants as well as favorably enhancing pathogens, insect and weed attacks.

Leaf spot of lettuce is one of the major diseases that often limit or reduce the production of lettuce. Due to leaf spot infection, cleaning of outer wrapper leaves may be intense resulting to reduction of weight, size and exposure of pale green inner leaves. Further, marketability would also be reduced. Using non-chemical alternative control strategies against leaf spot of lettuce is in direly important for the reason that lettuce is a salad crop. Since, potent fungicides used against lettuce leaf spot and other pesticides for other pests would not be neutralize, because lettuce as salad crop is not subjected to cooking.

Discovery of non-chemical products against leaf spot that is indigenous in the locality or those that are available from other source but could that be adopted and propagated within the locality could serve as a ready source of botanical fungicides against leaf spot. The positive result of the study would conform to the trend of current farming that is organic agriculture.

The study was conducted to evaluate the efficacy of selected plant extracts against *Cercospora longissima*.

The experiment was conducted at Ambiong, Riverside La Trinidad Benguet from March to May 2011.

REVIEW OF LITERATURE

Nature of *Cercospora* Leaf Spot

Cercospora spot (*Cercospora longissima*). *Cercospora* spot of lettuce is found predominantly in tropical countries. The spots appear as minute water soaked brown spots, each surrounded by a pale halo and appearing initially on the outer leaves of lettuce. The lesions may enlarge into irregular brown areas bounded by the leaf veins and coalesce to form large blotches. In a humid atmosphere there is a grayish to buff growth of mould giving rise to spores (conidia). This disease may also spread to younger leaves (Snowdon, 1992). Likewise Groenewald (2006) describe *Cercospora* leaf spot to initially present itself as tiny circular or oval spots on plant leaves that enlarge with time. The spots can vary in color from dark green to brown with or without maroon or purple margins. In later stages of the disease on the leaves or flowers may become yellow and fall off the stems, and leaves on edible crops may become brownish-gray color as they dry out and die completely.

Development of *Cercospora* leaf spot disease begins when the fungus spores are dispersed by rain irrigation water and wind. Germination occurs in humid conditions, usually during late spring and summer, and fungus growth is encouraged by frequently damp leaves. Plants that measure in the fall may escape acute infection. In general, the more rain, the worse the disease spreads. *Cercospora* infests seeds and crop residue where it harbors over the winter (Groenewald, 2006).

Homer (2000) also cited that *Cercospora* leaf spot symptoms development is most common on leaves but may occur on most above ground plant parts. Lesions are initially visible on the upper leaf surface as small purple spots. The spots enlarged slightly with age up to ¼ inch and may coalesce. The tissue in the center of the spot changes from purple to tan or gray and

eventually become white. The margin of the spots remains purple or brown giving the lesion a "bird's eye "appearance. Infection sites appear as indistinct tan or bluish areas on lower leaf surface. Symptoms expression is variable depending on the age of the leaf, susceptibility of the cultivar or species, fungal strain and environmental conditions.

Leaf spot may reach economic threshold levels, provided young leaves and inoculum are present, under conditions of high temperature and long period of leaf wetness. Research result show most severe infection of young leaves to occur during periods of leaf wetness from 12 to 96 hours when temperatures fall in the range of 59-68^{o}F or 15-20^{o}C. This data suggest that fungicide treatment should be applied early spring and after renovation of inoculum is present (Ngitew, 2003).

Several species of *Cercospora* are responsible for the diseases on the various hosts; some *Cercospora* species have *Mycosphaerella* as their teleomorph. The fungus produces long, slender, color less, to dark, straight to slightly curved, multicellular conidia on short dark conidiophores. Conidiophores arise from the plant surface in clusters through the stomata and form conidia successively on new growing tips. Conidia are detached easily and are often blown long distances by the wind. The fungus is favored by high temperatures and therefore is most destructive in the summer months and in warmer climates. Most *Cercospora* species produce the nonspecific toxin cercosporin, which acts as a photosensitizing agent in the plant cells; it kills cells only in the light. The toxin incites the production of reactive atomic oxygen in the cells. Although *Cercospora* spores need water to germinate and penetrate, heavy dews seem to be sufficient for infection. The pathogen over seasons in or on the seed and as minute black stomata in old infected leaves (Agrios, 1979).

There are several types of lettuce, differing in leaf shape and form and in the tendency to form a 'heart' or 'head' (Berg, 1998).

Control

Cercospora disease is controlled by using disease-free seed or seed least three years old, by which time the fungus in the seed has died; by using crop rotations with hosts not affected by the same *Cercospora* species; and by spraying the plants, both in the seed bed and in the field, with appropriate fungicides (Fry, 1982).

Other Diseases that is very common in Lettuce (Westcott, 1960)

Alternaria spot. This is caused by various species of *Alternaria*, has been recorded on lettuce in several countries, on Chicory in India and on endive in Greece, on Italy and Argentina. Endive cultivars are generally much more susceptible than Chicory to infection by *Alternaria cichorii*.

Myconcentrospora spot. This has been recorded on outdoor lettuce in France and in the UK following heavy rains and the disease also occurs in the USA. The causal fungus is *Mycocentrospore acerina*. Leaf spot are circular to angular with pale brown centers and darken margins, sometimes surrounded by a board band of grayish-green. Irregularly shaped lesions develop on the midribs of exposed leaves. Control by fungicides sprays has been suggested.

*Myrothecium r*ot. This is caused by *Myrothecium roridum*, and it has been recorded outdoor lettuce in sprain. Warm moist weather is conductive to infection, resulting in the formation of circular spots on both sides of the leaf blades.

Phytopthora rot. It has been recorded in Australia on lettuce as a firm dark stem rot extending upwards into the head. The disease was found only during winter in badly drained

fields. The causal fungus was a strain of *Phytophthora porri* which had an optimal growth temperature of 15^{o} C and failed to infect leeks on cabbages.

Phythium rot. This is caused by *Phythium aphanidermatum*, affects lettuce in India, leaves in with the ground are invaded, become water soaked and decay rapidly. In the Netherlands, species of *Phythium* are recorded as components of bottom rot.

Sclerotium rot. This is caused by *Sclerotium rolfsii* occasionally recorded on lettuce and endive in the Southern USA. The fungus is favored by warm wet conditions and attacks leaves in contact with the soil, giving rise to silky white mould and spherical resting bodies (sclerotia).

Plants with Antifungal Properties

Angel's Trumpet(*Brugmansia suarveolens*). Angel's Trumpet is a genus of seven species of flowering plants in the family Solanaceae. They are known as Angel's Trumpets sharing that name with the closely related genus Datura. *Brugmansia* are long-lived, woody trees or bushes, with pendulous not erect flowers, that have no spines on their fruit. Datura species are herbaceous bushes with erect (not pendulous) flowers, and most have spines on their fruit (Preissel, 2000). *Brugmansia* are large shrubs or small trees, reaching heights of 3-11 m, with tan slightly rough bark. The leaves are alternate, generally large 10-30 cm long and 4-18 cm broad, with an entire or coarsely toothed margin, and are covered with fine hairs. The name Angel's Trumpet refers to the large, very dramatic, pendulous trumpet-shaped flowers, 14-50 cm to 50-8 cm long and 10-35 cm across at the wide end. They are white, yellow, pink, orange or red, and have a delicate, attractive scent with light, lemony over-tones, most noticeable in early evening. Flowers may be single or double (Shaw, 1999). As with Datura all parts of *Brugmansia* are highly toxic. The plants are sometimes ingested for recreational or Shananic intoxication as the plant contains the tropane alkaloids scopolamine and atropine; however because the potency of

the toxic compounds in the plant is variable the degree of intoxication is unpredictable and can be fatal (Blanckaert, 2004).

Horsetail*(Ricinus communis*). Is a species of flowering plant in the spurge family, Euphorbiaceae. It belongs to a monotypic genus, Ricinus, and subtribe, Riciniae. The evolution of castor and its relation to other species is currently being studied. Its seed is the castor bean which, despite its name is not a true bean. Castor is indigenous to the Southeastern Mediterranean Basin, Eastern Africa, and India but is widespread throughout tropical regions. Castor seed is the source of castor oil, 40% and 60% oil that is also present in lower concentrations throughout the plant. The seeds from the castor bean plant, *Ricinus communis*, are poisonous to people, animals and insects. One of the main toxic proteins is "ricin", named by Still Mark in 1888 when he tested the beans extract on red blood cells and saw them agglutinate. Now we know that the agglutination was due to another toxin that was also present, called RCA (*Ricinus communis agglutinin*). Poisoning by ingestion of the castor bean is due to ricin, not RCA, because RCA does not penetrate the intestinal wall, and does not affect red blood cells unless given intravenously. If RCA is injected into the blood, it will cause the red blood cells to agglutinate and burst is hemolysis (Wiess, 1971).

Lantana (*Lantana camara L*). It consists of more than 150 species of shrubs and herbaceous perennials, of the vervain family Verbenaceae. Lantanas are mostly natives of the tropics and subtropics of America but some are natives of warm parts of the Old World. Their name is an ancient one used for the quite unrelated genus Viburnum. Wild lantanas are hairy and often prickly-stemmed. If rubbed and bruised, their leaves usually have a pungent odor. Verbena-like flowers are formed in clusters from the leaf axils or at the ends of branches. The small berry-like fruits contain seeds. In some regions, lantanas grow wild as weeds, chiefly spread by birds

that are very fond of their juicy fruits. Lantana leaves can be used as a soothing agent in cases of insect stings, skin eruptions, cuts scrapes, ulcerations, the itch of measles and chicken pox, parasites such as scabies. However, there often conflicting reports on its use as an herbal medicine. The green berries are toxic and there has been one human fatality attributed to them. Animals will also be affected by eating these plants (Ferla and D' Eeckendbrugge ,2000).

Neem tree (*Azadirachta indica*). As versatile as "kakawe" is the neem. In 1962, an Indian scientist found out thaqt neem seed extract proved operative as an insect repellant. Discovery of azadiracthan, a principal anti- feedant, was reported in 1986. Independent experiments by other respected scientists from all over the world disclosed other neem compounds, among them vitasinin and salanorin.

Sap from the neem tree has been tried as an insecticide and was found to destroy vicadas and astracods infesting rice fields. Neem cake- the residue left after oil is extracted from neem seeds- when incorporated in the soil kills nematodes.

Several experiments conducted at the International Rice Research Institute showed that leafhoppers feed less, grow poorly and lay fewer eggs on rice plants that have been sprayed with neem oil.

For its part, the Bureau of plant Industry of the Department of Agriculture once experimented the effects of neem oil extract on the corn borer, the prime suspect behind the 20-80 percent losses in domestic corn yields. The study confirms neem oil can destroy 93.3 percent of the dreaded pest. Neem is unique among plants with pesticidal properties since it has so many different effects on pests: It acts as a broad-spectrum repellent, insect growth regulator (it causes deformities in the insect's offspring) and insect poison. It discourages feeding by making plants unpalatable to insects or suppresses the insect's appetite (anti-feedant effect); if they still attack,

it inhibits their ability to moult and lay eggs. Unlike most botanical insecticides, neem also has a somewhat “systemic” effect. This means that plants can take up neem extracts through their roots and leaves, spreading the material throughout the plant tissues (Bradley, 1992).

Sunflower (*Helianthus annus L.*). Are annual plants native to the Americas, those posses a large inflorescence (flowering head). The florets inside the circular head are yellow, maroon, orange, or other colors. The florets within circular head are called disc florets, which mature into seeds. The florets within the sunflower’s cluster are arranged in a spiral pattern. This pattern produces the most efficient packing of seeds within the flower head. To grow well, sunflowers need full sun. They grow best fertile, moist; well-drained soil with a lot of mulch. The most serious diseases of sunflower are caused by fungi. The major diseases include rust, downey mildew,verticillum wilt, sclerotinia stalk and head rot, phoma black stem and leaf spot. The severity of these disease effects on total crop yield might be ranked: 1) sclerotinia, 2) verticillium, 3) rust (recently more severe), 4) phoma, and 5) downly mildew. Resistance to rust, downy mildew, and verticillium wilt has been incorporated into improved sunflower germplasm. The growth of sunflower as an oilseed crop has rivaled that of soybean, with both increasing production over 6-fold since the 1930’s. Sunflower oil is generally considered a premium oil because of its light color, high level of unsaturated fatty acids and lack of linolenic acid, bland flavor and high smoke points (Shosteck, 1974).

Common plantain (*Plantago major*). Is a species of Plantago, family Plantaginaceae. It is widely naturalized elsewhere in the world, where it is a common Plantain in some areas where it is introduced, particularly North America. Another one of its common names was “Soldiers Herb” for its use on the battlefield as a dressing. It is an herbaceous perennial plant with a rosette of leaves 15-30 cm diameter. Each leaf is oval, 5-20 cm long and 4-9 cm broad, rarely up to 30

cm long and 17 cm broad, with an acute apex and a smooth margin; there are five to nine conspicuous veins. The flowers are small, greenish-brown with purple stamens, produced in a dense spike 5-15 cm long on top of a stem 13-15 cm tall (Sauer, 1998).

MATERIALS AND METHOD

Collection and Diagnosis of Diseased Specimens

Infected leaves of lettuce were collected from the experimental farm in Ambiong, Riverside La Trinidad Benguet. The specimens gathered were sealed in paper bags and brought to the laboratory for diagnosis to confirm the causal pathogen.

Symptomatology and Microscopic Activity

Symptomatology and microscopic observations were done and recorded. The Microscopic examination of the structures of the pathogen from leaf samples was done to observe the shape, size, and color of the spores and filaments.

Isolation of Pathogen

The collected diseased plants were washed with tap water to remove dirt. Five pieces at 2-3 mm^2 were cut within progressively diseased portion on the leaves. The pieces of tissues were disinfected in 10% chlorox for one minute, washed in three changes of sterile water and blot dried on a sterile tissue paper. Five pieces of cut tissues from the leaves were planted in plated PDA to isolate the pathogen. Colonies of the pathogen were re-isolated in test tube slants to obtain pure culture. The pure cultures were sampled for microscopic observation to confirm the causal pathogen of lettuce leaf spot.

Collection and Preparation
of Botanical Fungicides

Plants evaluated for fungicidal properties were collected within Benguet, wherever it could be found. These were processed by macerating to obtain sap extracts. Botanical plants used were selected based on their use as medicinal plants or reported to be effective against pathogens and insect pest. The preparation of the botanicals followed the procedure using ethanol for extraction. For solvent extract, 30 grams of botanical plants were washed with tap water, chopped and placed in an Erlenmeyer flask. Ethyl alcohol (95 percent) was used to soak the plants. Tissues were macerated using the mortar and pestle. The suspensions were left to stand for 2-3 days. The tissues were separated from the liquid portion using a filter paper. For every 0.50mg of the plants extract, 1 ml of acetone was mixed to dissolve the plant extracts.

In the water extract procedure, 20 grams of botanical plants were disinfected with chlorox then rinsed with distilled water. Following the weight/ volume formula, 20 grams of botanical plants were soaked in 20 ml of water.

Seedbed Preparation and
Seedling Management

A seedbed was prepared for the growing of lettuce seedlings, Iceberg variety. Three (3) weeks after sowing, the seedlings of lettuce were transplanted in the experimental area.

All cultural practices involved in caring lettuce seedlings such as watering, replanting damaged by cutworms, and control of insect pest were done in all the treatments. Seedlings were not protected with fungicides from germination to transplanting up to the termination of the experiment.

Field Trial and Planting

The lettuce seedlings that were free from *Cercospora* leaf spot were transplanted in the experimental field. The plots measured 0.80m x 5m each. Double row planting was done per plot. Cultural practices were done regularly such as watering, weeding and hilling up. No chemicals and inorganic fertilizer where added except for the spraying of the different plant extracts. Treatments were replicated three times following the Randomized Complete Block Design (RCBD).

The Treatments were:

T_1- Control

T_2- Angel's Trumpet (*Brugmansia suarveolens*)

T_3- Lantana (*Lantana camara*)

T_4- Horsetail (*Ricinus commu*nis)

T_5- Neem (*Azadirachta in*dica)

T_6- Common plantain (*Plantago major*)

T_7- Sunflower (*Helianthus annus L.*)

Data Gathered were:

1. Diagnostic activity

a. Symptom description

b. Morphological Characteristics of the pathogen from the fresh plant samples and culture media.

c. Cultural characteristics, colony (color, spread or growth and unit time)

2. Field

a. Infection rating. The scale developed by the British Mycological Society (Anon, 1947) was used in the study.

Rating Scale		Description
1	0	No infection
2	10%	Only few leaves affected, up to one spot
3	15%	Nearly every plant affected
4	25%	Every plant affected and about half of the leaf area destroyed by spot
5	50%	About three quarters of the leaf is destroyed by spots

RESULTS AND DISCUSSION

Disease Symptoms

Cercospora longissima infection also called frog eyespot first appears as small yellowish spots on the upper leaf surface. As the spots develop and enlarge, brown to black dots appears in the center. Spots merge to form large brown lesions (Figure 1). The experimental set-up at the field is shown in Figure 2.

Microscopic Characterization

Shown in Figure 3 are the microscopic structures of the causal pathogen of leaf pot on lettuce. Microscopic observation of *Cercospora longissima* structure from the infected plants showed abundant branched mycelium, long and slender multi-celled conidia that are colorless to dark. Conidiogenous cells and conidia were observed on specimens from infected plants but were not formed in artificial media.

Figure 1. Leaf spot on leaves

Figure 2. Experimental set-up at the field

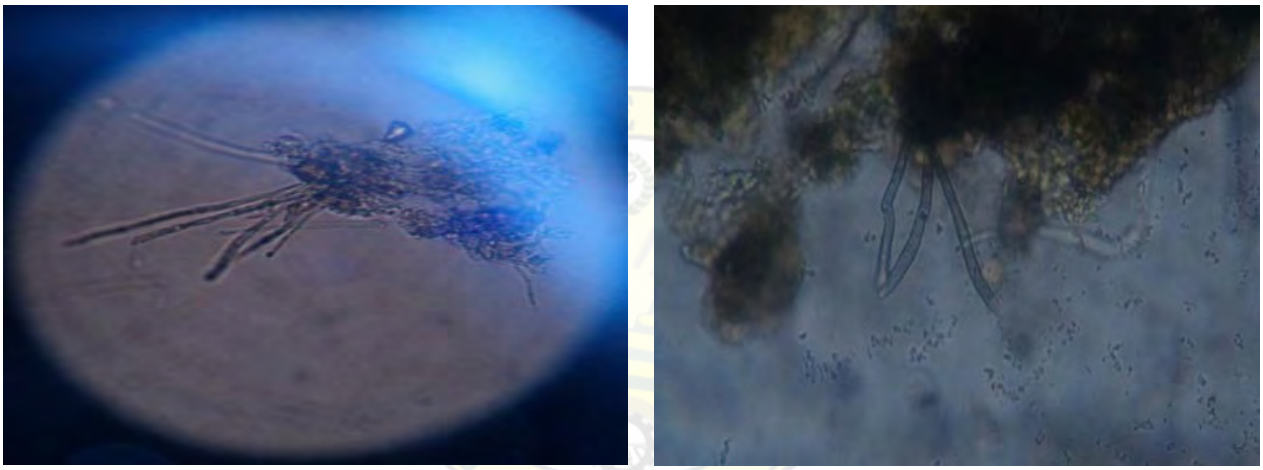

Figure 3. Conidiogenous cells and conidia of *C.longissima*

Weekly Assessment Leafspot Infection

Based on the severity rating which was done prior to the application of plant extracts, Sunflower has the highest mean of 22.4% and the lowest were from horsetail and control at 20.8% (Table 1). Statistical analysis shows no significant differences of the treatments. The second rating which was done one week after the first application of plant extracts, generally showed progress of leaf spot infections in all the treatments. The highest severity rating was obtained from plants treated with Lantana as 30.60%, followed by *Plantago major* at 30.53%,

Table 1. Means of spot severity rating on lettuce sprayed with plant extracts (%)

TREATMENT	INITIAL	2nd RATING	3rd RATING	FINAL
Control	20.80	25.67	30.87	43.13
Angel's trumpet	21.20	28.40	32.40	46.40
Lantana	21.60	30.60	32.80	45.00
Horsetail	20.80	29.60	35.00	44.80
Neem tree	21.20	27.53	32.87	47.47
Plantago major	22.00	30.53	34.67	48.47
Sunflower	22.40	29.53	34.33	45.60

Horsetail at 29.6%, Sunflower at 29.53%, Angel's Trumpet at 28.40%, Neem tree at 27.53% and the least was from the Control at 25.67% (Table 1). The Third leaf spot severity rating taken after two spraying of the plant extracts is shown in the Table 1. Plants sprayed with plant extracts generally showed higher severity ratings of leaf spot infection than plants without plant extracts sprays. Statistical analysis revealed no significant differences between the treatments.

In the final severity rating taken after three sprayings of the plant extracts, all the plant extract treatments did not show suppression of leaf spot infection as compared to the control Treatment. The severity ratings of leaf spot infections on plants treated with plant extracts were higher than the severity rating. The plants without plant extract spray (Table 1). Statistically no significant differences among the treatments.

The no suppression effect of the plant extracts could either due to low dosage used or their role is more of insecticidal properties as revealed in previous studies to most of these plants experimented.

hown in Figure 4. Initially

However, advances in

much affected at the

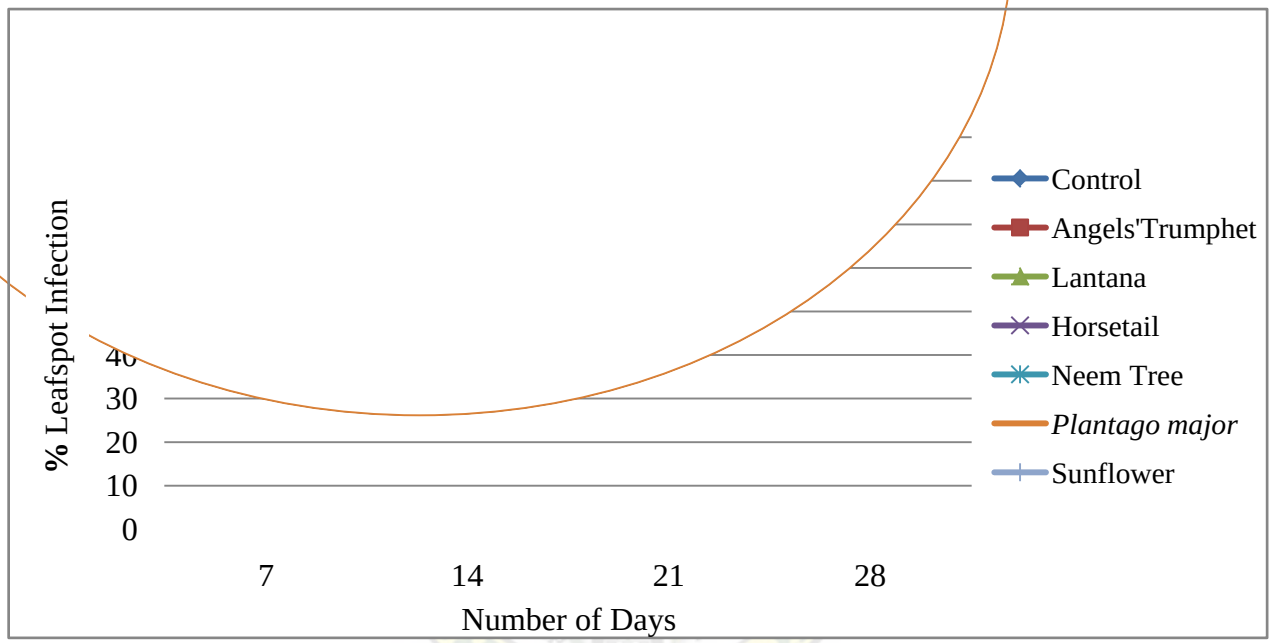

Figure 4. Weekly assessment of leaf spot infection on lettuce treated with plant extracts

Based on the marketable yield per plot of lettuce which was treated with the different plant extracts, Neem tree has the highest mean of 36.00 and the lowest were from control and Angel's trumpet at 28.00 (Table 2). Statistically analysis shows highly significant differences of the treatments.

Treatments show that there was an effect on the lettuce that it can be use as supplementary foliar fertilizer but not as antifungal sprays.

Table 2. Marketable yield per plot of lettuce treated with plant extracts

TREATMENT	MEAN
Control	28.33
Angel's Trumpet	28.00
Lantana	31.67
Horsetail	29.00
Neem tree	36.00
Common plantain	31.00
Sunflower	32.00

SUMMARY, CONCLUSION AND RECOMMENDATION

Summary

The study was conducted at Ambiong, Riverside La Trinidad Benguet from March to May 2011. It aimed to evaluate the plant extracts against *Cercospora* leaf spot of lettuce. Result of the study revealed that the plant extracts used in the study has no effect against *Cercospora* leaf spot of lettuce as compared to the control plants.

Conclusion

The plant extracts showed no effect against *Cercospora* leaf spot of lettuce. Leaf spot symptoms on the Iceberg lettuce varied from small yellowish spots with brown to black dots in the center. Adjacent small spots merged to forming large brown lesion. Most of the plant extracts, except the Angel's trumpet promoted higher yield than the control.

Recommendation

The plant extracts can be used as supplementary foliar fertilizer but not as antifungal sprays.

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APPENDICES

Appendix Table 1. Means of spot severity rating on lettuce sprayed with plant extracts (%)

TREATMENT	REPLICATION			TOTAL	MEAN
	I				
T_1	20	21.2	21.2	62.4	20.8
T_2	20	22.4	21.2	63.6	21.2
T_3	20	21.2	23.6	64.8	21.6
T_4	20	22.4	20	62.4	20.8
T_5	20	23.6	20	63.6	21.2
T_6	20	23.6	22.4	66	22
T_7	20	24.8	22.4	67.2	22.4
TOTAL	140	159.2	150.8	450	150
MEAN					21.43

ANALYSIS OF VARIANCE

					TABULAR F	
SOURCE	DF	SS	MS	F.VALUE	0.5	0.1
Replication	2	26.469	13.234	10.7222		
Treatment	6	6.583	1.097	0.8889^{ns}	3.0	4.82
Error	12	14.811	1.234			
TOTAL	20	47.863				

Coefficient of variation=5.18%

* Significant
** High significant
^{ns}=Not Significant

Appendix Table 2. Second rating on lettuce sprayed with plant extracts (%)

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
T_1	24.8	31	21.2	77	25.67
T_2	26.8	30	28.4	85.2	28.40
T_3	33.2	28.6	30	91.8	30.60
T_4	27.8	34.2	26.8	88.8	29.60
T_5	26.8	30.2	25.6	82.6	27.53
T_6	33.2	29.2	29.2	91.6	30.53
T_7	29.2	30.2	29.2	88.6	29.53
TOTAL	201.8	213.4	190.4	605.6	201.87
MEAN					28.84

ANALYSIS OF VARIANCE

SOURCE	DF	SS	MS	F.VALUE	TABULAR F 0.5	0.1
Replication	2	37.787	18.893	2.7461		
Treatment	6	56.983	9.497	1.3804^{ns}	3.0	4.82
Error	12	82.56	6.880			
TOTAL	20	177.330				

* Significant
** Highly significant
^{ns}=Not Significant

Coefficient of variation=9.10%

Appendix Table 3. Third rating on lettuce sprayed with plant extracts (%)

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
T_1	27.6	34	31	92.6	30.87
T_2	29.2	33	35	97.2	32.40
T_3	33.4	33	32	98.4	32.80
T_4	35	37	33	105	35.00
T_5	29.6	36	33	98.6	32.87
T_6	33	36	35	104	34.67
T_7	33	35	35	103	34.33
TOTAL	220.8	244	234	698.8	232.93
MEAN					33.28

ANALYSIS OF VARIANCE

SOURCE	DF	SS	MS	F.VALUE	TABULAR F 0.5	0.1
Replication	2	38.690	19.345	6.438		
Treatment	6	38.971	6.495	2.1616^{ns}	3.0	4.82
Error	12	36.057	3.005			
TOTAL	20	113.718				

* Significant
** Highly significant
^{ns}=Not Significant

Coefficient of variation=5.21%

Appendix Table 4. Final rating on lettuce sprayed with plant extracts (%)

	REPLICATION				
TREATMENTS	I	II	III	TOTAL	MEAN
T_1	46	43.6	39.8	129.4	43.13
T_2	48	43.8	47.4	139.2	46.40
T_3	45.6	45.2	44.2	135	45.00
T_4	47.4	43.8	43.2	134.4	44.80
T_5	45.4	47.4	49.6	142.4	47.47
T_6	47.2	49.6	48.6	145.4	48.47
T_7	46.2	46	44.6	136.8	45.60
TOTAL	325.8	319.4	317.4	962.6	320.87
MEAN					45.84

ANALYSIS OF VARIANCE

					TABULAR F	
SOURCE	DF	SS	MS	F.VALUE	0.5	0.1
Replication	2	5.501	2.75	0.6739		
Treatment	6	57.090	9.515	2.3312^{ns}	3.0	4.82
Error	12	48.979	4.082			
TOTAL	20	111.570				

* Significant

** Highly significant

^{ns}=Not Significant

Coefficient of variation=4.41%

Appendix table 5. Marketable yield per plot of lettuce treated with plant extracts

TREATMENT	REPLICATION I	II	III	TOTAL	MEAN
T_1	75	95	85	255	85
T_2	73	95	85	253	84.33
T_3	90	90	105	285	95
T_4	75	90	95	260	86.67
T_5	100	115	110	325	108.33
T_6	85	90	105	280	93.33
T_7	85	100	105	290	96.67
TOTAL	583	675	690	1948	649.33
MEAN					92.77

ANALYSIS OF VARIANCE

SOURCE	DF	SS	MS	F. VALUE	TABULAR F 0.5	0.1
Block	2	958.9523	479.47	14.37**	3.89	6.93
Treatment	6	1294.476	215.746	6.47**	3.0	6.93
Error	12	400.3809	33.365			
TOTAL	20	2653.810				

*Significant
**Highly Significant
^{ns} =Not Significant