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Analysis Of Leisa System Impact On Pest And Disease Attack On Seed Potatoes

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Abstract: The development of granola potato varieties in Bali for main, basic and scattered seeds group has a potency. The research objective was to identify pests and diseases in potato cultivation in the highlands of 900 - 1300 m asl in cultivation with the LEISA system. The cultivation experiment used the LEISA system with granola potato varieties in the G0, G1, G2 and G3 groups on an area of 1000 m^2. The potato plants are fertilized with compost at a dose of 20 tones / ha and NPK at a dose of 250 kg / ha. Treatment of plants by spraying using insecticides and fungicides intensively. The research data included: quality of seeds, quality of planting media, plant growth, attack of pests and diseases in plants besides potato tubers and plant productivity. The seed potatoes used met the seed standards with identification of less than 2.5% damage, and the experimental area was less sterile with the presence of white grubs and Fusarium bacteria. The rate of change in plant height and total biomass of potato plants in the vegetative phase was 0.8 - 1.2 cm / day and 15 - 48 g / week, the identification of pests and diseases in plants was 1.4 - 6.4%. The identification of damage of the cultivated seed potato tubers using the LEISA system was 1.87 - 3.88%.

Keywords: potato tubers, pest and diseases, LEISA

1. Introduction

Potatoes as the fourth staple food in the world because they contain a lot of hydrate (FAO, 2007; Wustman&Struik, 2008). The countries that have highlands cultivate potatoes. Potatoes grow in the mountains with an altitude between 1000 - 2000 m above mean sea level (asl.).The use of pesticides in the production of seed potatoes and granola potatoes as consumption to reduce crop failure due to

pests and plant diseases which is still practiced by farmers (Setiyoet al., 2017). Potato farmers are very intensively using different types of fungicides: Daconil, Acrobat, Atracol, and Dithane M45, while the insecticide groups used are Curacron and Detacron. The use of these drugs is very bad for humans, animals and causes environmental pollution (Sassenrath et al., 2019).The direct impact of using these insecticides and pesticides is an increase in metal content in plants and potato tubers (Setiyo et al., 2020).

In cultivation, it is indicated that there are still fusarium microbes in the land, with the number of plants affected by 5 - 10% (Suaryanti, 2012). Cultivation of granola seed potato varieties G0, G1 and G2 in open land using compost of chicken manure at a dose of 10-30 tonnes / ha still produced damaged tubers because they were rot, respectively 19.2 ± 1.2%, 29.4 ± 2.1% and 27.2 ± 2.5% (El-Sayedet al., 2015). The cultivation in open land already contained bacteria that can cause fusarium wilt disease (Setiyoet al., 2018).

In addition to the problem of land for cultivation, and environmental and climatic conditions during cultivation, there are other problems that are the cultivated seed potato tubers. The number of damaged tubers will increase if the seeds used are of the higher generation, because the generation level of seed potato tubers is very important in determining the level of disease contamination of the tubers. Granola seed potato varieties of groups G0, G1, G2 and G3 were attacked by pests and diseases during storage, 3-5%, 3 - 10%, 4 - 15% and 8 - 30% respectively (Ibeawuchi et al., 2015).

Potato farmers in Bali depend on potato seeds imported from Java. This condition has an impact on the non optimal of potato production in Bali, so that the need for consumption potatoes for people in Bali is mostly supplied from Java. The efforts of several farmers to make seedlings supervised by researchers from UdayanaUniversity have been carried out since 2016 in several farmer groups however the cultivation model to produce quality seed potatoes have not been found (Ibeawuchi et al., 2015).

The low external input on sustainable agriculture (LEISA) systemcultivation model has been carried out for planting potato seedlings of groups G0, G1 and G2. The application of the LEISA system was carried out by maintaining the use of chicken manure compost (Khalilet al., 2021). The modification of seed potato cultivation was carried out in open land by: (1) the old tillage layers that was not healthy was removed and replaced with the new tillage layers, and (2) cultivation with UV plastic shade. According to Khalil et al (2021) sustainable potato cultivation is needed to increase productivity while encouraging better resource management and optimization.

Replacing the old tillage layers with the new tillage layers that can control soil fertility and the health ofsoil. On land with a CEC of 23-25 meg / (100g-dry soil), therefore, the potato tubers produced have a uniform weight with an average size of 50 g. Meanwhile, the use of UV plastic shade was able to create a microclimate suitable for potato cultivation (Khalilet al., 2021; Ogu&Orjiakor, 2017). The

observation of the level and type of pest and disease attacks on granola seed potato varieties G0, G1 and G2 needs to be done, so that it can effectively identify the causes of pests and diseases of seed potato plants. In addition, it is able to develop a model for controlling pests and diseases of cultivated seed potato plants.

The specific objective of this study was (1) to identify the types and levels of pests and plant diseases and seed potato varieties of granola varieties G0, G1, G2 and G3 which was cultivated by using the LEISA system.

2. Materials and methods

2.1. Materials

The materials for the research were potato seeds in the certified basic and spreading seed group taken from the Sumedang nursery, fermented chicken manure compost, NPK 16:16:16 fertilizer, insecticides curacron, furadan, dithane M45 and acrobat, fungicides (Daconil and Atrakol) and plastic mulch.

2.2. Research design

The seed potato tubers of the basic seed group (G0, and G1) and the scatter seed group (G2 and G3) of the granola variety were used in this study. The seeds are certified by the Indonesian Seed Center. Each bed has 2 planting paths with a spacing of 35 cm x 60 cm. Each bed was covered with black plastic mulch [3].Potato plants were cultivated using the LEISA system. Potato plants are fertilized with chicken manure compost at a dose of 20 tones / ha and NPK fertilizer at a dose of 250 kg / ha (Setiyoet al., 2018). The cultivated potato plants were sprayed with pesticides every 2 weeks, starting from 1 month old until 75 days old.The research locations were on lands with an altitude of 900 - 1300 m asl. The research location chosen was the altitudes of 900, 1100 and 1300 m asl, these three elevation locations were replicated (Lópezet al., 2010; Suryani& Arya, 2017). The land area for each experiment is 1000 m^2.

2.3. Observation

2.3.1. The observation of the quality of seed potato tubers

The identification of the presence of scabies, powdery scab, shellac scab, and tuber blight, mechanical damage and insect damage, tuber borer damage, root spot nematode damage, brown rot and soft rot was carried out on 20 samples of seed potato tubers. The tubers were cut into half to identify the presence and absence of disease.

2.3.2. The observation of the quality variable of the growing media

Phyllophaga urethra or white grub, soil caterpillar pests (Agrotisipsilon) were observed in soil samples taken at a depth of 0-30 cm with an area of 25 cm^2, and then white grub the population was calculated. Fungi population and bacterial population were observed from 5 soil samples taken at a depth of 0-30 cm from 5 randomly determined points. Observations were made using the Total Plate Count (TPC) method.

2.3.3. The observation of the level of potato plant diseases attacks

The parts of the plant that are indicated to be affected by bacterial wilt are: some young leaves located at the top of the dead plant and the yellowing process of the leaves at the bottom, the base of the potato stem is cut, then a ring-shaped brown spot will appear on the cambium of the plant stem and if it is placed in the water, beige liquid will come out. The attack of bacterial wilt on the tuber because the wet soil around the tuber and the existence of mucus attached to the end of the potato tuber stolon, the eye of the tuber or the end of the tuber and the dark brown colour circles on the flesh of the tuber when the tuber is split.The parts of plants that are indicated to be affected by fusarium wilt are: plants affected by fusarium wilt will wither and die. Other characteristics are the same as plants affected by bacterial wilt, except that the part of the plant affected by fusariaum wilt disease if place into water no beige liquid came out of it.

Plants are attacked by late blight with the characteristics of small spots with a gray green colour and over time become blackish brown on the leaves, under the affected leaves there are white conidia spores, and brown spots to blackish purple colour on the tubers as an idication there was attack of this disease in the tubers.The number of plant samples observed were 20 plants in one block for each experimental unit.

2.3.4. The Observation of pest attacks

Potato plants infected by beetle pests (Epilachna sp.) are characterized by the leaves hole resembled the shape of a window. The attack starts from the middle of the leaf. If heavy category attack, then the leaves will only be left with the bones of the leaf.

The attacks from nematode pests (Meloidogyne incognita) are characterized by the presence of small rashes resembling pimples on the potato plant, namely in the roots or tubers, stunted growth, the leaves will turn yellow when the air is hot, and the leaves will experience a process of falling.

The part of the plant that is attacked by the spodoptera litura caterpillar is the leaves of the potato plant. The attack on the leaves occurs until only the epidermis remains so that the leaves look like withered. Phyllophaga (Holotricia) javana pests or mole crickets pests were observed by cleaving samples of potato roots and tubers to see whether or not these caterpillars were present.

Observations of aphids on potato leaves with the characteristics of young leaves will become wrinkled, twisted and have a yellowish color and the plants will become stunted because their growth is stunted.

2.3.5. The observation of potato tuber quality

The Observation of the quality of potato tubers was carried out by means of the following parameters: rotten tubers, mechanically damaged tubers, tubers infected by fungus, and tubers with holes. The samples of 100 tubers were cut into half to make a visual observation of the damage caused by the above diseases. Plant productivity observations were carried out by calculating the tuber weight of 20 plant samples taken randomly for each experimental unit.

2.4. Data analysis

The research data were analyzed using simple statistics to determine the average value of the variable and their standard deviation. Then tabulated and graphed of the relationship between plant age and plant height growth, total plant biomass, the level of pest and plant diseases was made.

3. Results and Discussion

3.1 The quality of seed potato tubers

Table 1 is the quality of G0, G1, G2 and G3 seed potato tubers. Based on the standard parameters of certified seeds, the seeds are very suitable as main seeds, basic seeds and scatter seeds. The rate of pest and disease attacks is between 0 - 2.4%. The biggest tuber damage due to attacks from scabies, powdery scab, and shellac scab was 2.40 ± 0.3%.

Table 1. The quality of seed potato tubers

Variable	Average			
	G0	G1	G2	G3
Identification of the presence of scabies, powdery scab, shellac scab, and tuber blight, %	0.00	1.00 ± 0.2	1.60 ± 0.3	2.40 ± 0.3
Identification of mechanical damage and insect damage, %	0.00	0.60 ± 0.02	1.20 ± 0.2	2.20 ± 0.3
Identification of damage by tuber borer, %	0.20 ± 0.02	0.40 ± 0.05	1.00 ± 0.2	1.20 ± 0.2

Identification of damage from root spot nematodes, %	0.20 ± 0.03	0.60 ± 0.2	1.20 ± 0.4	1.6 ± 0.20
Identification of tubers affected by brown rot and soft rot, %	0.00	0.20 ± 0.02	1.20 ± 0.1	1.40 ± 0.2

The average increase in damage due to attacks from scabies, insects, tuber borer, root nematode and rotten tubers was 0.8%, 0.73%, 0.33%, 0.47%, and 0.47%, respectively, with increasing tubers groups. The potato tuber quality of group G0 was the best compared to other groups. The sources of seeds, sterility of cultivated land and intensive handling of plants are the initial factors in producing quality seeds (Gildemacher et al., 2011; Eken et al., 2000). Incomplete storage processes also have an impact on the quality of seed potatoes produced, therefore the higher the level of the seed potato tubers, the less the quality of the seed.

3.2. The quality of seed potato growing media

Table 2 shows that land for G0 - G3 seed potato cultivation still contains hyllophaga white grub and soil worms with a population of 0.4 ± 0.2 to 1.75 ± 0.2 per m^2. The increase in white grub population due to the increased of seed potato levels was 0.44 urets / m^2. The effectiveness of spraying plants with insecticides and cultivation with crop rotation using horticulture other than potatoes resulted in the land becoming more sterile and able to suppress the development of hyllophaga white grub and soil worms.

Table 2. Specifications for fertilizing soil media using chicken manure compost

Variable	Average			
	G0	G1	G2	G3
Mole crickets, white grubs/m^2	0.6 ± 0.1	1.0 ± 0.1	1.6 ± 0.2	1.6 ± 0.2
Ground worm pests (Agrotisipsilon), caterpillars / m^2	0.4 ± 0.2	1.2 ± 0.3	1.4 ± 0.3	1.75 ± 0.2
Population of kapang / fungi, cfu	$1.6x10^3$-$34x10^5$	$7.6x10^4$-$5.4x10^5$	$7.8x10^4$-$6.4 x10^5$	$8.0x10^4$-$7.4x10^5$
Bacteria population, cfu	$4.6x10^5$-$34x10^7$	$7.6x10^5$-$5.4x10^8$	$7.8x10^5$ - $6.4 x 10^8$	$8.3x10^4$-$8.3x10^8$

According to Sabbour(2006), the level of hyllophaga white grub attack and soil worms is strongly influenced by soil organic matter content, soil pH and soil water content and nutrient content in the soil. These caterpillars eat potato tubers, so that potato tubers become hollow and easily rot.

Fungi population is fluctuating, at the beginning of the cultivation, week 0 - 2 were relatively stable and at week 4 it reached a peak population (1.6 x 10^3 - 8.0 x 10^5cfu). However, from week 6 the population decreased until it approached the population at the start of cultivation. The fluctuation of the mold population is caused by the availability of decomposed food for its development. The decomposed food came from compost, pesticide residues and plant residues (Mandicet al., 2011).

The population of bacteria in the potato cultivation area is very volatile due to the availability of food sourced from compost, insecticide residues and fungicides. The population of bacteria in agricultural land cultivated by potato tubers of granola varieties, the basic seed group and the seed varieties varied from 4.6 x 10^5 - 8.3 x 10^8cfu). The bacterial population is higher than the mold population because the moisture content in the root part of the plant is maintained at the moisture content of the field capacity, so that bacteria are easier to develop than mold with sufficient water availability (Setiyoet al., 2018; Suriani, 2018).

Bacteria and molds in the root zone are beneficial in breaking down organic matter in the compost into simple minerals that are easily absorbed by plants. In addition, it also breaks down insecticide and fungicide residues that fall to the ground (Setiyoet al., 2018). However, in the root zone there are microbes that cause potato plant diseases such as Fusarium, which cause plants to develop Fusarium wilt disease. According to Kerkeni et al. (2013) compost containing Fusarium ssp.

3.3. The cultivation quality of seed potatoes

Figure 1 shows that after the plants were 10 weeks old, the potato plants of groups G3, G2, G1 and G0 had a height of 78.45 ± 6.93 cm respectively; 77.33 ± 0.58 cm; 58.83 ± 1.26 cm and 48.13 ± 0.96 cm. The number of leaves averaged 36.9 ± 7.9 pieces; 29.33 ± 7.2 strands; 23.22 ± 2.1 and 18.67 ± 6.51 and the longest leaf length was 39.07 ± 3.32 cm; 33.63 ± 4.86 cm; 27.33 ± 2.16 cm and 24.20 ± 1.40 cm. In the growth phase or vegetative phase (0 to 8 weeks of age) plant growth tends to be linear, the high growth rate of potato plants in groups G3, G2, G1 and G0 are 1.7 cm / day, 1.6 cm / day, respectively., 9 cm / day and 0.8 cm / day. However, at the age of 9 weeks, plant growth begins to slow down.Nutrients that are absorbed by roots after being processed by photosynthetic reactions tend to be stored in tubers rather than for plant growth.

As with plant height growth, the total plant biomass in the vegetative phase increases, but in the generative phase the biomass volume decreases. The increase in plant height for groups G3, G2, G1 and G0, respectively 42.0 g / week, 32.8 g / week, 18.0 g / week and 15.6 g / week. The reduction in

plant biomass weight for groups G3, G2, G1 and G0 was 58.7 g / week, 42.3 g / week, 16.3 g / week and 13.6 g / week, respectively (Figure 2).

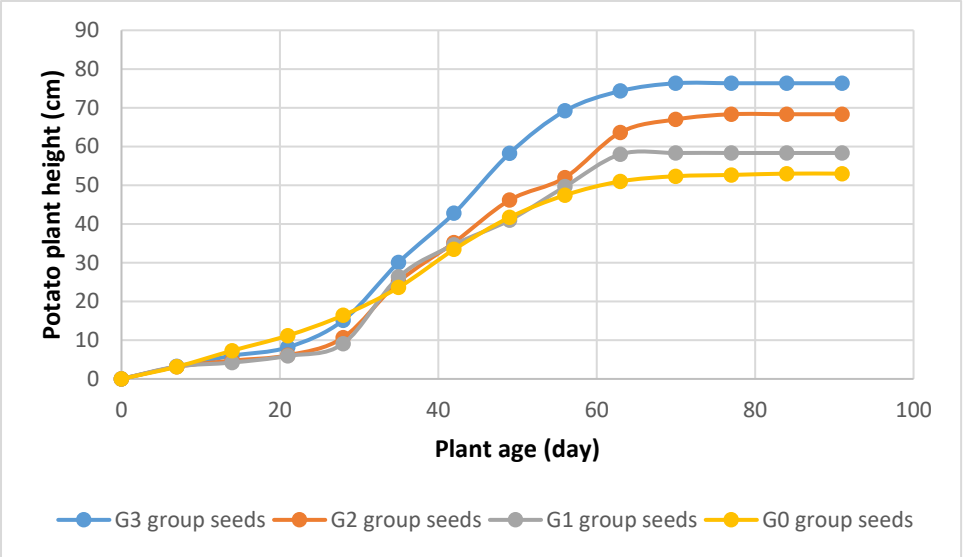

Figure 1.Relationship between plant age and plant height

The availability of nutrients from compost decomposition and nutrients from NPK fertilizers, soil pH and water availability cause potato plants in the G0, G1, G2 and G3 groups to grow ideally (Setiyoet al., 2018). In addition, a good microclimate factor supports the process of photosynthesis and plant transpiration to take place perfectly. The total increase in potato plant biomass was due to the increase in photosynthetic activity, while the weight decreased as a result of leaf drying without increasing the number of leaves and plant height.

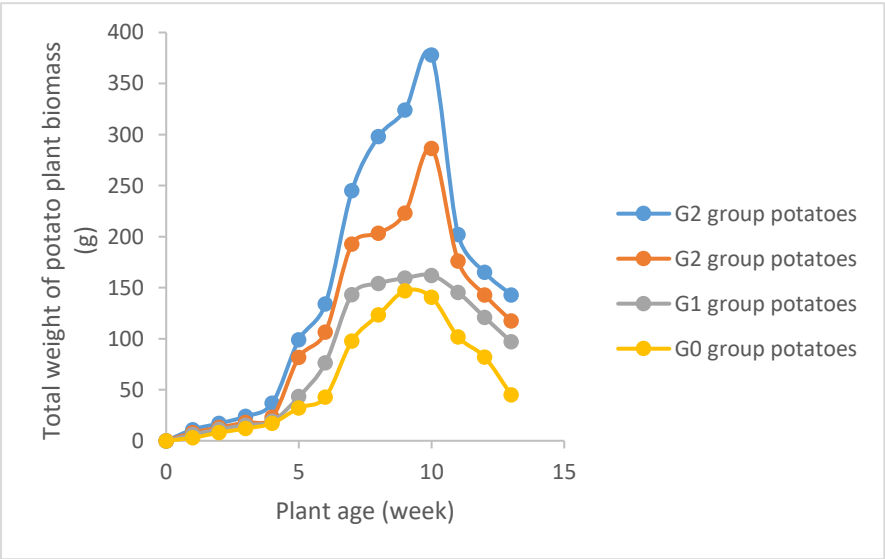

Figure 2. Relationship between plant age and total biomass

3.4. Pest and diseases attack level

Figure 3.shows that the number of potato plants that died due to Fusarium wilt was a maximum of 2% with an increase in attack on plants by 0.02% / day. The intensity of attacks by mole cricket, caterpillars, fungi and insects was 0.2 - 0.8%, 0.2 - 1.0%, and 0.2 - 1.2%, respectively. In addition, the increase of the age of the plant also causes an increase in the attack of mole crickets, caterpillars and fungus.

Intensive spraying by farmers using insecticides and fungicides of the Daconil and Atrakol types once a week is able to control pests and diseases of potato plants, although there is still potential for bacterial and fungal attacks in the media, planting soil and compost as organic fertilizer (Tsedaley, 2018; Gherbawy et al., 2019; Girma et al, 2013).The attack of caterpillars, mole crickets, and insects came from other people's land that was cultivated by other horticultural crops. The cultivation models that were not well scheduled with the harvest which were not simultaneously become a disease source for other crops. Meanwhile, fusarium attack on potato plants was the result of soil in the root zone fertilized with compost containing Fusarium microbes (Kerkeniet al., 2013; El-Hassan et al., 2007).

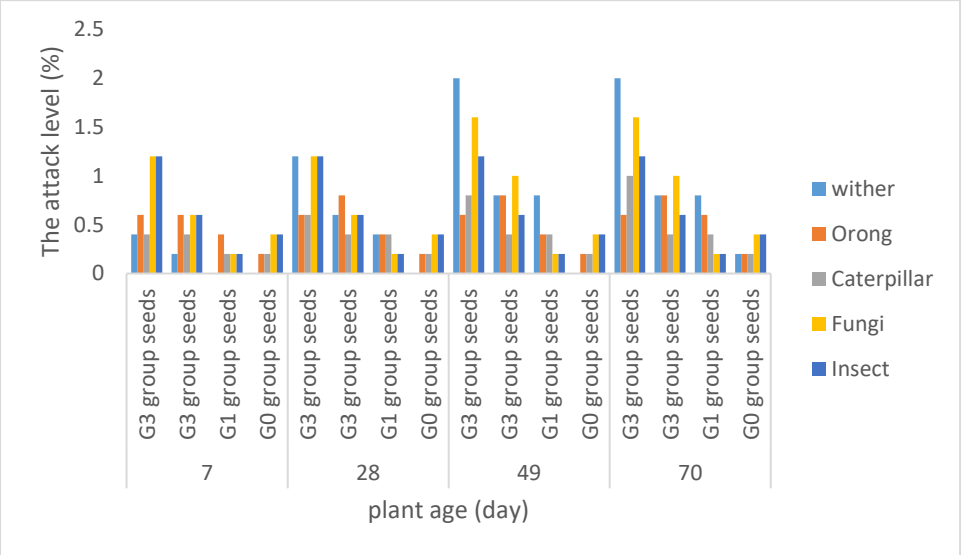

Figure 3. Relationship plant age with diseases attack level

3.5. The quality of harvested potato tubers

The LEISA system that was implemented was able to improve the total area of potato production from an average of 17 tones / ha to 28.22 - 33.1 tones / ha (Setiyo et al., 2018). Table 3 shows that the productivity of granola potato varieties in the G0, G1, G2 and G3 groups was different, the lowest productivity was in the G0 group and the highest was in the G3 group.

The differences in productivity of granola potato varieties, that was because the different drop rate level so the more productive and more adaptive the plants were to the environment. Potato productivity was also supported by improving the quality of planting media such as physical, chemical and biological properties of soil which can increase land productivity (Amara &Mourad, 2013; Eshonkulov et al., 2015).

The productivity of potatoes with the LEISA system has already reached the target. However, indications of damage to potato tubers for seedlings were still found, even though the amount of damage was very low. Mechanical damage due.

Table 3.Quality of harvested potatoes

Variable	G3group seeds	G2 group seeds	G1 group seeds	G0 group seeds
Total Production, kg / plant	416 ± 23	291.2 ± 15	215.6 ± 12	145.6 ± 20
Production per ha, ton / ha	32.8 ± 1.2	25.2 ± 0.9	17.5 ± 0.7	10.5 ± 0.6
Tuber attacked by mole crickets, %	1.37 ± 0.2	1.3 ± 0.3	0.9 ± 0.1	0.66 ± 0.2
Rotten Tuber, %	2.51 ± 0.4	2.48 ± 0.2	2.33 ± 0.3	1.33 ± 0.1
Wound tuber, %	1.03 ± 0.3	0.97 ± 0.3	0.68 ± 0.2	0.61 ± 0.3
Tuber infested with fungus, %	2.17 ± 0.3	2.09 ± 0.1	1.71 ± 0.2	1.27 ± 0.4

4. Conclusion

The level of pest and diseases attack on granola seed potato cultivated with the LEISA system is very low or less than 2% of the planting population, this is because pest and plant disease control was carried out in a well programming and the quality of the seeds used. The potato tubers produced were of very good quality, with total tubers that could be used as seeds for seed groups G0, G1, G2 and G3, respectively 97%, 91%, 85% and 32%.

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6. Conflict of Interest

All authors state that there is no conflict of interest between the authors or other parties

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