Constraints and Potential of Sweet Pepper Cultivation in Plastic Houses in Indonesia

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Keywords: *Capsicum annuum*, sweet pepper, cultivation methods, plastic houses, Indonesia

Abstract

At the start of a research project on the improvement of sweet pepper (*Capsicum annuum*) cultivation in plastic houses in Indonesia, an inventory of the present cultivation methods and constraints was made, together with an analysis of production costs and benefits. The inventory was carried out in the highlands around Bandung, the capital of West Java Province, Indonesia. A purposive method was used to select three large and fourteen small sweet pepper growers, for an interview about their present cultivation methods and conditions. Data on the costs and benefits of sweet pepper production were obtained from eight growers. The total number of plants cultivated per grower mostly was between 5,000 and 10,000 plants. 'Spartacus' and 'Edison' were the sweet pepper varieties most frequently cultivated. Commonly a plant density of three or four plants per m^2 was used. Yield per plant ranged from 1.0 to 3.0 kg per plant. Thrips was considered the most important pest to control. Pest and disease control, the quality of the material and the construction of the plastic houses and the availability of capital and labour were ranked as major constraints in the production of sweet pepper. Revenue costs ratios observed were 2.12 and 2.03 for a drip irrigated crop and a manually irrigated crop respectively. The results of the inventory and the financial analysis were discussed with growers, suppliers and research staff in a participatory workshop. Implications for research priorities were formulated.

INTRODUCTION

In Indonesia, most of the vegetable crops are grown in the open field. The tropical climate condition allows the production of vegetables throughout the year. The production of vegetables in the open field, however, faces many problems. Protected cultivation is a technique of vegetable growing that may alleviate many of the problems related to growing vegetables in the open field. Advantages of using protected cultivation for vegetable production include higher yields, better product quality, extended harvest time, and reduction of fertilizers and pesticides use (Agnet, 1999; Baron's Brae, 1991; Baudoin and Von Zabeltitz, 2002).

Sweet pepper is one of the important vegetables produced under protected cultivation in Indonesia. The farmers in Indonesia use simple plastic houses for protected cultivation. Information on this type of production, however, is limited. A common understanding about the potential and constraints of the existing sweet pepper production in plastic houses is important in order to further develop technologies for sweet pepper production in plastic houses that are suitable with the farmer's needs and conditions in Indonesia.

MATERIALS AND METHODS

In order to obtain the research objective of the project, three activities were conducted in 2003.

Informal Exploratory Survey on Vegetable Production in Plastic Houses

This activity included the field observation of vegetable production in plastic houses and informal interview of farmers. The exploratory survey was conducted in the highland area of Lembang and Bandung, which included Parongpong, Cisarua and Lembang sub-districts. A total of 17 farmers, three big growers and fourteen smaller ones, were visited and interviewed. A purposive method was used to select the farmers interviewed. One extension officer was involved as a guide person in the survey. A list of open-ended questions was used to explore the general view of natural and socio-economic circumstances concerning existing technologies and farming practices of vegetable growing in plastic houses.

Financial Analysis of Vegetable Production in Plastic Houses

This activity was conducted in July 2003 in the same area as the research activity. A total of eight farmers were interviewed. A purposive method was used to select the farmers interviewed. Sweet pepper was selected as a crop as the farmers grow this crop intensively. A balance sheet was constructed in order to determine the costs and return of producing sweet pepper.

Participatory Workshop on the Existing Vegetable Production in Plastic Houses

The participatory workshop was conducted on September 10, 2003 at the Indonesian Vegetables Research Institute, Lembang, Bandung. The participants consisted of the farmers visited and interviewed in the exploratory survey, researchers and others involved in protected cultivation, such as company representatives. The program of the workshop consisted of presentations on the results of the survey, on materials and construction of plastic houses, drip irrigation techniques, cultural practices and integrated nutrient management for vegetable production in plastic houses. The workshop was concluded with a discussion on the research needs for vegetable production in plastic houses.

RESULTS AND DISCUSSION

Informal Exploratory Survey on Vegetable Production in Plastic Houses

Results of the exploratory survey indicated that the age ranging from 31 to 40 years dominated the structure of farmer respondent (65%), followed by the age ranging from 41 to 50 years (23%) and the remaining farmer respondents were of the age of >60 years (12%). The formal education with BSc level, dominated the farmer respondent surveyed, i.e. 41%, followed by the senior high school level (35%).

Farmer as the main occupation dominated the farmer respondents surveyed, i.e. 70%. Most of the farmer respondents (59%) had six to ten years of experience in growing vegetables in plastic houses.

All the farmer respondents cultivated sweet pepper (100%), followed by tomato (23%), cherry tomato (18%) and cucumber (12%) (Table 1).

Most farmer respondents used a plant population of three plants per m^2 (59%); the others used four plants per m^2. The efficient use of pesticides and nutrition were the reason to use a higher number of plants per m^2. Carbonated rice husks in a plastic bag is the growth medium used.

There were eleven varieties of sweet pepper cultivated by the farmer respondents (Table 2), but only two varieties were commonly grown by the farmers, i.e. 'Spartacus' and 'Edison' (82 and 82% respectively). Their adaptation to local conditions and yields were the main criteria for the farmers to grow these varieties, besides other criteria like shape and size of the fruit. The yields of sweet pepper varied between varieties. 'Edison', 'Capino', 'Spartacus' and 'Manjalika' were the best varieties in terms of total fruit yield, which ranged from 1.5 to 3.0 kg per plant.

The number of plastic houses per farmer respondent ranged between two and eleven (Table 3). The size of an individual plastic house ranged between 300 to 4,000 m^2.

An area of 1,200 m^2 was the smallest total plastic house area owned by a farmer, up to 15,000 m^2 as a maximum. The total number of plants cultivated per farmer paralleled the area owned, 4,500 to 24,400 plants. Most farmers (70%) had a total area of 1,200 to 5,000 m^2 of plastic houses. The majority of farmers (85%) had 5,000 to 20,000 plants under cultivation.

The cost of plastic house construction varied between farmer respondents and ranged from US$ 1.58 to US$ 4.21 per m^2, with 41% of the farmers reporting a cost of US$ 2.10 per m^2. The cost for UV plastic was the highest cost allocated for plastic house construction, followed by the cost for bamboo, labour and screen.

Most farmers (88%) indicated that, in general, they could locally find all production inputs and facilities needed. The unavailability of sweet pepper seeds sometimes was a major problem.

The selling price of sweet pepper highly fluctuated from time to time, but followed a certain pattern (Table 4). The highest selling price of sweet pepper was, in general, obtained from January to May, ranging from US$ 1.05 to US$ 1.58 per kg. In general, the lowest selling price was obtained in the June to August period, ranging from US$ 0.31 to 1.00 per kg. There was variation in price between the different colours of the fruit.

As indicated by most farmer respondents, they were not aware of a government extension program on protected cultivation in plastic houses. Almost all sweet pepper farmers obtained the knowledge of the production techniques from the agricultural store, where they buy there inputs. Unfortunately, transferring the technology by this method resulted in very limited knowledge transferred to the farmers. The farmer respondents were interested in knowledge transfer by extension programmes on protected cultivation in plastic houses, especially on cultural practices and on control of pests and diseases.

The nutrition management in sweet pepper cultivation in plastic houses varied between farmer respondents. In general, the farmer respondents used ready made nutrition mixes, obtained from a shop or company, dissolved in water by the farmer. The liquid is applied to the crop in a dosage ranging from 750 to 2,000 cc per plant per day. The time of application, in general, varies from three to five times a day. In the dry season, the application interval is shorter as compared to that in the rainy season. Two systems of nutrition application are used, i.e. drip irrigation and manual irrigation, using a plastic hose.

Many pests and diseases were reported to attack the crop. Thrips was the most important pest in terms of estimated potential yield loss (10 to 60%). Bacterial wilt was reported as the most important disease that could attack sweet pepper. Because of a lack of knowledge on efficient pest and disease control, pesticide use is high. Most farmers routinely spray, often with a mix of several pesticides to increase efficiency of labour and costs. Most farmers reported to use a higher dosage than the recommended one on the label.

The survey indicated that the incidence of pests and diseases and their control was ranked first among the constraints of sweet pepper production in plastic houses by the farmer respondents (Table 5). The quality of either material or the construction of plastic houses ranked second, followed by the availability of capital and labour. Although the unavailability of information of sweet pepper production in plastic houses to the farmers was obvious, the availability of information was ranked only tenth among the constraints of sweet pepper production. This is likely due to the production technique information provided by private companies who supply the production facilities.

The farmer respondents nevertheless indicated the need of information for the improvement in cultural practices, including growing techniques, nutrition, pest and disease control, irrigation, planting media and seed availability. Other suggestions included non-technical aspects such as capital and marketing.

Financial Analysis of Vegetable Production in Plastic Houses

The data of the financial analysis of sweet pepper cultivation per 1,000 m^2 (3,000

plants) using drip irrigation and manual irrigation per growing season (8 months) were obtained from five and three farmer respondents, respectively (Table 6). The profit levels of sweet pepper using drip irrigation and manual irrigation were quite satisfactory with average Return Cost Ratios of more than two.

The cost of production per plant using the drip irrigation system is higher compared to that of the manual irrigation system (US$ 0.84 vs. US$ 0.67). But because the yield of sweet pepper per plant using the drip irrigation system is higher than that with the manual irrigation system (2.19 kg vs. 1.98 kg), the return of the system using drip irrigation is better than that of the manual irrigation system.

Participatory Workshop on the Existing Vegetable Production in Plastic Houses

The participatory workshop was conducted using a panel discussion approach. The workshop was initiated with the presentation of the results of the informal exploratory survey on vegetable production in plastic houses, followed by the explanation of the objective and expected outputs of the workshop. Several topics such as materials and construction of plastic houses, drip irrigation technique, pests and diseases of vegetables in plastic houses and their control, cultural practices, integrated nutrient management for sweet pepper production, and pre- and post-harvest handling were presented and discussed. In the last session of the workshop, agenda setting for research needs on the development of sweet pepper production under plastic house was discussed. Construction of plastic houses, material of plastic houses, nutrition and irrigation, control of pests and diseases and planting media came up as major subjects for research.

CONCLUSIONS

- Sweet pepper was the most common crop cultivated in plastic houses in the West Java area around Bandung, using drip irrigation or manual irrigation with a plastic hose.
- 'Spartacus' and 'Edison' were the sweet pepper varieties most commonly grown.
- Thrips was reported to be the main pest in sweet pepper cultivation.
- There is a need for independent information on all aspects of vegetable production in plastic houses.
- Sweet pepper cultivation in plastic houses is profitable.
- Construction of plastic houses, material of plastic houses, nutrition and irrigation, control of pests and diseases and planting media should be areas for future research.

Literature Cited

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Tables

Table 1. Vegetables cultivated in plastic houses.

Vegetables	Σ (n=17)	%
Sweet pepper	17	100
Tomato	4	23
Leafy vegetables	1	6
Kyuri	1	6
Cucumber	2	12
Cherry tomato	3	18
Zuccini	1	6
Melon	1	6

Table 2. Yield range (kg per plant) of several sweet pepper varieties.

Variety	Yield
Edison	1.5 – 3.0
Capino	1.7 – 3.0
Spartacus	1.5 – 3.0
Cadia	1.5 – 2.8
Manjalika	2.2 – 3.0
Gold flame	1.7 – 2.3
Kelvin	1.5 – 2.0
Athena	2.0 – 2.2
Park	1.5 – 2.0
Sylvia	1.0 – 1.5
Indra	1.5 – 2.0

Table 3. Number, size and capacity of plastic houses per farmer respondent.

Description	Range	
Number of plastic house per farmer	2 – 11	
Size of plastic house	300 – 4,000 m^2	
Total area of plastic house per farmer	1,200 – 15,000 m^2	
Total number of plants cultivated per farmer	4,500 – 24,400 plants	
	Σ (n=17)	%
Range distribution of total area of plastic house per farmer:		
• 1,200 – 5,000 m^2	12	70
• 5,001 – 10,000 m^2	3	18
• > 10,000 m^2	2	12
Range distribution of no of plant cultivated per farmer:		
• 4,500 – 5,000	1	6
• 5,001 – 10,000	8	47
• 10,001 – 20,000	6	35
• > 20,000	2	12

Table 4. Selling price (US$ per kg) of sweet pepper in 2003.

	Max. price	Month	Min. price	Month	Average
Sweet pepper (General)	1.05 – 1.58	Jan.-May	0.31 – 1.00	June-Aug.	0.74 – 1.21
Red	0.95 – 1.26	January	0.31 – 1.05	June	0.95 – 1.05
Green	0.74 – 0.95	January	0.31 – 0.74	June	0.63 – 0.79
Yellow	0.95 – 1.47	January	0.63 – 0.95	June	0.95 – 1.05

Table 5. Constraints of sweet pepper production in plastic houses.

No	Constraint	Ranking
1.	Pest and disease incidence and control	I
2.	Quality of plastic house	II
3.	Availability of capital	III
4.	Availability of labour	IV
5.	Availability of nutrition	V
6.	Availability of pesticide	VI
7.	Availability of water	VII
8.	Availability of planting media	VIII
9.	Selling price fluctuation	IX
10.	Availability of production technique information	X

Table 6. Financial analysis of sweet pepper cultivation per 1,000 m^2 (3,000 plants) using drip irrigation and manual irrigation per growing season (8 months).

A. Cost of production (US $ per season).

No.	Description	Drip irrigation (n=5)	Manual irrigation (n=3)
I	Plastic house		
	1. Material	170.22	172.37
	2. Labour	81.20	51.50
	Sub-total	251.42	223.87
II	Irrigation system		
	1. Material	171.36	21.92
	2. Labour	4.77	9.30
	Sub-total	176.13	31.22
III	Planting		
	1. Material	18.13	18.38
	2. Labour	1.09	2.63
	Sub-total	19.22	21.01
IV	Production		
	1. Equipment	313.79	89.31
	2. Material	1,355.60	1,416.56
	3. Labour	389.47	213.33
	Sub-total	2,058.86	1,719.20
Total		2,505.63	1,995.30

B. Yields (kg per season).

No.	Description	Drip irrigation (n=5)	Manual irrigation (n=3)
I	Yield		
	Grade A	3,338	2,950
	Grade B	1,940	2,553
	Grade C	1,291	422
	Total	6,569	5,925
II	Return		
	Total	5,299.95	4,053.96

C. Return and profit (US $ per season).

No.	Description	Drip irrigation (n=5)	Manual irrigation (n=3)
I.	Return	5,299.95	4,053.96
II	Cost of production	2,505.63	1,995.30
III	Profit	2,794.32	2,058.66
IV.	R/C ratio	2.12	2.03