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Potato Cultivation Technology for Increasing Farmers, Income in the Eruption Exposed Are of Mount Sinabung, Karo District

Teknologi Budidaya Kentang untuk Peningkatan Pendapatan Petani di Daerah Terpapar Erupsi Gunung Sinabung, Kabupaten Karo

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ABSTRACT

The negative impact of land exposed to the eruption of Mount Sinabung can be improved through the provision of soil amendments and improvement of soil fertility so that the physical and chemical properties of the land are suitable for potato plants. This study aims to compare the potato cultivation technology package recommended by the North Sumatra AIAT with the farmer technology package on land exposed to the eruption of Mount Sinabung. The experiment was conducted in one of the potato production centers that experienced the impact of the eruption in Kutarayat Village, Naman Teran District, Karo Regency, located 3 km from the eruption center from January - December 2019. The treatment of the cultivation technology package studied were: 1). Recommended technology package with twice soil processed , dolomite 2 tons/ha, manure sown in arrays 20 tons/ha, sawdust 5 tons/ha, NPK 500 kg/ha, urea 100 kg/ha, KCl 100 kg/ha and; 2). Farmer's technology package with once soil processed , manure in holes 10 tons/ha, NPK 250 kg/ha, urea 100 kg/ha, KCl 100 kg/ha. The results showed that the growth of potato plants was better, potato tuber produktion with the application of recommended technology resulted in the highest tuber production and the weight of large tubers (>200 g/tuber) was significantly higher and more abudant compare the farmers' technology package. As a result potato planting with the recommendation package input resulted in the highest tuber production of 39.81 t/ha and economically profitable with a B/C ratio of 2.69.
Keywords: potato, eruption, mount Sinabung, technology package

ABSTRAK

Akibat negatif lahan terpapar erupsi Gunung Sinabung dapat diperbaiki melalui pemberian bahan pembenah tanah dan perbaikan kesuburan tanah sehingga sifat fisik dan kimia lahan sesuai untuk tanaman kentang. Pengkajian ini bertujuan untuk membandingkan paket teknologi budidaya kentang rekomendasi BPTP SUMUT dengan paket teknologi petani pada lahan terpapar erupsi Gunung Sinabung. Percobaan dilakukan di salah satu sentra produksi kentang yang mengalami dampak erupsi di Desa Kutarayat, Kecamatan Naman Teran, Kabupaten Karo terletak 3 km dari pusat erupsi dari bulan Januari - Desember 2017. Perlakuan paket teknologi budidaya yang dikaji adalah : 1). Paket teknologi rekomendasi : Tanah diolah dua kali, dolomit 2 ton/ha, pupuk kandang ditabur dalam larikan 20 ton/ha, serbuk gergaji 5 ton/ha, NPK 500 kg/ha, urea 100 kg/ha, KCl 100 kg/ha; 2). Paket teknologi teknologi petani: tanah diolah satu kali, pupuk kandang dalam lobang 10 ton/ha, NPK 250 kg/ha, urea 100 kg/ha, KCl 100 kg/ha. Hasil pengkajian menunjukkan bahwa : (1) pertumbuhan tanaman kentang yang mendapatkan perlakuan teknologi budidaya paket rekomendasi lebih baik dibandingkan dengan paket teknologi petani. (2) produksi umbi tanaman kentang dengan penerapan teknologi rekomendasi menghasilkan produksi umbi tertinggi yakni 39,81 t/ha, sedangkan paket teknologi budidaya petani adalah 23,79 t/ha. (3) Demikian juga, bobot umbi ukuran besar (> 200 g/umbi) nyata lebih tinggi dan lebih banyak dibandingkan dengan paket teknologi petani. Penanaman kentang dengan masukan paket rekomendasi menghasilkan produksi umbi tertinggi yakni 39.81 t/ha. Secara ekonomi menguntungkan dengan B/C rasio 2,69.

Kata kunci : Kentang, erupsi, gunung Sinabung, paket teknologi

INTRODUCTION

According to the National Agency for Disaster Management in Karo Regency, North Sumatra Province, losses due to the eruption of Mount Sinabung, according to the National Disaster Management Agency, reached more than Rp. 1.49 trillion. Head of the Center for Data, Information and Public Relations of the National Disaster Management Agency (BNPB) Sutopo Purwo Nugroho said the estimate was a temporary calculation due to the eruption which began on September 15, 2013.

The biggest losses and damages were in the productive economic sector, including agriculture, plantations, livestock, trade, tourism, fisheries, SMEs, and industry which is estimated to reach Rp 896.64 billion. Meanwhile, other losses and damages include the housing sector Rp 501 billion, infrastructure Rp 23.65 billion, social Rp 53.43 billion, and cross-sector Rp 18.03 billion (Kompas, 2015) The area of agricultural land damaged by the eruption of Mount Sinabung in Karo Regency reached 50,921 ha, consisting of food crops, horticulture, and plantations and 12,399 ha of them experienced puso or crop failure. Losses from the Agricultural Sector are estimated at 1.3 – 1.5 trillion (Agricultural Research and Development Agency, 2014)

. Rehabilitation and restoration of land with an eruption impact in the short term, depending on the condition of the land experiencing light to moderate ash cover, can be done through liming technology and application of organic matter as well as perfect soil management. In addition to the problem of the physical properties of the land, there are also changes in the chemical properties of the soil such as an imbalance of nutrients in the land due to volcanic ash which contains excessive and insufficient elements in the soil, so that the recommendations for available cultivation technology, especially fertilization, are no longer available. suitable for the area. Thus, the recommendations for available potato cultivation technology packages or vegetable cultivation technologies commonly used by farmers are no longer suitable to be applied due to environmental factors and different land conditions.

MATERIALS AND METHOD

The location of the potato cultivation technology package study was carried out in Kutarayat Village, Naman Teran District, which is located 3-5 km from the center of the eruption of Mount Sinabung, while the eruption dome that often occurs is Southeast-South and the location of the activity is in the Northeast - East. Thus, the location is in the safe zone, but the ash distribution still reaches the activity location. This village is located at an altitude of ± 1,400 m above sea level with Andisol soil type. The time of the study was carried out from January to December 2017. The materials used in the implementation of the activity are potato seeds (G2), Dolomite lime, manure, sawdust, NPK fertilizer, Urea, KCl, insecticides, fungicides, herbicides, and auxiliary materials. Agricultural equipment and machinery needed is a sprayer and field equipment.

The components of cultivation technology that are studied and compiled into a cultivation technology package include: a. Appropriate land preparation or tillage technology and depending on the thickness of the dust/ash so that the soil structure becomes crumbly b. Technology for improving soil physical properties through the application of organic matter or manure c. Technology to improve soil chemical properties through liming, soil repair and fertilization Furthermore, it is assembled into 3 (three) treatment packages for potato cultivation technology as presented in Table 1, as follows:

Table 1. Potato cultivation technology package on land exposed to the eruption of Mount Sinabung

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Technology Components	Potato Cultivation Technology	
	Recommended Technology Package	Farmer Technology Package
Tillage	2 times	1 times
Manure (t/ha) and application	20 in the run	10 in the hole
Sawdust (t/ha) sprinkled on gludan	5 sown	- -
Dosage of lime (t/ha) and application techniqu	2 sown	- -
NPK fertilizer (kg/ha) and application techniqu	500 run	250 hole
Urea fertilizer (kg/ha) as supplementary fertilizer	100	100
KCl fertilizer (kg/ha) as supplementary fertilizer	100	100

The stages of activities in the implementation of the assessment in the field are as follows: 1. Land preparation through land preparation using a tractor and clearing the land, then a map is made according to the specified size. 2. Potato seeds of the Granola L (G2) variety were prepared beforehand in the form of tubers that had sprouted 1-2 cm. 3. The land that has been processed is plotted with a size of 8 m x 6 m (48 m2) and then on the plot of land it is sprinkled with dolomite lime according to the treatment. 4. Next, an array or plant hole is made according to the cultivation package treatment.

Organic fertilizer in the form of manure is given in rows or holes according to the treatment and sawdust in the recommended technology package is given after the planting seeds are sown on a mound of soil arrays evenly. 5. NPK compound fertilizer (16-16-16) as basic fertilizer is given after manure in the array or hole according to the treatment before potato seeds are planted. 6. Potato seeds are planted with a spacing of 80 cm x 30 cm or each plot of 200 clumps of plants, then covered with mound-shaped soil. 7. After the potato shoots grow above the soil surface, then the first weed and supplementary fertilizer (Urea and KCL), then the first planting is done as high as 20-25 cm at the age of 50 Days After Planting (DAP) and the age of 65 DAP the second weeding and second hoarding. 8. Pest and disease control is carried out by spraying insecticides and fungicides at intervals of 1 time/week according to the recommended dose. 9.

Observation of plant growth, namely plant height measured from the soil surface to the highest growing point at the age of 50 DAP, 65 DAP and 80 DAP. Observation of the number of main stems by counting the number of stems in one clump at the age of 65 DAP. 10. Observations of production data were carried out after harvest, including tuber weight per plot, tuber weight per plant clump, and number of tubers per plant clump. 11. Observation of tuber quality was carried out by weighing the weight of tubers per clump and the number of tubers according to the criteria, namely class A (> 200 g/knol); class B (151-200 g/knol); class C (101-150 g/knol); class D (46-100 g/knol) and class E (< 46 g/knol).

Parameters observed were plant growth, tuber production and tuber class. To determine the feasibility of each farming technology package studied, data on production costs and production values were recorded and analyzed to obtain the R/C ratio

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RESULTS AND DISCUSSIONS

Region Description

Karo Regency, one of the centers of horticultural crop production in North Sumatra, is located in the highlands with a cool climate. There are 4 sub-districts around the Mount Sinabung area, namely Naman Teran, Simpang Empat, Tigaderket and Payung Districts. As a result of the eruption of Mount Sinabung since 2013 it has disrupted the lives and economy of the community, especially in the 4 sub-districts above. The government has relocated residents who live in 3 villages totaling 370 families to the Siosar area, Brand District, Karo Regency. Most of the agricultural land that used to be very fertile was covered by volcanic ash so that it became problematic in agricultural businesses, especially in the cultivation of vegetable crops.

The eruption of Mount Sinabung caused the condition of the land in the affected area to change/damage, both physical, chemical and biological properties of the soil. The results of previous observations that most of the land was covered with dust ash with a thickness of 10-50 cm resulted in changes in soil properties and the balance of nutrients was disturbed.

Potato Plant Growth

The growth of potato plants is shown by the diameter of the crown and the height of the plant. The diameter of the crown is related to the number of main stems and each stem produces a number of leaves. Plant height observations were made at the age of 50 DAP, 65 DAP and 80 DAP (Table 2). Overall the development of plant growth was initially slightly delayed. This is due to the dry season so that the appearance of tuber shoots on the soil surface takes longer than usual (30 DAP). Observation of growth data such as plant height was measured after the age of 50 DAP, 65 DAP and 80 DAP. The height of potato plants at the age of 50 DAP has begun to show differences and the highest plants are produced in plants that get the recommended technology package, which is 17.27 cm, while the lowest is in the farmer technology package (farmer technology) which is 13.87 cm. Furthermore, when the observations were made at the age of 65 DAP and 80 DAP, the highest plants were found in potato plants that received the recommended technology package, which was 46.02 cm and the lowest was in plants with the farmer technology package, which was 35.58 cm.

The number of main stems of potato plants was calculated at the age of 65 DAP observations. Table 2 shows that the number of main stems of potato plants with the input of the recommended technology package (4.96 stems) was significantly higher than the other improvement technology packages and farmer technology packages. In addition, the recommended technology package also improved the land quality by providing manure as well as organic sawdust (5 t/ha) that resulting significantly better potato growth than the farmer method. This is possible because the sawdust provided can play a role in storing water and reducing water evaporation so that the soil conditions around the plant roots are still moist, especially when plant shoots appear on the soil surface. Furthermore, the soil structure becomes more crumbly around the potato plant stems so that the development of plant roots is better.

This situation is also caused at the time of planting until 1-2 months after planting there is no rain or dry season, even though efforts are made to water the plants 3 times, the plants that get the recommended technology package are still better.

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Table 2. The effect of the cultivation technology package on potato plant growth

Technology package	Plant height (cm) at age			Number of main stems (65 DAP)
	50 DAP	65 DAP	80 DAP	
Recommendation	17.27	35.58	46.02	4.96
Farmer	13.87	26.34	39.30	3.80

Expl.: DAP:Days After Planting

Provision of sawdust by sowing on top of the gludan plants at the time of planting the seeds and then after weeding the soil is carried out so that the sawdust is in the root environment of potato plants.

Potato Tubers Production and Quality

Potato tuber production was obtained by weighing the tuber weight and counting the number of tubers harvested. The highest data on tuber weight per clump of potato was produced in plants that received the recommended technology package technology, namely 1.39 kg per clump, followed by the high input technology package, while the farmer package only produced 0.95 kg per plant clump (Table 3). On the other hand, the average number of tubers per clump was produced by farmer technology packages was 10.70 bulbs, while plants with land improvement packages ranged from 6.55-8.70 bulbs per clump. This means that although the number of bulbs was higher but the weight of the tubers was lower. Sutater et al (1986) stated that the size of the tuber is determined by the amount of photosynthate produced and the capacity of the tuber to absorb photosynthate.

The tuber production per plot (48 m2) was significantly higher in the recommended technology package (191.8 kg) and the farmer technology package only 114.2 kg/plot. From the results of the conversion of tuber weight per plot to tuber production per hectare of potato plants, it is known that the production sequentially is the recommended technology package (39.81 t); and in the farmer technology package (23.79 t/ha).

Table 3. The effect of the cultivation technology package on potato tuber production

Technology package	Bulb weight / clump (g)	Number of tubers / clump	Bulb weight (kg) / 48 m2	Bulb weight per ha (t)
Recommendation	1.392,13	8.70	191.10	39.81
Farmer	950,35	10.70	114.20	23.79

This results because supported by better growth data (plant height and number of main stems). Tanaka (1980) stated that the yield of potato tubers is determined by the strength of the source and the tuber's ability to absorb photosynthesis (sink). The results of research by Nurhasanah in Anda et al (2010) stated that the volcanic ash of Mount Merapi can increase levels of Ca, Mg and K and reduce Al saturation.

The application of volcanic ash significantly increased the growth and weight of soybean and corn on Ultisol, Oxisol and Andisol soils. Thus, even though the dose of fertilizer (fertilizer and artificial fertilizer) was increased, it was no longer able to increase the growth and production of tubers because the volcanic ash contained in the soil was sufficient to meet the nutrient needs of potato plants.

The yield of potato tubers produced in this study is much higher than the results of previous studies that have been carried out, namely 18.05 t/ha in Primatani activities in Nagalingga Tanah Karo Village (Nainggolan, 2009) and 32.06 t/ha in Tongkoh KP using imported Granola seed varieties (Nainggolan, 1991). This is possible because it is supported by 2 factors, namely: 1) the quality of the Granola-L seed used is still the 2nd derivative,

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generally the higher the seed derivative, the lower the production produced, 2) the condition of the growth phase during planting. The longer the age of the plant in the field or the bulb filling phase, the higher the tuber production will be. The period or length of potato growth until harvested in this study reached 125 DAP, meaning that 2 weeks before harvest, the potato leaves were still green and fresh, whereas in general, the age of the potato was less than 100 DAP.

Table 4. The effect of the cultivation technology package on tuber weight per potato clump

Technology package	Bulb weight (g) per clump				
	Grade A (> 200 g)	Grade B (151-200 g)	Grade C (101-150 g)	Grade D (46-100 g)	Grade E (< 45 g)
Recommendation	721,60	300,50	172,75	116,00	28,13
Farmer	309,20	265,93	165,85	149,33	140,23

The quality of potato tubers was determined based on the size (grade) or weight per tuber produced (Tables 4 and 5). The weight of large tubers or grade A (> 200 g/bulb) significantly increased with the recommended technology and treatment. The recommended technology package resulted in the highest average tuber weight (721.60 g/clump) with a total of 2.65 bulbs/clump, while the technology farmers only produced 309.20 g/clump with a total of 1.13 tubers/clump. The grade of medium size tubers (>101 - <200 g/clump) was not significantly different and on the other hand, the weight and number of small tubers (<100 g/tuber) were significantly higher in farmers' technology packages.

Table 5. The effect of the cultivation technology package on the number of tuber sizes per potato Clump

Technology package	Number of tubers per clump				
	Grade A (> 200 g)	Grade B (151-200 g)	Grade C (101-150 g)	Grade D (46-100 g)	Grade E (< 46 g)
High input	2.23	1.18	1.18	1.35	1.33
Recommendation	2.65	1.65	1.55	1.88	0.98
Farmer	1.13	1.18	1.18	1.98	5.25

Farming Analysis

Based on the analysis of farming through the application of the technology package recommended for potato cultivation on land exposed to the eruption of Mount Sinabung, it was found that with technological improvement or without improvement, a decent profit was obtained with a B/C ratio > 1.00. The highest B/C was obtained by input or improvement technology (recommended technology package) which was 2.69, while the customary technology of farmers with a B/C ratio was only 1.68. Table 6, shows that the allocation of production costs per hectare is highest for purchasing potato seeds (G2) as much as 1,350 kg per ha at a cost of Rp. 18.900,000, - or 37.13 - 60.67% of the total production costs or 25.52-36.24% of the total required production costs, followed by the costs of procuring organic fertilizers, artificial fertilizers and pesticides. The cost of labor wages ranges from Rp. 21,000,000 to Rp. 23.400.000.-per ha or 36.21 to 40.27 % of the total production cost of potato farming.

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Table 6. Farming analysis of several potato cultivation technology packages on land exposed to the eruption of Mount Sinabung in one growing season

DESCRIPTION	Recommended Technology Package		Farmer Technology Package	
	Volume	Value (Rp)	Volume	Value (Rp)
A.INGREDIENTS		41,225,000		31,150,000
Seeds (kg/ha)	1,350	18,900,000	1,350	18,900,000
Manure (kg/ha)	20,000	12,000,000	10,000	6,000,000
Organic matter (kg/ha)	5,000	500,000	0	0
Inorganic fertilizer				
NPK (kg/ha)	500	4,750,000	250	2,375,000
Urea (kg/ha)	100	200,000	100	200,000
KCl (kg/ha)	100	400,000	100	400,000
Dolomite (kg/ha)	2,000	1,200,000	0	0
Pesticide				
Insecticide (l)	15	1,275,000	15	1,275,000
Fungicide (kg)	20	2,000,000	20	2,000,000
B. LABOR COSTS				
Tillage 1	45	3,375,000	45	3,375,000
Tillage 2	25	1,875,000	0	0
Hole/run	20	1,500,000	20	1,500,000
Whitewash	2	150,000	0	0
Feeding	20	1,500,000	15	1,125,000
Cultivate (2x)	20	1,500,000	20	1,500,000
Plant	30	2,250,000	30	2,250,000
Watering (3x)	15	1,125,000	15	1,125,000
Afternoon/seasoning (2x)	40	3,000,000	40	3,000,000
Spray (12x)	25	1,875,000	25	1,875,000
Harvest	55	4,125,000	55	4,125,000
Sort	15	1,125,000	15	1,125,000
C. TOTAL LABOR COSTS	312	23,400,000	280	21,000,000
D. INGREDIENTS TOTAL		41,225,000		31,150,000
E. TOTAL COST (Rp)		64,625,000		52,150,000
F. INCOME (Rp)	39,813	238,878,000	23,792	139,752,000
G. PROFIT (Rp)		174,253,000		87,547,000
(R/C)		2.69		1.68

Expl.: Labor cocts (UHL): Rp. 75,000/HOK; potato seed price Rp. 14,000/kg; selling price of potato tubers Rp. 6,000/kg

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CONCLUSION

Production of tubers produced by potato plants with the application of improved technology The recommended technology package is the soil is processed twice, dolomite 2 tons/ha, manure is sown in arrays of 20 tons/ha, sawdust 5 tons/ha, NPK 500 kg/ha, urea 100 kg/ha, KCl 100 kg/ha resulted in the highest tuber production of 39.81 t/ha, while the farmers' cultivation technology package produced 23.79 t/ha.

The yield of tubers, the weight of large tubers (> 200 g/tuber) was significantly higher and more abundant than the farmers' technology package. Planting potatoes on erupted covered land with the input of the recommended technology package: the soil is processed twice, dolomite 2 tons/ha, manure is sown in an array of 20 tons/ha, sawdust 5 tons/ha, NPK 500 kg/ha, urea 100 kg/ha ha, KCl 100 kg/ha is economically very profitable with a R/C ratio of 2.69.

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