Knowledge, attitude and action of farmers in controlling plant pest and disease of potato in Garut, West Java

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Abstract. Potato (Solanum tuberosum L.) is one of the 5 leading commodities of seasonal vegetables and a source of income for people in Indonesia. Plant pests and diseases are still the main obstacles in potato production. Since 1992, the government of Indonesia has determined that control of plant pest and disease should be carried out with an integrated pest management system (IPM). The objective of this research was to study the implementation of an integrated pest management (IPM) system of pests and diseases of potato by farmers in Cikajang and Cisurupan sub-district, Garut district, West Java. The study was conducted by direct interviews with 80 potato farmers as respondents. The selection of respondent farmers was carried out systematically. The results of study showed that the majority of the respondents were able to identify the types of the importance pests and diseases of potatoes and their impact on crop losses. Likewise, some of farmers have implemented of several IPM components in controlling pests and diseases, including good practices in soil management, providing manure and synthetic fertilizers, using healthy seeds, observing pests and diseases routinely in the field. In controlling action of plant pest and disease on potato, the majority of respondent used synthetic pesticides. They applied pesticides every week and often used more than 2 types or mixing 2 or 3 types of pesticides in each application.

1. Introduction

Potato is one of the world's important crops after rice, wheat and corn. Therefore, potatoes have the potential as substitutive crops in food diversification program. Garut District is one of the potato producing centers in West Java Province. Some obstacles in the cultivation of potatoes are the unavailability of quality seeds and the resistant varieties to pests or diseases, the conventionally cultivation technique with no crop rotation, the inappropriate determination of harvest time and post-harvest handling, and the never-ending pest and plant diseases problems.

Generally, farmers in Asia and Africa use conventional controlling methods by using synthetic chemical pesticides [1]. The use of fungicides in potato cultivation in one season can reach up 40% of production costs [2]. Chemical control using pesticides applied by farmers is not a sustainable control strategy both from ecological and economic aspects [3]. The government has issued a policy that the plant protection program should be implemented with integrated pest management (IPM) system. The
regulation for IPM was stated in Presidential Decree 3/1986 which was then emphasized again through Law No. 12/1992 concerning Plant Cultivation Systems. The IPM system approach includes cultivation of healthy plants, utilization of natural enemies, routine monitoring, and farmers as IPM experts [4].

Integrated pest management is a controlling system that exerts all efforts to prevent losses in crop cultivation due to attacks of plant pests and disease by setting the use of pesticides as the last alternative. The main problem in implementing integrated pest control in Indonesia is the change in ecosystem dynamics and human behavior, the weak institutional coordination, the limited facilities, infrastructure, and farmers resources. Increasing awareness and quality of human resources including farmers are very important in supporting the success IPM. Because plant pests and diseases controlling program is the responsibility of the government and the community.

Some of IPM targets are the increasing of crop productivity, the increasing of farmer’s welfare, and the decreasing of pests and diseases populations and activity [5]. The successful of IPM is depended on how much the efforts to manage the favourable environment for plants, but not suitable to the development of plant pests and diseases. The objective of this research was to obtain information about the knowledge, attitudes and actions of farmers in the implementation of the principle of integrated pest control (IPM) of potato plants in Cikajang and Cisurupan sub-district, Garut, West Java.

2. Methods
This study was conducted in Girijaya, Simpang, and Cikajang Villages, Cikajang and Cisurupan sub-district, Sukasenang and Sukatani villages, Cisurupan sub-district, Garut district, West Java, from July until Sept 2016. The research method consisted 2 activities namely potato pests and diseases survey and interview the respondents who are potato farmers.

Interview was conducted with 80 potato farmers as respondents with each 40 respondents from Cikajang and Cisurupan sub-district. The interviewed farmers from each village were determined purposively by 2 criteria: has cultivated potato in at least 3 years and managed their own potato fields. The interview system was conducted using questionnaire with several list of questions about: 1) the background of the farmers’ education, field ownership, and farming experiences, 2) the habits of farmers in managing the pests and diseases of potato such as seed selection, land management, fertilization, knowledge about potato pests and diseases symptoms in the field, and pest control techniques that have been carried out. The data obtained were analyzed using Microsoft Excel.

3. Results and discussion
Agricultural products that are produced in Garut include rice, tomatoes, chillies, corn, soybean, cabbage and potato. Potato fields in Garut are scattered in several districts, namely Pasirwangi, Pangatikan, Cigedug, Sukaresmi, Bayongbong, Sukaresmi, Cikajang, and Cisurupan Districts.

Results from survey and interview indicated that based on their level of education, more than 87% of the respondent farmers in both districts were graduated from elementary and junior high school, while the 13% of them were graduated from high school education. Based on their age, 65% of respondent farmers in Cikajang District are aged over 41 yr, while in Cisurupan District 65% of respondents farmers are under 41 yr. This shows that the productive age of farmers in Cisurupan District is better than that of respondent farmers in Cisurupan District (Table 1). Age and education level of farmers is one of the factors related to work ability and speed in accepting innovation in running a farming business [6].

The results of this study also showed that the potato is still become the main commodity cultivated in this area. In general, farmers planted potatoes on their own land (more than 80%) and the remaining rent from the other field owners. The average of potato cultivation area is between 0.5 - 1.2 ha. Mostly, the farmers has been cultivated the potato for 10-20 yr, while the remaining have 20 yr experience. Most of the respondent farmers had participated in the integrated pest management farmer field school (IPM-FFS) which was organized by the Ministry of Agriculture in collaborating with local
government and farmer organization (Table 1).

The potato varieties commonly grown by respondents in Cikajang and Cisurupan sub-districts are Granola and Atlantic. Some farmers use Granola variety because it is easy to cultivate, more resistant to pest attacks, and has higher productivity than other varieties. While, some farmers use Atlantic variety because of its certainty of guaranteed selling prices that do not fluctuate so as to minimize losses that occur during harvest (Table 2). Moreover, Atlantic variety is stable and has higher selling prices. The selling price is stable because farmers who used Atlantic variety obtained seeds directly from the company with a contract system that the potatoes have to be sold to the company at a price that has been predetermined by the company and the farmer.

The interview results showed that the majority of respondents produced their own seed to be planted in the next season because it is difficult to find seeds with high quality and affordable. However, there was a few farmers who bought seeds from breeders.

The cropping patterns used by the farmers were monoculture (60%) and intercropping (40%). Most of farmers prefer monoculture cropping pattern because of higher yields compared with intercropping (Table 2). However, intercropping field system could maintain soil fertility due its abundant and diverse organic materials [8].

Table 1. General characteristics of respondents or potato farmers in the Cikajang and Cisurupan sub-district.

| Farmer’s characteristics       | Cikajang       | Cisurupan      |
|--------------------------------|----------------|----------------|
|                                | Numbers of     | Number of      |
|                                | respondent     | respondent     |
|                                | Percentage (%) | Percentage (%) |
| Age                            |                |                |
| 21 – 30 year                   | 6              | 7              |
| 31 – 40 year                   | 8              | 19             |
| 41 – 50 year                   | 15             | 8              |
| > 50 year                      | 11             | 6              |
| Education                      |                |                |
| SD                             | 28             | 21             |
| SMP                            | 9              | 14             |
| SMA                            | 3              | 4              |
| University                     | 0              | 1              |
| Land ownership status          |                |                |
| Private land                   | 34             | 33             |
| Rent                           | 6              | 7              |
| Participation in IPM-FFS       |                |                |
| activities                     | Yes            | 27             | 37             | 92.5 |
|                                | No             | 13             | 3              | 7.5  |
| Farming experience             |                |                |
| 1 - 10 year                    | 11             | 16             |
| 11 - 20 year                   | 18             | 14             |
| 21 - 30 year                   | 8              | 7              |
| > 30 year                      | 3              | 3              |
| The area of land under         |                |                |
| cultivation                    | 0.4-0.8 ha     | 25             | 8              |
|                                | 0.9-0.2 ha     | 9              | 20             |
|                                | 1.3-1.8 ha     | 3              | 8              |
|                                | >1.8 ha        | 3              | 4              | 7.5  |
Table 2. Characteristics in potato cultivation by respondents in Cikajang and Cisurupan sub-district.

| Potato cultivation                  | Cikajang |         | Cisurupan |         |
|-------------------------------------|----------|---------|-----------|---------|
|                                     | Number of respondent | Percentage (%) | Number of respondent | Percentage (%) |
| Varieties used                      | 25       | 62.5    | 37        | 92.5    |
| Granola                             | 15       | 37.5    | 3         | 7.5     |
| Atlantik                            |          |         |           |         |
| The reason for using the selected variety | 16       | 40.0    | 25        | 62.5    |
| Easy to cultivate                   | 15       | 37.5    | 3         | 7.5     |
| The selling price is stable         | 4        | 10.0    | 8         | 20.0    |
| Resistant to pests                  | 5        | 12.5    | 4         | 10.0    |
| High productivity                   |          |         |           |         |
| Origin of seed                      | 24       | 60.0    | 37        | 92.5    |
| Nursery yourself                    | 1        | 2.5     | 0         | 0.0     |
| Buy from a breeder                  | 15       | 37.5    | 3         | 7.5     |
| Contracts with private companies    |          |         |           |         |
| Cropping pattern                    | 23       | 57.5    | 24        | 60.0    |
| Monoculture                         | 17       | 42.5    | 16        | 40.0    |
| Intercropping                       |          |         |           |         |
| Type of fertilizer used             | 40       | 100.0   | 40        | 100.0   |
| Synthetic                           | 40       | 100.0   | 40        | 100.0   |
| Organic/compost                     |          |         |           |         |
| Fertilization intensity per planting season | 1       | 2.5     | 4         | 10.0    |
| 1 time                              | 39       | 97.5    | 36        | 90.0    |
| 2 times                             |          |         |           |         |

Based on interviews and observations in the field, the majority of respondents have already known the types of pests and of potatoes and their natural enemies. Respondents in the 2 sub-districts also understood that weeds were included in the pest category that could interfere with the growth of potato plants (Table 3). Weeds in the field of potato should be controlled because it could be the limiting factors in production of potato. The respondent known some of natural enemy of pest but they did not know how to manage and to conserve beneficial insect in the field.

The knowledge of respondents in pest control methods showed that all respondent use synthetic chemical pesticides to control pests in potato fields (Table 4). Respondents considered that if they did not apply pesticides, they will have a huge crop losses potential. The majority of respondents in Cikajang sub-district and in Cisurupan sub-district have taken control action with pesticides regularly, and only a few farmers carried out control methods based on the presence or absence of pest and disease populations in the field (Table 4). This result was in line with other research that majority of respondents used chemical pesticides in controlling leaf mining pests (Liriomyza huidobrensis) on potatoes in Cianjur District based on schedule. Controlling the pests and diseases with pesticides was considered as the most effective way in potato cultivation [9]. For controlling weeds, many farmers have used mechanical methods instead of chemistry by using of plastic mulch.
Table 3. Respondents' knowledge of plant pests and disease and their natural enemies in sub-district Cikajang and Cisurupan.

| Questions                                                                 | Cikajang                  | Cisurupan                  |
|---------------------------------------------------------------------------|---------------------------|----------------------------|
|                                                                           | Number of respondent (%)  | Number of respondent (%)   |
| Do respondents know potato pests                                        |                           |                            |
| Yes                                                                       | 40 (100.0)                | 40 (100.0)                 |
| No                                                                        | 0 (0.0)                   | 0 (0.0)                    |
| Is nematode classified as a disease of potatoes                          |                           |                            |
| Yes                                                                       | 30 (75.0)                 | 36 (90.0)                  |
| No                                                                        | 10 (25.0)                 | 4 (10.0)                   |
| Are aphids including potato pests                                        |                           |                            |
| Yes                                                                       | 31 (77.5)                 | 34 (85.0)                  |
| No                                                                        | 9 (22.5)                  | 6 (15.0)                   |
| Do you know the types of natural enemies of potato plant pests           |                           |                            |
| Yes                                                                       | 21 (52.5)                 | 26 (65.0)                  |
| No                                                                        | 19 (47.5)                 | 14 (35.0)                  |
| Are weeds classified as pest                                             |                           |                            |
| Yes                                                                       | 40 (100.0)                | 40 (100.0)                 |
| No                                                                        | 0 (0.0)                   | 0 (0.0)                    |

Table 4. The attitudes of respondents in pest control methods on potato in sub-district Cikajang and Cisurupan.

| Questions                                                                 | Cikajang                  | Cisurupan                  |
|---------------------------------------------------------------------------|---------------------------|----------------------------|
|                                                                           | Number of respondent (%)  | Number of respondent (%)   |
| Efforts are made if there are pests and diseases                          |                           |                            |
| Not controlled                                                            | 0 (0.0)                   | 0 (0.0)                    |
| Controlled                                                                | 40 (100.0)                | 40 (100.0)                 |
| Selected Control                                                          |                           |                            |
| Natural / organic                                                         | 0 (0.0)                   | 0 (0.0)                    |
| Chemical                                                                  | 40 (100.0)                | 40 (100.0)                 |
| Decisions in control measures                                             |                           |                            |
| Scheduled control                                                         | 37 (92.5)                 | 29 (72.5)                  |
| The presence / absence of symptoms                                        | 3 (7.5)                   | 11 (27.5)                  |
| Attack rate                                                               | 0 (0.0)                   | 0 (0.0)                    |
| Weed control measures                                                     |                           |                            |
| Mechanical                                                                | 25 (62.5)                 | 14 (35.0)                  |
| Chemical                                                                  | 6 (15.0)                  | 7 (17.5)                   |
| Combination mechanic and chemical                                         | 9 (22.5)                  | 19 (47.5)                  |
All respondent farmers in 2 sub-districts took control measures against pests in the plantations. In general, farmers also observe pests in the potato field. The purpose of observations is as a basis for farmers to take control measures even though some farmers carry out control on a scheduled basis (Table 5). As many as 47.5% of respondent farmers in Cikajang sub-district observed the pest regularly, while in Cisurupan sub-district the percentage of farmers was 65%. Pest observation in potato plant is by visually seeing the presence of pests and diseases in potato plants.

Table 5. The respondents’ actions in the use of pesticides for controlling pests and diseases of potato in Cikajang and Cisurupan.

| Questions                                                                 | Cikajang          |          | Cisurupan        |          |
|--------------------------------------------------------------------------|-------------------|----------|------------------|----------|
|                                                                          | Numbers of        | Percentage| Numbers of        | Percentage|
|                                                                          | respondent (%)    |          | respondent (%)    |          |
| Is chemical control carried out routinely                                | Yes: 40 (100.0)   |          | Yes: 40 (100.0)   |          |
|                                                                          | No: 0 (0.0)       |          | No: 0 (0.0)       |          |
| How many types of pesticide are used in each application                 | 1 type: 2 (5.0)   |          | 1 type: 1 (2.5)   |          |
|                                                                          | 2 type: 8 (20.0)  |          | 2 type: 4 (10.0)  |          |
|                                                                          | 3 type: 25 (62.5) |          | 3 type: 23 (57.5) |          |
|                                                                          | More than 3 type: 5 (12.5) |          | More than 3 type: 12 (30.0) |          |
| Spraying time                                                             | Morning: 31 (77.5) |          | Morning: 36 (90.0) |          |
|                                                                          | Daytime: 0 (0.0)  |          | Daytime: 0 (0.0)  |          |
|                                                                          | Afternoon: 9 (22.5)|          | Afternoon: 4 (10.0)|          |
| The reason for choosing certain pesticides is because                    | Other farmers’ recommendations: 12 (30.0) |          | Other farmers’ recommendations: 8 (20.0) |          |
|                                                                          | Pesticide Shop: 23 (57.5) |          | Pesticide Shop: 14 (35.0) |          |
|                                                                          | Information from agricultural officers: 5 (12.5) |          | Information from agricultural officers: 18 (45.0) |          |

Table 6. The respondents’ actions in mixing pesticides in Cikajang and Cisurupan.

| Question                                  | Cikajang          |          | Cisurupan        |          |
|-------------------------------------------|-------------------|----------|------------------|----------|
|                                                                          | Numbers of        | Percentage| Numbers of        | Percentage|
|                                                                          | respondent (%)    |          | respondent (%)    |          |
| Do mixing pesticides                      | Yes: 29 (72.5)    |          | Yes: 24 (60.0)   |          |
|                                                                          | Not: 11 (27.5)    |          | Not: 16 (40.0)   |          |
| How many types of pesticides are mixed   | 2 types: 8 (20.0) |          | 2 types: 9 (22.5)|          |
|                                                                          | 3 types: 11 (27.5)|          | 3 types: 14 (35.0)|          |
|                                                                          | More than 3 types: 10 (25.0) |          | More than 3 types: 1 (2.5) |          |
| The reason for mixing                    | Easier application: 7 (17.5) |          | Easier application: 6 (15.0) |          |
|                                                                          | The results are more satisfying: 22 (55.0) |          | The results are more satisfying: 18 (45.0) |          |
Synthetic chemical pesticides was used by respondents regularly. The majority of respondents used 2 or 3 pesticides brand in one planting season. Generally, the farmers spray the pesticides in the morning because it can minimize evaporation after spraying. The pesticide preference was gained from the local agricultural officers or from the other farmers (Table 6).

The results showed that the majority of respondents 72% in Cikajang and 60% in Cisurupan applied mixing pesticides at the same time. Some respondent farmers mixed between 2 or 3 types of pesticides, some even more than 3 types of pesticides (Table 6). Farmer respondents thought that by mixing pesticide would be more satisfying, with shorter time because they did not have to spray twice. Farmers do not yet know the impact of mixing pesticides on the development of pests and diseases on potatoes.

4. Conclusion
The majority of respondents have already known the types of plant pests and disease of potatoes and their natural enemies of pests. Respondents in the 2 sub-districts Cikajang and Cisurupan also understood that weeds could interfere with the growth of potato plants. The knowledge of respondents in pest control methods showed that all respondent controlled and relied synthetic pesticides to control pests in potato fields. Respondents considered that if they do not applied pesticides, the risk of crop losses would be very large. The majority of respondent potato farmers have implemented good practices in soil management, providing manure and synthetic fertilizers, using healthy seeds, observing pests and diseases routinely in the field and controlling actions. In general, all respondents were highly dependent on synthetic pesticides in the implementation of pest and disease control in potato plants.

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