The Philippine Journal of Plant Industry

(FORMERLY THE PHILIPPINE JOURNAL OF AGRICULTURE)

Vol. 67 No.1 January-March 2002

CULTURAL MANAGEMENT OF EXPORTABLE FOLIAGE PLANTS

Amelia M. Nicdao and Herminigilda A. Gabertan[1]

ABSTRACT

To establish a technology on the production and management of a cutfoliage farm, Nicdao and Gabertan (2001) conducted a study on exportable foliage at the BPI-LBNCRDC.

The study collected, propagated and evaluated materials used as cutfoliage. It also determined the response of each group of foliage plant varieties to different levels of nitrogen fertilizer, plant spacing, time of pruning and percent shade.

The researchers found three exportable foliage plants which responded well in the open-field. These included *D. marginata* (Tricolor), *P. reflexa* (Song of India), and *M. paniculata* (Kamuning). On the other hand, three other foliage plants, namely: *M. punctatum* (Polypodium), *D. sanderiana* (Gold), and *D. godseffiana* (Florida Beauty) preferred partial shade condition.

Interaction between N and Ca fertilizers resulted to significant differences in the number of stems of *M. paniculata*. *D. marginata* treated with 60 kg/ha of nitrogen level significantly produced the tallest mean shoots (51.25 cm).

D. sanderiana, on the other hand, significantly attained the tallest plant (122.84 cm) at 70% shade. Levels of nitrogen application significantly affected height and number of stems formed by *D. godseffiana*, but insignificantly affected by shade.

D. marginata receiving N fertilizer at 180-0-0 kg/ha, with a spacing of 40 cm between hills, obtained the highest Return-On-Investment (ROI) with a mean of 41.78%. *D. godseffiana* receiving 20 gram N/ plant with a 30 percent shade gave the ROI with a mean of 43.21% and for *M. paniculata* plants fertilized at 5 grams N without Ca obtained the highest (ROI) of 41.42%.

[1]/ Both Agriculturist II, Project Leader and Study Leader, respectively at BPI-Los Baños National Crop Resesarch and Development Center.

RATIONALE

Foliage ornamental plants possess attractive, colorful and elegant leaves. They are preferred more for the elegance of their leaves, than for the beauty of their flowers. Foliage consist mainly of herbaceous plants and the juvenile forms of certain shrubs and trees and of fresh cutfoliage for flower arrangements. Some of these are known by the names like cordylines, pleomeles, murrayas, microsoriums, philodendrons, palms and aglaonemas.

At the local market, foliage ornamental plants constitute roughly 80% of the total value of ornamental products that are traded domestically. In the past, only a few engaged in selling foliage plants. In recent years, the population of growers has increased significantly.

In 1993, for example, records showed that about 10,000 farmers were into ornamental production. This enthusiasm has spurred the development of this once backyard enterprise into a sunshine business.

Giving further encouragement to the business climate, are a string of principal centers for ornamental production. These are found in Cordillera Autonomous Regions (CAR), Central Luzon, Southern Tagalog, Western and Central Visayas and Northern and Southern Mindanao (Agribusiness Investment Profile Philippines 1996-1997).

At the local market, foliage ornamental plants attract various customers. Aside from their use in bouquets and floral arrangements, various industries such as real estate developments for housing, recreation areas like resorts and golf courses, service centers like banks, hotels, restaurants and churches, have expanded with corresponding demand for ornamentals. This is accompanied by the government's nationwide clean and green program campaign.

At the International market, the demand for ornamental exports is consistently increasing. Export earnings in 1997 for live plants and dried flowers totaled 60.25%. The remaining 39.75% came from fresh

flowers and foliage with an estimated value of US$ 1.98 Million in 1997 (Agribusiness Investment Profile Philippines 1996-1997).

In addition, the World Floriculture predicts that the world's major markets such as Europe, Japan and the US will continue to increase their ornamental consumption between 4% to 6% annually, as worldwide population shifts from rural to urban areas (Flower TECH, 1999).

These markets can be a good outlet for the Philippines as it strives to develop foliage plant business. There are inherent advantages of the country that permit the production of globally competitive foliage plants. One is the ideal climate for all year round production. Second is the proximity of the Philippines to major Asian markets (1995).

Economically, the Philippine foliage plant industry has a substantial potential to generate export revenues and livelihood opportunities to most of our small-and-large-scale ornamental growers. However, there are problems that have to be addressed to fully harness the potentials of foliage plant business.

Most prominent problems include the need to satisfy the demand in terms of volume and quality of foliage plants required by the importing markets. In view of this, the study tried to evaluate technologies on some cultural management aspects such as application of fertilizer, plant spacing, light requirement, and pruning in order to come up with commercially viable and globally competitive plant products.

OBJECTIVES

The objectives of the studies are the following:

1. To collect, propagate and evaluate materials used as cutfoliage.
2. To determine the response of each group of foliage plant varieties to different rates of fertilizer, pruning, spacing and shade.
3. To establish a technology on the production and management of a cutfoliage farm.

METHODOLOGY

A. Survey and Field Visitation

The researchers conducted surveys on the existing foliage plants grown at different locations. They observed and recorded the growers varied cultural and management practices. A total of twenty-nine (29) growers/ farm owners from Luzon, Visayas and Mindanao were surveyed and visited from July to December, 1996. The survey was conducted to identify the priority foliage plants that were being grown by the growers.

Plant Collection, Propagation and Evaluation

Foliage plants that were identified as top priority were collected, mass produced and evaluated based on the cultural practices used by growers. Prioritization was made based on the demand both in the local and international market.

B. Field Experiments

Three studies were conducted. These were:

Study 1. Effect of different levels of nitrogen fertilizer and plant spacing on the growth of *Dracaena marginata* "Tricolor".

Study 2. Effect of different levels of nitrogen fertilizer and time of pruning on the growth of *Pleomele reflexa* "Song of India".

Study 3. Effect of different levels of nitrogen fertilizer and calcium fertilizers on the growth of *Murraya paniculata* "Kamuning".

Soil Sampling

Before land preparation was done, soil samples were randomly collected at 50 centimeters depth from the experimental field. Ten samples were taken from all over the area at one kilogram per sample. The samples were thoroughly mixed and dried at room temperature, pulverized and five (5) kilos were submitted to the Department of Soil Science, UP Los Baños for analysis. Result of the soil analysis is presented in Table 3.

Land Preparation

The experimental area was prepared thoroughly by two plowings and two harrowings, which were done alternately to soften the soil and attain good soil tilt.

Study 1. Effect of different levels of N-fertilizer and plant spacing on the growth of Dracaena marginata "Tricolor".

Experimental Design/Field Layout

Split-plot in Randomized Complete Block Design was used in the study. An area of 292.5 m^2 was divided into three blocks with equal measurements. The distance between blocks was 1.5 meters and between rows was 1 meter with varying spacing between plants. Each block was subdivided into three main plots to accommodate the main treatments which were the three levels of fertilizer. The main plots were further subdivided into four (4) subplots with an area of 5.0 x 0.5 meters. Assigned with the sub-treatments were the different plant spacings.

Treatments

Main treatments (levels of N-fertilizer)

T1 - 0 kg N/ha

T2 - 60 kg N/ha
T3 - 120 kg N/ha
T4 - 180 kg N/ha

Sub-treatments (spacings)
D1 - 70 cm between plants (28,571 plants/ha)
D2 - 60 cm between plants (33,333 plants/ha)
D3 - 50 cm between plants (40,000 plants/ha)
D4 - 40 cm between plants (50,000 plants/ha)

Study 2. Effect of different levels of N-fertilizer and time of pruning on the growth of *Pleomele reflexa* "Song of India"

Experimental Design/Field Layout

Split-plot in Randomized Complete Block Design was used in the study. An area of 472.59 m^2 were divided into three blocks with equal measurements. Each block was subdivided into three mainplots to accommodate the main treatments which were the three levels of N fertilizer. The main plots were further subdivided into three subplots with an area of five meters, assigned with the sub-treatments were the different time of pruning. The distance between blocks was 1.5 meters and between rows was 1 meter.

Treatments

Main Treatments (levels of N-fertilizer)
T1 - 0 kg N/ha
T2 - 60 kg N/ha
T3 - 120 kg N/ha
T4 - 180 kg N/ha

Sub-treatments (Time of Pruning)
P1 - no pruning
P2 - pruning one month after planting
P3 - pruning two months after planting
P4 - pruning three months after planting

Study 3. Effect of different levels of N-fertilizer and calcium fertilizers on the growth of *Murraya paniculata* "Kamuning".

Experimental Design/Field Layout

Completely Randomized Design (CRD) with four replications was used in the study, with different levels of N fertilizer (Urea, 46%) as the main treatments and Calcium Nitrate ($Ca(NO_3)_2$) as the sub-treatments. One hundred and forty-four (144) established pencil-sized shoots of Kamuning were planted in pots on December 16, 1998. The potting medium used was a mixture of 1:1 ratio of garden soil and coconut coir dust placed in 10" size clay pots.

The experiment was conducted in pots under open field due to unavailability of experimental area in the field during the set-up of the study.

Treatments

Main Treatments (levels of N-fertilizer)
T1 - 0 kg N/ha (0 gm /plant)
T2 - 50 kg N/ha (5 gm /plant)
T3 - 100 kg N/ha (10 gm /plant)
T4 - 150 kg N/ha (15 gm /plant)

Sub-treatments (levels of Ca/ pot)
T1 0 gm/plant
T2 - 2.5 gm/plant
T3 - 5.0 gm/plant
T4 - 7.5 gm/plant

Other Cultural Practices

The following cultural practices were employed in the three foliage plants planted under open field condition.

- Weeding and Cultivation

Shallow cultivation around the plants was done as weeds emerged. Black polyethylene plastic mulch was used to prevent growth of weeds.

➢ Irrigation

Watering was done immediately after planting through the drip-irrigation system every other day for two (2) hours with water discharge of 1.75 liters per hour during dry months and rain water during wet season.

➢ Control of Insect Pests and Diseases

Insecticides and fungicides at the recommended dosage were sprayed as soon as signs of pests and/ or disease infestation was observed. This was done every month for prevention.

Data Gathered

The following data were gathered for the three foliage plants planted under the open-field. Monthly observations were done and data gathered were as follows:

1. Height of shoots
2. Height of plant
3. Number of shoots
4. Number of leaves
5. Number of stems
6. Yield

Data Analysis

Analysis of variance was done for all sets of data. Significant treatment means were compared using the Duncan's Multiple Range Test (DMRT).

C. Greenhouse/ Pot Experiments

After a year of evaluation on potting media and coming up with sufficient number of planting materials, actual pot experiments on these foliage plants under partial shade were started. Three greenhouse/ pot experiments were conducted to evaluate the response of each group of foliage plant varieties to different rates of fertilizer and shade. These were:

Study 4. Effect of different levels of N-fertilizer and percent shade on the growth of *Microsorium punctatum* "Polypodium"

Experimental Design

All the three pot/greenhouse experiments were laid out in Complete Randomized Design (CRD) in three replications. Identified top priority foliage plants were planted in pots using different rates of N fertilizer and varying percent of shading (30, 50 and 70%).

Planting Materials

Plants with 3-4 initial fronds were planted on June 4, 1998 in 219 #10 clay pots filled with a potting medium of 1:1:1 ratio of garden soil, coconut coir dust and rice hull. The plants were placed under calibrated nets of 30, 50 and 70% shade. Application of the different levels of N fertilizer (10, 20 and 30 gm per plant) was done one month after planting.

Study 5. Effect of different levels of N-fertilizer and percent shade on the growth of *Dracaena sanderiana* "Gold"

Planting Materials

Three rooted stems per pot of *Dracaena sanderiana* of more or less uniform height of one foot were planted on July 8, 1998 in 120 #10 clay pots with a potting mixture of 1:1:1 ratio of garden soil, coconut coir dust and rice hull. The plants were also placed under calibrated nets of 30, 50 and 70% shade for establishment.

Study 6. Effect of different levels of N-fertilizer and percent shade on the growth of *Dracaena godseffiana* "Florida Beauty"

Planting Materials

Three established cuttings of more or less 15 cm tall were planted in 108 #10 clay pots. The plants were placed under calibrated nets.

Data Gathered

The following data were gathered for the three foliage plants: Monthly observations were done and data gathered were as follows:

1. Height of shoots
2. Height of plant
3. Number of shoots
4. Number of leaves
5. Number of stems
6. Yield

Data Analysis

Analysis of variance was done for all sets of data. Significant treatment means were compared using the Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

A. Survey and Field Visitations

The ornamental growers surveyed are shown in Table 1. Among the 29 growers surveyed, 34% (10 growers) are considered commercial and export growers of the identified exportable foliage plants. The rest are considered small-scale backyard growers. Most of the farms are planted in combination with non-foliage plants with an area ranging from 0.50 to 50.0 ha.

In Luzon, only three farms located in Calauan, Laguna; Lucban, Quezon and Tagaytay City were classified as the large-scale production of cutfoliage involving *Pleomele reflexa Dracaena marginata* and *Dracaena fragrans* "Fortune Plant" or "Lady's Corn" for both local and export markets.

Researchers found the largest field plantation of the most of the identified exportable foliage plants in Batangas. *Dracaena marginata, Pleomele reflexa* and *Murraya paniculata* were planted in plots in the open-field; while *Dracaena sanderiana* (Gold) and (Ivory) were planted in plots under two layers of net.

In other smaller farms where cutflowers were the main crop, these foliage plants were planted along the fence to serve as hedge. *Microsorium punctatum* and *Dracaena godseffiana* are planted in clay pots in greenhouses and some under coconut palms.

The potting medium used was pure coconut coir dust for newly cut "Tricolor". A 1:1:1 mixture of coconut coir dust, garden soil and rice hull was the common growing medium used for other foliage plants.

In the Visayas, particularly in Cebu, most ornamental plants (foliage and cutflowers) were planted in pots with media combination of garden soil, coconut coir dust and rice hull.

Planting Materials

Three rooted stems per pot of *Dracaena sanderiana* of more or less uniform height of one foot were planted on July 8, 1998 in 120 #10 clay pots with a potting mixture of 1:1:1 ratio of garden soil, coconut coir dust and rice hull. The plants were also placed under calibrated nets of 30, 50 and 70% shade for establishment.

Study 6. Effect of different levels of N-fertilizer and percent shade on the growth of *Dracaena godseffiana* "Florida Beauty"

Planting Materials

Three established cuttings of more or less 15 cm tall were planted in 108 #10 clay pots. The plants were placed under calibrated nets.

Data Gathered

The following data were gathered for the three foliage plants: Monthly observations were done and data gathered were as follows:

1. Height of shoots
2. Height of plant
3. Number of shoots
4. Number of leaves
5. Number of stems
6. Yield

Data Analysis

Analysis of variance was done for all sets of data. Significant treatment means were compared using the Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

A. Survey and Field Visitations

The ornamental growers surveyed are shown in Table 1. Among the 29 growers surveyed, 34% (10 growers) are considered commercial and export growers of the identified exportable foliage plants. The rest are considered small-scale backyard growers. Most of the farms are planted in combination with non-foliage plants with an area ranging from 0.50 to 50.0 ha.

In Luzon, only three farms located in Calauan, Laguna; Lucban, Quezon and Tagaytay City were classified as the large-scale production of cutfoliage involving *Pleomele reflexa Dracaena marginata* and *Dracaena fragrans* "Fortune Plant" or "Lady's Corn" for both local and export markets.

Researchers found the largest field plantation of the most of the identified exportable foliage plants in Batangas. *Dracaena marginata, Pleomele reflexa* and *Murraya paniculata* were planted in plots in the open-field; while *Dracaena sanderiana* (Gold) and (Ivory) were planted in plots under two layers of net.

In other smaller farms where cutflowers were the main crop, these foliage plants were planted along the fence to serve as hedge. *Microsorium punctatum* and *Dracaena godseffiana* are planted in clay pots in greenhouses and some under coconut palms.

The potting medium used was pure coconut coir dust for newly cut "Tricolor". A 1:1:1 mixture of coconut coir dust, garden soil and rice hull was the common growing medium used for other foliage plants.

In the Visayas, particularly in Cebu, most ornamental plants (foliage and cutflowers) were planted in pots with media combination of garden soil, coconut coir dust and rice hull.

One farm in Malagos, Davao had *Microsorium* planted in the soil under trees but covered with chopped wood. Researchers also observed that for commercial farming, watering was done daily and all plants were provided with the drip-irrigation facilities. In contrast, small growers especially those in Lucban, Quezon, watering is depended on rain water alone.

Complete fertilizer (14-14-14) and Urea (46-0-0) are commonly applied directly to those planted in the field while organic fertilizer such as chicken or hog manure was used as fertilizer. The organic fertilizer was normally incorporated in the media at planting and applied on a regular weekly basis.

B. Plant Collection, Propagation and Evaluation

Collection

After a series of surveys and farm visits from July to December 1996, twenty-three (23) species of different exportable and non exportable foliage plants were collected, propagated and maintained at the BPI-LBNCRDC (Appendix Table 1).

Propagation

Table 2 shows the method of propagation that were observed from the growers and used in the study. For *Murraya paniculata* , several planting materials were propagated through marcotting rather than by just mere stem cuttings. The "Kulob System" of propagation was adapted for *Pleomele reflexa*, division of rhizomes for *Microsorium* and stem cuttings for *D. marginata*, *D. sanderiana* and *D. godseffiana*.

Evaluation

D. marginata, *Pleomele reflexa* and *Murraya paniculata* were evaluated and showed good performance under open-field or full sunlight condition.

On the other hand, *Microsorium*, *D. godseffiana* and *D. sanderiana* performed better under partial shade.

C. Field Experiments

Soil Chemical Properties

The result of the analysis as presented in Table 3 shows that the pH of the soil was 6.5, organic matter was 1.43% which was relatively lower. Phosphorus was 24.22 ppm and potassium was 1.01 milliequivalent per 100 grams.

No fertilizer recommendation was formulated since this was the first time ornamental foliage crops would be planted in the field and no previous studies had been conducted to serve as basis.

Study 1. Effect of different levels of N-fertilizer and plant spacing on the growth of *Dracaena marginata* "Tricolor".

Height of Shoots

The height of shoots of *D. marginata* as affected by levels of nitrogen fertilizer and different plant spacing is presented in Table 4. Height of shoots of *D. marginata* was significantly affected by the different levels of fertilizer application. Plants treated with the lowest amount of 60 kg N/ha significantly produced the tallest shoots measuring 51.25 cm while the unfertilized plants measured the shortest shoots of 43.55 cm. Higher rates did not significantly increase growth or height of the plants compared to the 60 kg N/ha.

On the other hand, no significant differences were observed on the height of the shoots among the different plant spacings. The plants have an average height of 47.92 cm.

Yield

Table 5 shows the shoot yield of *D. marginata*. Significant differences were observed among treatments. The data also shows that

increasing the level of N enhances the yield of *D. marginata*. Significant interaction between N fertilizer and plant spacing was observed. Highest yield was obtained from 180 kg N at 40 cm plant spacing but was not significantly different from lower N rates of 120 kg N and 60 kg N at 40 cm plant spacing.

Economic Analysis

Nitrogen at the rate of 180 kg/ ha at 40 cm plant spacing significantly yielded 55,670 shoots and the highest Return on Investment (ROI) of 41.78% (Tables 6). Unfertilized plants yielded the least with a mean of 18,670.

A foot long shoots of *D. marginata* were harvested ten months after field planting. The shoots were cut leaving one-meter height from the base of the plant. The shoots were sold at P2.00/shoot. Commercial and small-scale growers from Los Baños and nearby towns of Bay, Calauan and Calamba were buying from the Center. After the first cut, the remaining shoot would give 3-4 more shoots. On the second year, the shoots were harvested 4-5 times.

Study 2. Effect of different levels of N-fertilizer and time of pruning on the growth of *Pleomele reflexa* "Song of India".

Plant Height

The effects of the different levels of N fertilizer and the time of pruning on the growth of *P. reflexa* are shown in Table 7. The application of N fertilizer and the time of pruning the plants did not significantly affect the plant height of *P. reflexa*. The data showed that the plants fertilized with 120 kg N/ha pruned one month after planting produced the tallest plant with a mean of 100 cm. The unfertilized gave the shortest plants with a mean of 50.07 cm. The plants have an average height of 74.5 cm. The same findings was published in the AVRDC Progress Report (1990) wherein the unfertilized soybean plants produced pod yields that were comparable with those given with high amount of sugarcane compost (120 t/ha).

Yield

Number of shoots produced by *P. reflexa* as affected by different levels of N- fertilizer and time of pruning is shown in Table 8.

Statistical analysis showed no significant differences on the effect of different levels of fertilizer and time of pruning on the number of shoots produced. It was recorded
that plants applied with 120 and 180 kg N/ha produced more shoots than the 60 kg N/ha and the control.

In addition, number of shoots produced was not affected by time of pruning. The plants which were not pruned reached the height of 95.98 cm. A mean of 5-6 side shoots/ plant was recorded which was not significantly different from each other.

On a related study, Guimond **et al.** (1998) reported that in sweet cherry, summer pruning influenced the number of both flower buds and lateral shoots subsequently formed on the shoots. All of the timings and pruning lengths significantly increased the number of both flower buds and lateral shoots, but differences between pruning times were not significant. There was significantly less regrowth when shoots were pruned just below a node or in the center of an internode. In young high-density sweet cherry plantings, summer pruning may be useful for increasing flower bud formation on current-season shoots. The time of pruning, length of the shoots after pruning and location of the pruning cut can influence subsequent flower bud formation and vegetative regrowth.

Study 3. Effect of different levels of N and Calcium fertilizers on the growth of *Murraya paniculata* "Kamuning".

Plant height (cm)

Plant height of *Murraya paniculata* as affected by different levels of N and Ca fertilizers are shown in Table 9. Height of *M.*

paniculata was not significantly affected by different levels of N and Ca fertilizers. Results showed that plants tested with 50-0-0 gm/pot of nitrogen produced the tallest mean plant height of 121.3 cm while the unfertilized plants had a mean height of 88.25 cm.

In terms of Ca fertilizer, plants applied with 20 gm/ pot yielded the tallest mean height of 115.15 cm while without Ca application plants gave a mean height of 99.92 cm which was not significantly different from the rest of the Ca treated plants.

Yield

The effect of different levels of N and Ca fertilizers on the number of stems produced by *M. paniculata* is shown in Table 10.

Researchers observed significant interaction in the rates of Nitrogen and Ca fertilizer applied. It was clearly observed that the number of stems produced by *M. paniculata* responded differently in varying rates of N and Ca applied. An application of 5 grams N per plant at 0 Ca and 5 grams N at 7.5 grams Ca per plant yielded the highest stem per plant with a mean of 8. The former is better because there is no expense for Ca. All the treatments performed significantly better as compared with the unfertilized plants.

Similar findings was observed in the study of Fenn and Feagley (1999) wherein vegetables and ornamental foliage plants under greenhouse and field studies showed significant growth increases from increasing Ca ($^{++}$) : $NH_{(4)}^{+}$ ratios in the growth media. Increased root growth was normally the first plant response. Direct measurement of Ca^{++} stimulated NH_4^+ absorption were obtained in isotopic N. As Ca^{++} were increased. An increase in NH_4^+ absorption was obtained in all plant species tested. All the treatments performed significantly better as compared with the unfertilized plants.

Economic Analysis

Economic analysis in Table 11 shows that an application of 5 grams N/plant at 0 Ca and 5 grams N at 7.5 grams Ca/plant recorded the highest Return on Investment (ROI) at 41.42% AND 40%. The former is better than the later since it didn't entail additional cost. However visual observation showed that the application of Ca enhanced the glossiness of the leaves of "Kamuning". One-foot long shoots were cut when the plants reached one-meter long and sold at P7.00 each.

D. Greenhouse/ Pot Experiments

Study 4. Effect of different levels of N-fertilizers and percent shade on the growth of *Microsorium punctatum* "Polypodium".

Plant Height (cm)

The effect of different levels of nitrogen fertilizer and percent shade on the height of *M. punctatum* is presented in Table 12. Significant interaction was noted among treatments. Unfertilized plants under 50% shade gave the tallest plants but not significantly different from plants fertilized with 10 grams N per plant under 50% shade and all fertilizer treatments under 70% shade. The varying percent shade was found to have significantly increased the plant height. Plants in 50% shade with a mean of 60.18 cm significantly produced comparable height in plants under 70% shade with a mean of 58.43 cm.

In patchouli, Reglos and de Guzman (1991) observed that regardless of N levels, increasing shade from 0 to 25% level significantly increased plant height. Increasing further the shade level to 50% maintained plant height in the control and decreased plant height in the N-treated plants.

Yield

Table 13 shows that insignificant differences were obtained on the number of leaves/ fronds produced by *M. punctatum* as affected by

different levels of N and percent shade. Compared with the other treatments, more fronds were produced at 10 gm N/plant and at 50% shade with a mean of 56 and 45 leaves, respectively. Moreover, yellowish green, stiff and erect leaves were observed in plants fertilized with 30 gm N/ pot.

On related studies, Reglos and de Guzman in 1991 also found out that production of leaves in patchouli was two to three times higher in fertilized plants than the unfertilized plants at all levels of shade (0, 25, 50%). In hazelnut, Hampson **et al.** (1996) reported that shade was more detrimental to yield than flowering. Shade reduced yield primarily by decreasing nut number and secondarily by decreasing nut size. The incidence of several kernel defects increased as shade increased.

Study 5. Effect of different levels of N fertilizers and percent shade on the growth of *Dracaena sanderiana* "Gold"

Plant Height (cm)

The height of *D. sanderiana* was significantly affected by the different levels of nitrogen fertilizer and percent shade (Table 14). *D. sanderiana* attained the highest growth at the level of 60 gm N/ pot having a mean of 107.15 cm. while the shortest was on the unfertilized plants with a mean of 87.88 cm. It was also observed that the plants preferred the highest shade of 70% which enable them to attain a height of 122.84 cm. However, Table 14 shows that the number of stems produced was not significantly affected.

Yield

Table 15 shows the stem yield of *D. sanderiana* as affected by different levels of N fertilizer and varying percent shade. The stem yield did not vary significantly among treatments. A mean of 2-3 stems was attained in all treatments.

Study 6. Effect of different levels of N-fertilizers and percent shade on the growth of *Dracaena godseffiana* "Florida Beauty".

Plant Height (cm)

Plant height of *D. godseffiana* was significantly affected by levels of nitrogen fertilizer applied but insignificantly affected by percent shade (Table 16). Generally, all fertilized plants were significantly taller than the unfertilized plants. Tallest plants were observed from plants fertilized with 10 grams N/plant under 30% shade. This was not significantly different with plants fertilized with 20 grams N/plant under 50% shade and plants fertilized with 120 and 180 grams N/plant under 70% shade.

Yield of *D. godseffiana*

As shown in Table 17 stem yield of *D. godseffiana* was significantly affected by the levels of N fertilizer. All fertilized plants gave comparable results but differed significantly with the unfertilized plants. Highest number of stems was obtained from 20 grams N/plant but was not significantly different compared with that of 10 and 30 grams N/ plant. Percent shading did not significantly affect the number of stems per plant. Mean number of stems in each plant was 8.

Propagation of *D. godseffiana* started 18 months after planting. Stems with 2-3 nodes were cut and propagated. Established plants were sold as potted plants.

Economic Analysis

Economic Analysis of *D. godseffiana* is presented in Table 18. The highest Return on Investment was computed at 43.21% with the application of 20 grams N/plant under 30% shade. The shoots were sold at P6 each to florists and other commercial growers for rooting. The investment can be recovered in a relatively longer period of time since it is a slow-growing plant.

CONCLUSION

Based on the result of the study, the following conclusions were derived:

- For *D. marginata* "Tricolor" application of nitrogen at the rate of 180 kg/ ha spaced at 40 cm significantly yielded 55,670 shoots and the highest Return on Investment (ROI) of 41.78%.

- The stem yield of *M. paniculata* responded differently in varying rates of N and Ca applied. An application of 5 grams N per plant at 0 Ca and 5 grams N at 7.5 grams Ca per plant yielded the highest stem per plant with a mean of 8 at 41.42% and 40.00% ROI.

- Stem yield of *D. godseffiana* was significantly affected by the levels of N fertilizer. The highest Return on Investment was computed at 43.21% with the application of 20 grams N/plant under 30% shade.

RECOMMENDATION

The ornamental industry has a bright prospect. The generated production technology in this study will guide the growers in their ventures.

BIBLIOGRAPHY

Agribusiness Investment Profile Philippines, 1996-1997.

AVRDC. 1990. Progress Report. Shanhua, Tainan, Taiwan.

PCARRD. Integrated Ornamental Horticulture Res. and Devt. Program. 1995.

Flower TECH. Production and Marketing of Ornamentals Worldwide. 1999. Vol. 2 (2).

GUIMOND, C.M. **et al**. 1998. Timing and Severity of Summer Pruning Affects Flower

Initiation and Shoot Regrowth in Sweet Cherry. HORTSCIENCE. Alexandria Va: The American Society for Horticultural Science. Vol. 33(4): 647-649.

REGLOS, R. A. and C.C. de GUZMAN. 1991. Morpho-Physiological Modifications in Patchouli, *Pogostemon cablin* (Blanco) Benth., Under Varying Shade and Nitrogen Levels. The Philippine Agriculturist. Vol. 74 (3): 429-435.

Table 1. Growers/ Farm Owners Identified at Different Locations.

Location	Farm/ Owner	Area	Foliage Planted
1. Silang, Cavite	Belen Madina		Assorted potted foliage plants
2. Calauan, Laguna	Romeo Cruz	2.0 ha	*Pleomele reflexa*
3. Tanauan, Batangas	Cecille Dinglasan	1.5 ha	Only a small portion is planted with *D.godseffiana* (in plots) under trees
4. Lucban, Quezon	Frits Spaargaren	50 ha	*D. marginata, D. sanderiana,* other foliage
5. Lucban, Quezon	Nilda Salvalion	0.5 ha	Assorted foliage plants
6. Lucban, Quezon	Joseph de leon	2.0 ha	*D. marginata*
7. Tagaytay City	Flower Farm Corp.	3.0 ha	Few foliage plants
8. Tagaytay City	Phil. Dracaena Garden Corp.	-	*Dracaena fragrans*
9. Lipa City	All Season's Farm	-	*Dracaena godseffiana*
10. Brgy. Labak, Lipa City	Uni-Green Inc.	-	Most of the identified exportable foliage plants are planted in the field
11. Brgy Casili, Mandaue City	Shirley Santos	-	Assorted potted ornamental plants
12. Cabangkalan, Cebu City	Cebu Legacy Mktng Corp./ Mr. Chua	-	Assorted potted ornamental plants
13. Liloan, Cebu	Cabahug Ornamental Plants/ Rose Cabahug	-	Assorted potted ornamental plants
14. Poblacion, Liloan, Cebu	Dr. Felipe Vista	-	Assorted potted ornamental plants
15. Tagakpan,Tugbok Davao City	-	-	Assorted potted ornamental Plants

Location	Farm/ Owner	Area	Foliage Planted
16. Malagos, Baguio District, Calinan, Davao City	Puentespina Garden		Assorted ornamental foliage & flowering plants
17. Los Amigos, Calinan District, Davao City	Alcon Garden	-	Assorted foliage plants
18. Catalunan, Pequerio, Davao City	Yuhico Orchid Garden	-	Assorted foliage and flowering plants
19. Tugbok, Davao City	Ben Gallego	-	Potted and field Plantation of diff. foliage plants
20. Mintal, Davao City	Hernandez Garden	-	Assorted potted ornamental plants
21. Flores Village, Bangkal, Davao City	Noel's Garden	-	Assorted potted ornamental plants
22. Guimaras Province	Cutflower & Ornamental Producers Federation	-	Assorted potted ornamental plants
23. San Miguel, Guimaras	Rhoda's Garden	-	Assorted potted ornamental plants
24. Jordan, Guimaras	Amparo's Garden	-	Assorted potted ornamental plants
25. Buenavista, Guimaras	Mardone's Garden	-	Assorted potted ornamental plants
26. Talisay, Negros Occ.	Sweet Greens	-	Assorted potted ornamental plants
27. Victoria's Negros Occ.	Victoria's Cutflowers	-	Anthuriums
28. Sagay, La Carlota City	-	-	Assorted potted ornamental plants
29. San Miguel, La Carlota City	Conchita Cerdaña	-	Anthurium and potted foliage plants

Table 2. **Methods of propagation used for the different ornamental foliage plants collected.**

Foliage	Methods of Propagation
M. paniculata "Kamuning"	Marcotting
P. Reflexa "Song of India"	Kulob System
M. punctatum "Polypodium"	Division of Rhizomes
D. marginata "Tricolor"	Stem Cutting
D. sanderiana "Gold"	Stem Cutting
D. godseffiana "Florida Beauty"	Stem Cutting

Table 3. **Soil Chemical Properties of the Experimental Area**

Chemical characteristics	Level
PH	6.5
OM (%)	1.43
P (ppm)	24.22
K (m.e./100 g)	1.01

Table 4. Height of shoots (cm) of *D. marginata* as affected by different levels of nitrogen fertilizer and plant spacing.

Level of Nitrogen Fertilizer (kg/ha)	Spacing (cm)				Mean
	40	50	60	70	
0-0-0	47.08	42.69	44.32	40.13	43.55 b
60-0-0	52.47	50.83	51.20	50.48	51.25 a
120-0-0	50.13	47.42	48.13	45.55	47.81 ab
180-0-0	47.16	49.27	53.19	46.60	49.05 ab
Mean	49.21	47.55	49.21	45.69	

C.V. % a) 6.57 b) 5.93

Means followed by the same letter are not significantly different at 5% level using DMRT.

Table 5. Shoot yield of *D. marginata* as affected by different levels of nitrogen fertilizer and plant spacing.

Level of Nitrogen Fertilizer (kg/ha)	Spacing (cm)				Mean
	40	50	60	70	
0-0-0	35330 bcd	22670 de	24670 de	18670 e	25335
60-0-0	52000 a	45070 abc	33780 cd	27620 de	39615
120-0-0	49000 ab	44270 abc	34000 cd	24000 de	37817
180-0-0	55670 a	46930 abc	36440 bcd	30090 de	42285
Mean	47999	39733	32221	25094	

C.V. % a) 10.83 b) 14.57

Means followed by the same letter are not significantly different at 5% level using DMRT

Table 6. Yield and economic analysis of *D. marginata.*

Treatment (Fertilizer/Spacing)	Gross Income	TC	Net Benefit	ROI (%)
180-0-0 /40	111,340	80,000	31,340	41.78
60-0-0 /40	104,000	77,500	26,500	35.33
120-0-0 /40	98,000	78,700	19,300	25.73
180-0-0 /50	93,860	80,000	13,860	18.48
60-0-0 /50	90,140	77,500	12,640	16.85
120-0-0 /50	88,540	78,700	9,840	13.12
0-0-0 /40	70,660	-	-	-
180-0-0 /60	72,880	-	-	-
60-0-0 /60	67,560	-	-	-
120-0-0 /60	68,000	-	-	-
180-0-0 /70	60,180	-	-	-
60-0-0 /70	55,240	-	-	-
0-0-0 /60	49,340	-	-	-
0-0-0 /50	45,340	-	-	-
120-0-0 /70	48,000	-	-	-
0-0-0 /70	37,340	-	-	-

Table 7. Plant height (cm) of *Pleomele reflexa* as affected by different levels of nitrogen fertilizer and time of pruning.

Level of Nitrogen Fertilizer (kg/ha)	Time of Pruning				Mean
	Unpruned	P1	P2	P3	
0-0-0	57.03	42.73	50.92	49.58	50.07
60-0-0	88.67	67.94	65.18	67.95	72.44
120-0-0	93.11	100.06	82.18	76.79	88.19
180-0-0	78.76	70.69	76.19	70.84	74.12
Mean	95.98	70.36	68.77	66.29	

C.V. % a) 14.73 b) 31.30

Table 12. Plant height (cm) of *Microsorium punctatum* as affected by shade and different levels of nitrogen fertilizer.

Level of Nitrogen Fertilizer (gm/plant))	% Shade			Mean
	30	50	70	
0	52.58 c-e	65.78 a	59.75 a-c	59.37
10	50.17 de	63.14 ab	62.33 ab	58.55
20	46.92 e	55.77 b-d	60.92 ab	54.54
30	52.42 c-e	56.02 b-d	50.75 de	53.06
Mean	50.52 a	60.18 b	58.43 b	

C.V. % a) 7.71 b) 11.78

Means followed by the same letter are not significantly different at 5% level using DMRT.

Table 13. Leaf yield of *Microsorium punctatum* as affected by shade and different levels of nitrogen fertilizer.

Level of Nitrogen Fertilizer (gm/plant)	% Shade			Mean
	30	50	70	
0	35	36	35	35
10	54	60	54	56
20	30	40	26	32
30	39	42	37	39
Mean	40	45	38	

C.V. % a) 32.85 b) 11.92

Table 14. Plant height (cm) of *Dracaena sanderiana* as affected by shade and different levels of nitrogen fertilizer.

Level of Nitrogen Fertilizer (gm/plant)	% Shade			Mean
	30	50	70	
0	70.75	80.21	112.68	87.88 b
10	82.26	83.77	128.81	98.28 ab
20	93.31	95.13	132.92	107.15 a
30	84.02	91.06	116.84	97.31 ab
Mean	82.59 b	87.54 b	122.84 a	

C.V. % a) 8.09 b) 10.78

Means followed by the same letter are not significantly different at 5% level using DMRT.

Table 15. Stem yield of *Dracaena sanderiana* as affected by shade and different levels of nitrogen fertilizer.

Level of Nitrogen Fertilizer (gm/plant)	% Shade			Mean
	30	50	70	
0	3	3	2	3
10	3	4	3	3
20	3	3	2	3
30	3	3	2	3
Mean	3	3	2	

C.V. % a) 20.80

Table 16. **Plant height of *Dracaena godseffiana* as affected by shade and different levels of nitrogen fertilizer.**

Level of Nitrogen Fertilizer (gm/plant)	*% Shade*			*Mean*
	30	*50*	*70*	
0	20.24 e	33.55 cd	25.08 de	26.29 a
10	48.36 a	36.35 bc	35.70 bc	40.14 b
20	36.17 bc	39.31 a-c	45.69 ab	40.39 b
30	37.01 bc	37.33 bc	43.18 a-c	39.17 b
Mean	35.44	36.63	37.41	39.17 b

C.V. % a) 14.95 b) 21.85

Means followed by the same letter are not significantly different at 5% level using DMRT.

Table 17. **Number of stems of *Dracaena godseffiana* as affected by shade and different levels of nitrogen fertilizer.**

Level of Nitrogen Fertilizer (g/plant)	*% Shade*			*Mean*
	30	*50*	*70*	
0	2	2	3	2 b
10	10	11	10	10 a
20	11	11	11	11 a
30	9	8	10	9 a
Mean	8	8	9	

C.V. % a) 24.05
Means followed by the same letter are not significantly different at 5% level using DMRT.

Table 18. **Yield and economic analysis of *Dracaena godseffiana* under varying percent shade and levels of N fertilizer.**

Treatment (fertilizer / % shade)	*Gross Income*	*TC*	*Net Benefit*	*ROI (%)*
20 N / 30	118,800	106,700	12,100	43.21
10 N / 50	118,800	107,100	11,700	41.78
20 N / 50	118,800	107,200	11,600	41.42
20 N / 70	118,800	107,700	11,100	39.64
10 N / 30	108,000	106,600	1,400	5.00
10 N / 70	108,000	107,600	400	1.42
30 N / 70	108,000	107,800	200	0.71
30 N / 30	97,200	106,800	-	-
30 N / 50	86,400	107,300	-	-
0 N / 70	32,400	107,500	-	-
0 N / 30	21,600	106,500	-	-
0 N / 50	21,600	107,000	-	-

APPENDIX 1. Foliage plants collected, propagated and maintained at BPI-LBNCRDC

1. *Cordyline terminalis* "Pink top"
2. *Cordyline terminalis* "Kiwi"
3. *Cordyline terminalis* "Willy's Gold"
4. *Cordyline terminalis* "Golden Ti-plant"
5. *Dracaena marginata* "Tricolor"
6. *Dracaena marginata* "Red Margin"
7. *Dracaena marginata* "Ivory"
8. *Dracaena godseffiana* "Florida Beauty"
9. *Dracaena sanderiana* "Gold"
10. *Dracaena sanderiana* "Ivory"
11. *Dracaena godseffiana* "Milky Way"
12. *Dracaena godseffiana* "Gold Dust"
13. *Dracaena goldienna*
14. *Dracaena rotheina*
15. *Dracaena draco*
16. *Dracaena derumensis* cv. Warneckii
17. *Dracaena compacta*
18. *Dracaena sanderiana* cv. Virens
19. *Dracaena godseffiana* cv. Bausei
20. *Microsorium punctatum*
21. *Murraya paniculata* "Kamuning"
22. *Pleomele reflexa* "Song of India"
23. *Pleomele reflexa* "Song of Jamaica"

NEW TECHNOLOGIES FOR OFF-SEASON LEAFY VEGETABLES AND TOMATO PRODUCTION

Adoracion A. Virtucio*

ABSTRACT

Leafy vegetables and tomatoes are important vegetables of the country. Nutritionally, leafy vegetables and tomatoes are good sources of fiber and nutrients needed to be healthy. Economically, leafy vegetables provide short turnover of investment because they are very easy to grow and could be harvested after 30 days. Tomato in the other hand is a valuable cash crop for the farmers.

Vegetable consumption of Filipinos is low at 106 g/capita. Socio economic studies showed that the reasons for low consumption are limited supply and unaffordable price. Unfavorable conditions (high temperature, abundant rainfall and high humidity) make production of vegetables seasonal. This project is conducted to enhance productivity and reduce seasonality of vegetables while simultaneously reducing the use of pesticides and inorganic fertilizers. Off-season production technologies such as raised beds, application of net structures, right fertilizer management, integrated pest management, proper cultural practices and use of improved varieties were generated.

In pechay, planting in raised beds and applying rice straw compost (1 kg/m^2), basal application of 90-20-20 kgs NPK/ha and twice foliar spraying of 19-19-19 + ME gave
47.5% increase in yield over the farmers' practice of applying chicken manure compost and urea fertilizers. The application of net tunnels over pechay beds to reduce impact of rain and prevent invasion of pests had 34.6% yield advantage.

---

*Supervising Agriculturist and Project Director, AVRDC-Philippine Outreach Program , BPI National Crop Research and Development Center, Los Baños, Laguna.