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PRODUCTION MANAGEMENT PRACTICES OF JASMINE (*Jasminum sambac* [L.] Aiton) IN THE PHILIPPINES

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ABSTRACT

Jasminum sambac [L.] Aiton, locally known as sampaguita in the Philippines, is a traditional plant cultivated for its fragrant flowers. The study was conducted to evaluate the present cultural management practices as well as problems and issues that confront the farmers/producers in major jasmine production areas in Laguna, Quezon and Pampanga, Philippines. Specifically, the study focused on production schemes and pest management to enhance the viability of jasmine production.

The major problems identified by the 172 respondents were the high production costs, inefficient farm management, seasonality of bud formation, and lack of proper information dissemination. Farmers regularly pruned, defoliated and applied commercial fertilizers to enhance bud formation. The occurrence of morphological and physiological disorders was noted. Farmers perceived opportunities in increased production due to the foreseen income potentials for fresh flowers and other products. The income of farmers from fresh buds ranged from Php 3,000 to Php 26, 000 per month. The major insect pests were whiteflies (*Dialeurodes kirkaldyi* Kotinsky) and microlepidoptera (tiny moth). Drying of the roots and yellowing of the leaves were observed. Cultural management and harvesting practices need to be improved through adequate production inputs and proper tools and equipment for rapid farm operations. It is important to create an integrated pest management (IPM) protocol for jasmine farming and come up with a resistant variety most especially when jasmine is intercropped with cash crops. Institutional and financial support are also important for research on technologies in processing jasmine into high-valued products to increase its economic value and widen the market potential.

Key words: propagation techniques, morphological disorders, production seasonality, defoliation, pruning, pest and disease management.

INTRODUCTION

Jasminum sambac (L.) Aiton (syn. *Nyctanthes sambac* Linn.) is a species of jasmine native to southwestern and southern Asia, in the Philippines, India, Myanmar and Sri Lanka (http://en.wikipedia.org/wiki/Jasminum *sambac*). The term jasmine is derived from the Arabic Persian word? "yasmin" or "gift from god". The commercially important species grown for cut flowers and perfumery industry are *J. sambac*, *J. grandiforium*, and *J. auriculatum* (Rimando, 2003). In the Philippines, three types of *J. sambac* (traditionally termed sampaguita) flowers are grown, the single-petal or "Maid of Orleans", semi-double or "Belle of India" and the multi-petal or "Grand Duke of Tuscany". Sampaguita is a Spanish word for the local phrase "sumpa kita", meaning "I promise you" so that the flower became a symbol of fidelity, purity and eternal love in the Philippines. It is the Philippine national flower and is considered as a symbol of honor and dignity (Tan, 2004). As a fresh flower, jasmine is used in bouquets and garlands to honor guests. The

different parts of *J. sambac* such as the leaf, stem, bark and roots are important as source of chemicals that are useful in the pharmaceutical industries.

Very limited research on production requirements and marketing has been reported (Rimando, 2003). Hence, research is necessary to increase volume of production and improve the blossom quality to exploit local and export markets. The study sought to evaluate jasmine production practices in selected major production areas in Laguna, Lucena City (Quezon) and Pampanga. Specifically, it evaluated the present cultural management practices in the selected areas; identified and analyzed the problems and issues in the establishment and maintenance of jasmine farms; and evaluate the system of harvesting and handling of the blossoms. The results of the study are envisioned to benefit the stakeholders not only in the selected production areas but also other jasmine production areas in the country.

MATERIALS AND METHODS

Coordination meetings were conducted with the key informants from the provincial and municipal agriculturists' office and other stakeholders. Site visits to the different production areas were done for initial gathering of information which served as baseline data for evaluation/assessment of farming systems and management of jasmine as a main or alternative crop. Issues and problems were also gathered for process evaluation. The questionnaires were based on the baseline data.

The study sites were selected based on the degree of involvement of the farmers as identified by the traders. The jasmine producers were identified by the Municipal Agriculturist Office. Snowball sampling determined the number of respondents as well as the willingness of the farmers to participate in the survey, resulting in 172 respondents that included 86 in Laguna, 47 in Pampanga and 37 in Quezon province (Figure 1).

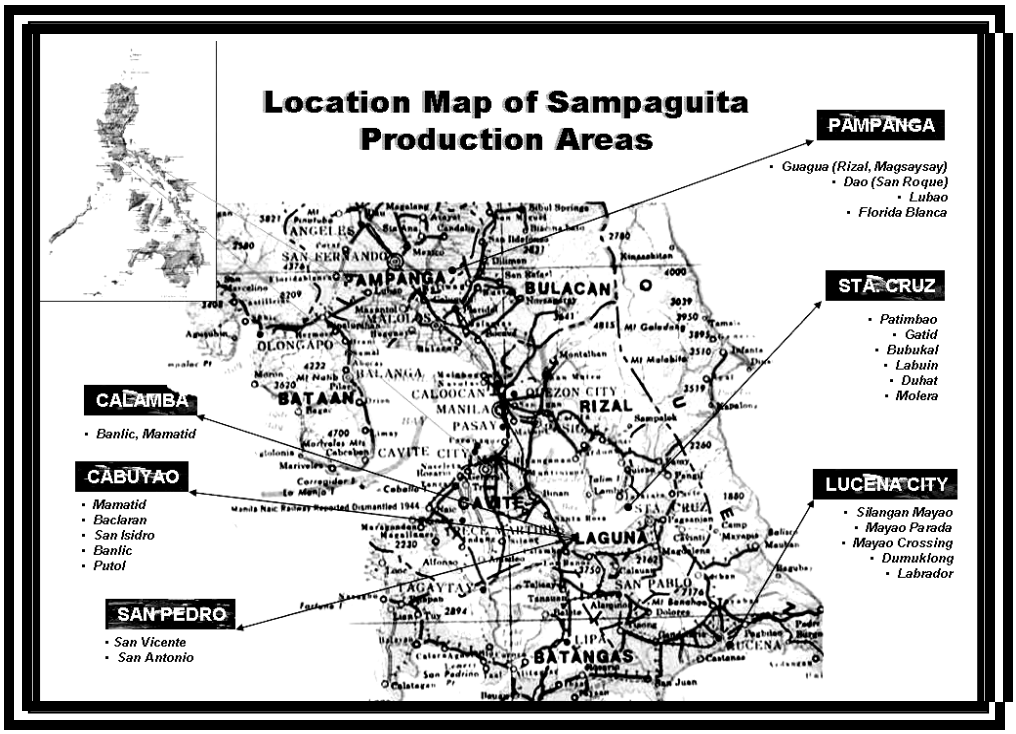

Fig.1. Production sites of jasmine in Luzon, Philippines

The municipalities in Laguna included: Calamba (Banlic), Cabuyao (Mamatid, Baclaran, San Isidro, Banlic, Putol), San Pedro (San Vicente, San Antonio), and Sta. Cruz (Patimbao, Gatid, Bubukal, Labuin, Duhat, Molera). In Lucena City (Quezon Province), jasmine farmers from Silangan Mayao, Mayao Parada, Mayao Crossing, Dumuklong and Labrador were interviewed. Lastly, the respondents from Pampanga included the producers in Guagua, Dao, Lubao, San Roque and Florida Blanca. The number of respondents from Sta. Cruz, Laguna was relatively higher compared to other production areas since the buds provided them their daily income.

Based on the data generated, current production practices, issues and concerns of the farmer/producers were assessed. Strategies were formulated for improvement of jasmine production in the Philippines.

RESULTS AND DISCUSSION

The farmer/producer respondents were 20 to 77 years old where young producers (20-25 yr. old) got involved in the operation after inheriting the farm from their parents. Their exposure to jasmine production equipped them to master the trade. Farmer/producer respondents consisted of 58 % male and 42 % female. The level of educational attainment of the farmer/producers was relatively low, where 37.8% and 32.6 % graduated from elementary and high school, respectively and 22.66 % either started or finished college education. All the respondents are married and about 85.5% relied on jasmine production as their main income. About 14.5% of the respondents, who are either involved in rice farming, livestock, orchard, vendor, furniture making, fishing, selling dry goods, laborers or contractors, considered jasmine production as an additional source of income. In the province of Laguna, the respondents were involved in jasmine farming for 8 to 51 years where those in San Pedro for 3 to 41 years, in Cabuyao for 2 to 25 years, in Sta. Cruz for 3 to 51 years and 3 to 16 years in Calamba. On the other hand, jasmine farming was done for 2 to 35 years by the respondents from Pampanga, and 2 to 16 years in Lucena, Quezon.

Cultural management practices of jasmine in selected areas

The prevailing climate conditions in the Philippines are favorable for the culture of *J. sambac*. Jasmine is sun-loving, thrives best under relatively dry conditions and requires light intensities ranging from 4,000-8,000 foot candles for profuse flowering (Pal and Krishnamurthi, 1967). High temperature (30^{o}C) and cumulative heat are favorable for growth and flower induction (Rai, 1984). The commonly planted *J. sambac* variety is the single-petal type where its main use is for fresh flower buds. The double-petal type commonly called *kampupot* is rarely planted. The single-petal jasmine flowers whole year round while the double-petal type blossoms only once a year. The cultural practices are almost similar in the different sites from the establishment of the plants to harvesting of the buds. Farm activities such as propagation from cuttings or marcots, weeding, watering, pruning, defoliation, fertilization and pesticides application are the common cultural practices involved in jasmine production.

Propagation and planting

The common planting materials are stem cuttings (8 to 10 inches) while in Sta. Cruz, (Laguna), Pampanga and Lucena a few farmers used marcotted plants since these are expensive and not readily available. The stem cuttings are usually bought in Talisay (Batangas), Mamatid (Cabuyao) and Bulacan and are easily handled, available and much cheaper than marcots. Farmers however, prefer marcotted plants due to the assurance of the survival and early flowering. Other asexual propagation methods include layering, grafting, and budding (Rimando, 2003). For mass production of planting materials, shoot tip cuttings of about 15 cm. long with four leaves are rooted in vermiculite, volcanic cinder, or coir dust and grown in screen house provided with misting facilities.

In other countries, jasmine propagation is done by ground layering and sucker, cutting and rooting, and tissue culture method for large scale multiplication of uniform and disease-free plants (Banerji and Dwivedi, 2007). These methods increase supply of planting materials for expansion of production areas. *J. sambac* was reported to be planted as 1.2 m x 1.2 m. or 0.75 m x 0.75 m (Rimando, 2003) however, the study found that the common spacing used is 0.5 m between plant and 1 m between rows. This spacing is convenient as it facilitates harvesting and cultural maintenanc. Therefore, there is a need to determine the right distance of planting that is convenient for the farmers while producing maximum yield of jasmine flowers.

According to the Bureau of Plant Industry, there are many inquiries about steady supply of fresh flowers for garlands and for essential oils for industrial and medical applications. However, there is no large-scale jasmine production. Since jasmine is easy to grow, thrives on many types of soils in a wide range of climatic conditions, it is recommended that government should give attention to this potential dollar earner plant of the country (Anon. 2010).

Water requirements

Stem cutting propagation of jasmine using medium-mature stems (8 to 10 inches long) is done by planting in perforated plastic bags filled with sandy-loam soil and watered daily. The water supply is one of the difficulties faced by the farmers. Although water is available in the vicinity, its source is several meters away from their farm. In jasmine cultivation, water is critical especially during the establishment period where rooting and rapid plant growth occurs. Studies have shown that the soil should be saturated with moisture to the root zone for good growth (Rimando, 2003). The flowering of jasmine is not correlated with the amount of rainfall although the water status in the soil prior to induction may influence the intensity of flowering (De la Paz 1986). However for potted jasmine, a total of eight flowering cycles per year is achieved at 44 days between cycles during dry months and 55 days during wet months. Furthermore, the low flower yield during the wet season is not correlated to the available water but to the high incidence of pests and diseases.

Weeding and mulching

Weeding is considered by farmers as a backbreaking maintenance activity. The presence of too much weeds in farm serves as breeding ground for some insect pests. Jasmine farmers weed as often as necessary and is done on the average, 2 to 3 times a week. In Sta. Cruz, farmers use rice stalk not only as mulching materials but also for weed management while in Pampanga, farmers used thick black plastic (polyethylene) sheet to cover the basal portion of jasmine plant (Fig. 2). Other mulching materials such as decomposed leaves and stem from pruning and defoliation operations and rice hulls were utilized by some farmers.

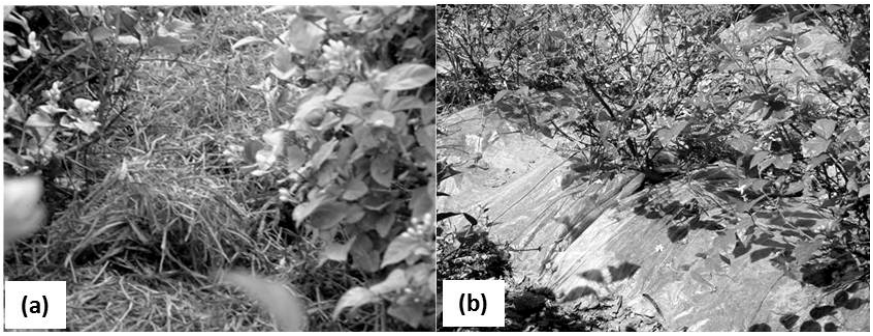

Fig. 2. Use of (a) rice stalk as organic supplement and (b) black polyethylene plastic for weed control

Production inputs

One of the major costly inputs of farmers in jasmine production is the use of chemicals like fertilizers and pesticides. The producers used both organic and inorganic fertilizers to produce high quality buds of jasmine. Common organic fertilizers included decomposed plant parts and animal manure. According to some of the respondents, organic fertilizers are seldom used because it is not effective as the inorganic fertilizer for plant growth and development. Commercially available inorganic fertilizers applied by farmers are urea, complete fertilizer and ammonium sulfate as well as potash. Based on farmer's experience, these fertilizers increase the productivity of their jasmine farms from 40% to 50% of their usual harvest. The application of nitrogen fertilization for increased flower yield are supported by the findings of Kumar and Gill (1983) who reported that the application of 30 g. N per plant gave the highest flower yield of 635.8 g per plant. In addition, the recommended fertilizer rates in India are 50 g N, 200 g P_2O_5 and 150 g K_2O per plant per year if farmyard manure has not been applied. If manure is applied at the rate of 10 kg per plant per year, N may be reduced to 5 g and the P_2O_5 to 100 g. In the case of the respondents, the mixing of different kinds of fertilizers before application is more effective in improving quantity and quality of the flowers. The frequency of application would depend on the availability of cash, plant size and quantity of the buds and foliage color. Some farmers used mulching materials such as the jasmine trimmings after pruning and defoliation activity as fertilizer input.

The commercial pesticides used by farmers are those that are readily available in the nearby market and recommended by the chemical representatives. Some of these pesticides are methomyl, carbaryl, deltamethrin, benomyl, carbofuran, endosulfan, cartap hydrochoride, cypermethrin and malathion. Pesticide application varied from 2 to 3 times a week similar to fertilizer application. The farmers observed some problems such as leaf twirling, yellowing of buds, discoloration of foliage and "burning effect" or toxicity in using these chemical pesticides. Probably the problems arose from improper application methods, frequency, timing and quantity applied. Improper methods of application of these chemicals also affected farmer's health because some of them experienced dizziness, vomiting and skin itchiness or allergies which may be caused by the absence of safety gadgets during application and improper use of the chemicals.

Defoliation and Pruning

Farmers practiced defoliation and pruning to initiate flowering and enhance production of buds. Based on their observation, these practices influenced the quality and quantity of the harvested buds. These practices are considered unique, interrelated and sequential maintenance activities applied by jasmine producers and usually done before the onset of rainy season to prevent pest and diseases occurrence, to have sufficient water supply, and to promote rapid shoot formation. Generally, these practices are done after the first to second flowering season or if jasmine is matured enough to be defoliated and pruned. According to the farmers, frequency of defoliation and pruning would also depend on the demand of buds in the market.

Despite of the positive effect of defoliation for bud production, producers also complain that it is time-consuming and labor intensive requiring the hiring of additional labor. Defoliation techniques applied to other plants should be tried in jasmine to be able to lessen the labor cost and shorten the time devoted in doing this activity (Anon., 1980). It was observed that for the sequential and simultaneous defoliation, pruning and harvesting operations, the farmers in Pampanga divided their farms into several equal blocks depending upon the size of the farm where one block is defoliated; another block is pruned, and another block harvested while the rest of the blocks are at the stage of shoot formation. Under this rotation of activities, there is sustainable farm production of buds. Based on the farmer's observation, defoliation and pruning practices influenced the quality and quantity of the harvested buds. These practices are considered unique, interrelated and sequential

maintenance activities applied by jasmine farmers during the onset of rainy season. These practices prevent occurrence of pest and diseases, assure sufficient water supply, and promote rapid shoot formation. Generally, these practices are done after the first to second flowering season or if jasmine is matured enough to be defoliated and pruned. The frequency of defoliation and pruning would also depend on the demand of buds in the market. It has been reported that pruning at six months intervals increase the flower formation (Muthuswamy and Rao, 1980).

Harvesting practices

Jasmine flower blooms only for less than a day on the plant, lasting for about 12 to 20 hours. The peak of flower opening is around 6 to 8 in the evening when the ambient temperature becomes cooler. The common practice of the farmers is to pluck or harvest the unopened matured flowers early in the morning although Rimando (2003) reported that fully developed unopened buds are picked late in the afternoon till sunset. Harvesting is one of the significant stages in jasmine production and there are three key players involved, the farmer/producer, the pickers (may be hired) and the runners (also considered as dealer in Pampanga) who collect the harvested buds in the farm. Harvesting usually starts as early as 3 to 5 in the morning. This activity requires efficient time and effective labor to harvest more buds at the earliest and shortest time before sunrise when buds tend to open. Although open flowers may find utilization as raw material for oil extraction, there is no technology yet established in the country. Also, large volumes of open flowers are needed for oil extraction which is not available this time

The maturity index of jasmine should be studied and established because this would help predict the proper time of harvesting. If the time of harvesting matured buds can be projected, then it would be easy for the farmers to calendar farming activities.

Crop protection management

About 53.5% of jasmine farmers in all provinces surveyed viewed whitefly (*Dialeurodes kirkaldyi*) as a serious problem both during wet and dry seasons (Table 1). It sucks the plant juices causing stunted growth and drying of plants under severe infestation. Based on the ocular inspection of jasmine production sites, the said insect was indeed prevalent at an alarming level during the dry season coinciding with the peak of bud production. The damage caused by this insect led to the reduction of flower formation. *Microlepidoptera* and whitefly were considered major pests. However, inspection of the area during the wet season, when *Microlepidoptera* population should be relatively high did not support the farmers' perception. Approximately 90% of jasmine plants were visibly infested by the whitefly, while only 5% were infested by *Microlepidoptera*.. Bud borers also infested jasmine flower buds. Despite the fact that jasmine is a perennial crop, white grub and termites were not considered serious by jasmine farmers. Some farmers mistook the lygaeid bug ("*atangya*") for a pest although it is a beneficial insect.

Some of the morphological disorders observed are discoloration of foliage, white spots, folding of foliage, basal rot, gradual death of the plant and damaged buds. Sooty mold was perceived as the most important disease. However, sooty mold is more of a symptom of infestation of a sucking insect such as the whitefly and can be washed away from leaves. Drying of roots is mainly due to infection by the soil-borne mold, *Sclerotium rolfsii*. Yellowing of leaves may be due to the yellowing mosaic virus which is of low incidence.

Table 1. Farmers' perception of pest and disease problems of jasmine.

Perceived Problems	Number of Respondents				
	Laguna	**Quezon**	**Pampanga**	**Total[1]**	**Percentage**
Insect					
Whitefly	47	19	26	92	53.5
Microlepidotera	50	18	33	101	58.7
Flower bud borer	11	0	3	14	8.1
White grub	8	0	3	12	7.0
Termite	1	3	0	4	2.3
Lygaeid bug[2]	15	5	0	20	11.6
Others	1	0	6	7	4.1
Disease/ Symptoms					
Sooty mold	27	4	18	49	28.5
Drying of roots	15	4	2	21	12.2
Yellowing of leaves	15	7	2	24	13.9
Others	11	0	0	11	6.4

[1]Total respondents for all provinces was 172. [2]Lygaeid bug is a predator of other insects and not a pest.

All farmers interviewed relied heavily on the use of chemicals for insect pest and disease management (Table 2). A few used other control measures such as handpicking of infested or infected leaves and treatment with smoke. Insecticides used were methomyl, carbaryl, cartap hydrochloride and several pyrethroids such as lambda cyhalothrin, cypermethrin and deltamethrin. Combinations or "cocktails" of 2 or 3 insecticides was practiced which may result in overdosing, insect resistance and excessive exposure of applicators to chemicals.

Table 2. Pest management practices of jasmine farmers.

Control Method	Number of Respondents				
	Laguna	**Quezon**	**Pampanga**	**Total[1]**	**Percentage**
Use of Insecticides					
Methomyl	40	7	13	60	34.9
Carbaryl	13	7	10	30	17.4
Cyhalothrin	3	1	9	13	7.6
Cypermethrin	5		2	7	4.1
Deltamethrin	5	1	2	8	4.6
Others	26	7	2	35	20.3
Cocktails					
Methomyl + Carbaryl	6	9	0	15	8.7
Methomyl+ Cyhalothrin	4	1	1	6	3.5
Other cocktails	17	7	5	29	16.9
Use of fungicides					
Mancozeb	7	0	0	7	4.1
Benomyl	1	2	0	3	1.7
Other methods (handpicking, etc.)	2	0	6	8	4.7

[1]Total respondents for all provinces was 172.

Very few farmers used fungicides for disease control. Some farmers used insecticides to control diseases, which reflects the lack of proper information about chemical usage and disease control. Nearly 20% of farmers applied chemicals twice a week and another 17.4%, thrice a week (Table 3). While these application frequencies are already excessive, a few farmers admitted having applied chemicals everyday or every other day. Excessive application of chemicals often results in the rapid build-up of pest populations due to extermination of natural enemies and/or development of resistance to chemicals by the pests.

Table 3. Frequency of pesticide application by farmers on jasmine.

	Number of Respondents				
Application Frequency	**Laguna**	**Quezon**	**Pampanga**	**Total[1]**	**Percentage**
Once a week	5	1	4	10	5.8
Twice a week	22	4	8	34	19.8
Thrice a week	15	10	5	30	17.4
Other frequency	16	9	4	29	16.9

[1]Total respondents for all provinces was 172.

Issues, concerns and strategies in jasmine production

The production areas of jasmine in the Philippines are still considered as a backyard or secondary operations and is rarely planted solely for commercial purposes. In the selected sites, jasmine is planted either along the highways, railroads, as secondary crop in the rice fields and vegetable production and in small patches in backyards. Some areas were planted for decades (51 years ago) in San Pedro, Laguna but are now converted to poultry and orchard farms, residential areas, dumpsites, subdivisions and industrial sites resulting in declining jasmine production. There was a continuous increased production of jasmine buds in Sta. Cruz, Lucena City and Pampanga. In all the production areas surveyed, the farmer plant intercrops to augment their income and maximize farm space. In Sta. Cruz, vegetables and rice crops are commonly integrated in their jasmine farm. Meanwhile, in San Pedro, Pampanga and Lucena, ilang-ilang (*Cananga odorata*), champaca (*Michelia champaca*) and camia (*Hedychium coronarium*) are planted for their flowers as accessories in special garlands. Calamba and Cabuyao farmers incorporate corn, citrus and vegetables to fully utilize the entire narrow farm spaces.

Based on the existing production schemes several issues and concerns in jasmine production were identified in the study. These include 1) limited production areas devoted for jasmine production; 2) seasonal production and unstable price of jasmine buds; 3) lack of quality control in the harvested buds; and 4) non-availability of modern farming techniques in terms of asexual methods of propagation, availability of growth promoting chemicals and resistant plant variety which could tolerate pest and diseases.

The lack of comprehensive recommendations for growing aromatic crops as an intercrop or mixed cropped with traditional agricultural crops has also been identified in India, which is a major world producer of aromatic plants. Incomplete recommendations targeting increased production of aromatic plants have limited use as these are difficult and uneconomical for farmers (Tewari, 2010). On the other hand, improved production systems can also utilize exogenous chemicals such as the application of hormones, NAA or PP 333, which can improve floral bud formation (Huang et al 2009).

Enhancing the benefits derived from jasmine production will encourage the farmers/entrepreneurs to venture in the business. One strategy is the availability of plant materials that will facilitate the establishment of commercial farms in the country. The seasonality of jasmine production which results in unstable price for jasmine buds is the major concern. Peak production of blooms is usually from April until June and the price is relatively low. Improved plant varieties like tissue culture, selection and mass propagation of non-seasonal blooming variety of *J. sambac* are important research areas to solve the seasonality of flower formation. Another strategy is to design a planting scheme where jasmine production areas are distributed all over the country. The regions in the Philippines differ in rainfall distribution so that harvesting of flowers can be rotated resulting in stable prices through year round production.

Quality of jasmine buds tends to be variable due to the uncontrolled production environments and differences in the production and post-harvest handling practices (Sanchez, et. al. 2003). The quality of buds is affected by the production environment: pest and diseases, seasonal bud production, and variation in bud size (as influenced by the farm inputs used such as fertilizers and pesticides) and availability of storage facilities to maintain bud freshness. The price of jasmine varies depending on whether the buds were stored overnight or are freshly harvested. Cold stored buds are cheaper because of lower scent quality. Therefore, quality standard for different grades of jasmine buds should be developed by concerned government agency to encourage improved farming practices.

Information dissemination regarding the proper and improved cultural and pest management of jasmine is needed from agriculturists, extension workers and horticulture specialists. Most farmers relied on the recommendations of chemical sales representatives even without farm trials. Other problems mentioned by the producers that need attention are irrigation systems, transportation and government subsidy for fertilizers, pesticides and micro-financing for their operating expenses.

CONCLUSION

There is a need to improve the production technology, insect pests and diseases management and harvesting practices of *J. sambac*. Selection of cultivars for high quality flower production should focus on varieties that could produce flowers even during the rainy months. Another option is infrastructure facilities that could house jasmine during the rainy months to prevent pest infestation of blossoms. A planting scheme can be designed to have jasmine production areas distributed all over the country so that floral buds are available the whole year thus stabilizing the prices.

Population density, fertilization and height of pruning are among the most important factors affecting the production of jasmine flowers. New production techniques and crop protection practices, which could address the current issues on irregularity of flower production, must be dealt with. Farmers should be given sufficient support in terms of materials, tools and technology to support their manual technique in inducing flower production. These could be done by having effective and efficient tools in harvesting and using environmentally safe chemicals or plant growth regulators to support the defoliation and pruning practices. Similarly, there is a need to determine the optimum maturity index and to improve harvesting practices for the fresh market.

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