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Growth and production of two varieties of potatoes in plains medium with methanol supplements

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A B S T R A C T

The aim of study is to applied methanol supplement two potatoes varieties in order to evaluate the development growth and production in plain medium area about 400 – 800 meter above see level. Generally potato is grown in highlands with agroclimate, temperatures around 17°C – 20°C with optimum temprature tuber formation 18°C. Planting potato in highland continually cause of problem such as erosion, declining soil productivity, limited area, and high production costs. Therefore, the extension step development of the potato should be directed to the plain medium (400-800 m asl) that their area is wider than the high plateau, so that in the long term can realize performance for increased production and productivity, and quality of potatoes in a sustainable manner while meeting the needs of the potato national and reduce imports of seeds gradually.Specific targets to be achieved in this research is to obtain potatoes of aeroponic technology results with the use of methanol in the medium-lying land with high levels of production and productivity, as well as free from pest attack. To achieve these goals in the second year will be multilocation trials research activities, on land plains medium (± 400, ± 600, and ± 800 m above sea level and will be done in three places/ regions in South Sulawesi, namely, Gowa, Bantaeng, and Jeneponto. Each location will be measured altitude, above sea level (above sea level), geographic location, humidity, temperature, soil pH, and soil texture. The study uses two varieties of potatoes (Granola and Atlantic) with a concentration of 15% methanol application (which gives the best results in the first year of research) that is designed with a pattern design Separate plots.The results showed that: 1) application of 15% methanol in potato varieties in the highlands Granola medium (± 400, ± 600, and ± 800 m above sea level) provide plant height, amount of bulbs, tubers and higher weight than the varieties of the Atlantic, but the results tubers per hectare is higher (33.91 t/ha) in the Atlantic variety; 2) The results of aeroponic technology and Atlantic Granola potato variety developed at three locations (± 400, ± 600, and ± 800 above sea level) give a different response to the growth, production and quality of potatoes.

Introduction

Potato productivity in Indonesia is still very low at 13 t ha^{-1}, much of the potential production that can reach 40 t ha^{-1} (DJBPH, 2010). Weak seed systems, the high risk of failure due Plant Pest Organisms (PPO) and low mastery of production technology is a major problem low national potato production. This causes the need for a national potato seed is still very dependent on imports, the availability of only around 5.97% of the needs of 121,753.5 tones $year^{-1}$, with a value of ±Rp 1.25 trillion (DPSP, 2010).

One seed production technology is being developed aeroponic technology solution that is giving nutrients to plant roots by means of nebulization (Jensen and Collins, 2005; Howard, 2006), root crops are left hanging, then from the bottom sprayed nutrient solution through the sprinklers and the roots will catch and absorb the nutrients (Resh, 2004; Park, 2005).

The results of the study Competitive Grant (HB) 2008-2009 by Muhibuddin *et al.*, (2009), has Developed a production system with a tissue culture system cuttings early detection of pathogens, *ELISA* and *PCR* and rapid propagation of cuttings to cuttings, followed by aeroponic technology. With proper nutrient formulation in aeroponic technology has gained a healthy potato seed industry and quality generation of zero (GO = source) on a scale greenhouses and seed G1 (breeder) on screen house. Formulation of N 260 (7: 1 NO3: $NH_4^{+)}$, P 87, K 416, 175 Ca, Mg 75, S 136.5, Fe 5.0, Cu 0.4, 0.05 Mo, Mn 3,0, Zn Bo 0.3 and 0.7 mg L^{-1} provides the best results for quality improvement, growth, and production of potatoes, both in variety Granola and the Atlantic with an average yield of 25-30 tubers $plant^{-1}$, which production much higher than conventional systems that only produce 3-5 knol $plant^{-1}$.

Development of potato in South Sulawesi during this directed at plateau region (800 - 1500) 11.405 m above sea level with potential ha (Central Statistcal Data,2010). The region is getting narrower due to the transfer of functions and other uses, so it is necessary to find an alternative that can be developed on the plain medium (500-700) m. Constraints faced in potato cultivation in the plains of the medium among others, temperature and high light intensity causes high photorespiration (high CO_2 release) so that the lower rate of photosynthesis causes low production as well as pests and diseases Plant Pest Organisms (PPO), In addition, the low production during the national potato seed systems is due to the weakness and lack of mastery of production technology.

Photorespiration high, causing wasteful/release of CO_2 from plants (Barnes and Houghton, 1994; McGiffen and Manthey, 1996), this situation reduces the diffusion of CO_2 into the leaf and further decrease the rate of photosynthesis. To overcome these problems which can be used methanol supply of CO_2 into the leaf cells, so as to compensate for the loss of CO_2 in the process of photorespiration (McGiffen and Manthey, 1996; Zakaria, 2010). Preliminary observations on the plain medium conducted in the greenhouse by spraying methanol Muhibuddin showed that 10% every week on potato increase potato production by 35% compared with no methanol (Muhibuddin, 2010). Furthermore, the results of the National Strategy in 2013 by Muhibuddin, *et al*., (2013), indicates that the application of methanol in two varieties of potatoes in plain medium multiplied Aeroponic technology, providing the best results in 15% methanol concentration on the production and quality of potatoes.

Aeroponic technology systems through the application of methanol, which is the source of production of tissue culture cuttings are expected to contribute in solving most of the problems to accelerate the increase in the national potato production, while reducing the import of seeds gradually. However, the ability of methanol increases the production of potatoes on medium-lying still needs to be tested further at various locations / regions plains medium with a different geographical location.

Materials and Methods

The research activities of II is multilocation trials, on land plains medium (± 600) m above sea level will be done in three places/regions in South Sulawesi, namely, Gowa, Bantaeng, and Jeneponto. Each location will be measured altitude, above sea level (above sea level), geographic location, humidity, temperature, soil pH, and soil texture. The study uses two variety of potatoes (Granola and Atlantic) with a concentration of 15% methanol application (which gives the best results in the first year of research), by comparing the results between the variety of Granola and Atlantic.

Results and Discussion

Aspects of growth and production

High crop

Based on Duncan test in Table 1 indicate that the variety Granola (V_1) showed higher plant height and significantly different than the Atlantic variety (V_2) at 6 MST. 800 m altitude above sea level (H_3) the highest yield and plant height were significantly different compared to 600 m above sea level (H_2) and 400 m above sea level (H_1), both at 4 MST, 6 WAP, and at 8 WAP with the application of methanol concentration of 15% .

The number of bulbs, tubers Diameter, Weight bulbs and tubers Results

Based on Duncan test in Table 2 shows that the number of tubers on the variety Granola (V_1) is higher and significantly different than the Atlantic variety (V_2). 800 m altitude above sea level (H_3) resulted in the highest number of tubers and significantly different compared to 400 m above sea level (H_1) but not significantly different from 600 m above sea level (H_2) at a concentration of 15% methanol application ..

Based on Duncan test in Table 2 shows that the diameter of the bulbs did not show significant differences between varieties of granola (V1) with the Atlantic variety (V2). 800 m altitude above sea level (H_3) diameter tuber yield is the highest and significantly different compared to 400 m above sea level (H1) but not significantly different from 600 m above sea level (H_2) at a concentration of 15% methanol application.

Based on Duncan test in Table 2 indicates that tuber weight on the variety Granola (V_1) is lower and significantly different than the Atlantic variety (V_2). 800 m altitude above sea level (H3) produces the highest tuber weight and significantly different compared to 400 m above sea level (H_1) but not significantly different from 600 m above sea level (H_2) at a concentration of 15% methanol application.

Quality aspects bulbs

Tuber dry matter content, Violence bulbs, tubers thickness,carbohydratecontent and Percentage Quality Bulbs

Based on Duncan test in Table 3 shows that the dry matter content of tubers on the variety Granola (V_1) is lower and significantly different than the Atlantic

variety (V_2). 800 m altitude above sea level (H_3) tuber dry matter yield the highest and significantly different compared to 400 m above sea level (H_1) but not significantly different from 600 m above sea level (H_2) at a concentration of 15% methanol application.

Based on Duncan test in Table 3 shows that violence Granola tuber variety (V_1) was not significantly different than the real Atlantic variety (V_2). 800 m altitude above sea level (H_3) bulbs produce a lower hardness and significantly different compared to 400 m above sea level (H_1) but not significantly different from 600 m above sea level (H_2) at a concentration of 15% methanol application.

Based on Duncan test in Table 3 indicate that the interaction variety Granola (V_1) and the altitude above sea produce lower skin thickness compared with the interaction of the Atlantic variety (V_2) and the altitude above sea level. Interactions variety Granola (V_1) and altitude H_1 (±400 m) (30/24ºC) produces the highest tuber skin thickness (0.29 mm) on the interaction significantly different V_2H_1 and V_2H_2 and V_2H_3.

Based on Duncan test in Table 3 indicate that the carbohydrate content of the variety Granola (V_1) is lower and significantly different than the Atlantic variety (V_2). Altitude above sea level, did not show differences in carbohydrate content of potato tubers, either on a variety Granola as well as on the variety of the Atlantic.

Treatment varieties (Granola and Atlantic) at different heights above sea level (± 400, ± 600, and ± 800 m above sea level) indicates that the response to the altitude above sea varieties (temperature difference) in the grading. Granola varieties have sized tubers> 60 g more at an altitude of ± 400 m (30/24ºC) and tuber size 30-60 g more in height ± 600 m (29/22ºC) and ± 800 m (26/21ºC). Atlantic varieties have sized tubers> 60 g and 60-30 g more at an altitude of ± 600 m (29/22ºC) and tuber size 20-10 g more at an altitude of ± 800 m (26/21ºC).

Aspects of growth and production

The results showed 15% methanol application every two weeks on two varieties of potato (Granola and Atlantic) in height/different temperatures (±400 m (30/24ºC), ±600 m (29/22ºC, and ± 800 m (26/21ºC) (Table 1.2, 3, and 4) give a different effect on the parameters of growth, production and quality of potatoes. this is due to the effect of methanol on the growth, production and quality of potatoes can not be separated from the physiological activity of the potato crop, especially photosynthesis. Activities photosynthesis determine growth and yield of potato.

Treatment of high-yielding crop varieties Granola, especially at the age of 6 MST, which is higher than the Atlantic variety (Table 1). This relates to the type of growth both varieties, which caused differences in genotypes that cause differences in the ability of each variety in the absorption of nutrients, especially CO_2. Research results Mueller *et al.,* (2004) showed that the effect of nutrients on plant growth depends, among others, by the concentration of CO_2 and plant species. High nutrient absorption greatly affect vegetative growth, which in turn determines the reproductive phase. In addition, differences in the characteristics of varieties of granola and Atlantic affecting the photosynthetic activity that determines the growth of plant height. One of the factors that affect the growth and production of potato plants are species or species of plants associated with genotype (Mantel *et al.,* 1985).

The number of tubers and tuber weight higher than the variety Atlantic and 800 m above sea level altitude (H_3) (26 / 21ºC) showed higher plant height compared with the height of 400 m above sea level (H_1), but tuber yield was higher in the Atlantic variety (Table 2). According to Loveless (1997), the number of tubers formed much can result in a decrease in tuber weight. Consequently bulbs that have grown compete for assimilates with bulbs emerging from stolonnya, so many candidates bulbs that do not grow bigger because of the lack of assimilates. It has been reported earlier investigators, that the number of bulbs that many will result in a decrease in tuber weight (Subhan, 1990).

Research results Mueller *et al.,* (2004) showed that the effect of nutrients on plant growth depends, among others, by the concentration of CO_2 and plant species. Methanol concentration of 15% (M_3) increase the number of tubers and tuber weight compared to the effect of other treatments. Effect of methanol concentration levels that produce CO_2 for the production of components, especially the number of tubers, tuber weight and diameter of the bulb is also associated with the vegetative growth of the potato crop.

Altitude above sea level, resulting in different plant height, height H_3 (800 m) (26/21ºC) produces the highest plant height at 8 WAP compared with 600 m above sea level (H2) and 400 m above sea level (H_1), with applications methanol concentration of 15%. This is due to the plant's response to stress temperature (low or high) differ between species and even between organs and the level of development of plants (Harjadi and John, 1988) .In the quantitative determination of the absolute value of the high temperature stress is difficult to determine, but the value of the highest temperature above 15^0C respectively each group is considered as the threshold of heat damage, especially for groups who can not stand that psikrofil, however, there are certain types that have a damage threshold below 15^0C. For example: Koliella tatrae Algae can grow optimally at temperatures of 4^0C but when the time is at a temperature of 10^0C can cause death for this species.

Duncan test results (Table 2) shows that. the number of tubers and tuber weight, the higher the variety Granola compared with the Atlantic varieties at different heights, while the tuber yield was higher in the Atlantic and the diameter of the tuber varieties showed no difference between the two varieties.

The difference is due to the minimum requirements that must be met for the growth and development of each different potato varieties. If the temperature is too high during the photosynthesis activity will be reduced because it is accompanied by a high photorespiration. Similarly, high night temperatures cause the transport of sugars from the leaves to the tubers decreased, so that the accumulation of starch in tubers low. Therefore, there will be a decrease in the yield on variety sensitive to high temperatures because not happen tranpor carbohydrates into the tuber, all decomposed back into energy for the formation of the leaves or the top of the plant.

In addition to regional disparities, the temperature also varies based on the time, both air temperature and soil temperature (morning-afternoon-evening). Effect of temperature on the growth of plants is known as the cardinal temperatures which includes the optimum temperature (under these conditions the plants can grow well), the minimum temperature (the temperature underneath the plants can not grow), and the maximum temperature (at a temperature higher plants can not grow). Cardinal

temperatures for each type of plant does vary from one another.

Effect of temperature on the growth and development of plants are distinguished as follows: (1) Temperature limits to the growth and development of plants, and (2) limit the temperature does not help the growth and development of plants. Temperature limits to the growth and development of plants known as the optimum temperature range. At this point all the basic processes such as photosynthesis, respiration, water absorption, transpiration, cell division, cell elongation and cell function changes will take place well and certainly will obtain the highest crop production. The optimum temperature limit is not the same for all plants, for example: apples, potatoes, sugar-beet requires a lower temperature compared: citrus crop, sweet potatoes or gardenia. Temperature limits are not profitable classified as the following:a) temperature above the optimum: the plants that grow in these conditions at the end of growth usually results in low production. This is due to the lack of balance between the size of the resulting photosynthesis and carbohydrate reduction due to respiration. Increased temperature will accelerate the process, but in the atmosphere above the optimum limit, the process of respiration will lasts greater than photosynthesis, thus increasing the high temperature would result in reduced production, and b). Temperatures below the optimum limit: plants that grow in these conditions will result in poor growth and production will be lower. This is due to the low temperature and the amount of photosynthesis produced protein is formed in a state minimum, resulting in slow growth and development and production of low.

The weight of tubers produced by plants is the result of the process of photosynthesis, respiration, and translocation. Glucose formed from the photosynthesis immediately converted to fructose or sucrose combine to form, then translocated to other cells or polymerized into carbohydrate as food reserves while in the chloroplast. Sucrose toward the cell walls were enlarged and in the cells transformed into structural components such as cellulose. Sucrose is also transferred to the parts of the plant such as to place the active growth (meristems) atauke pegubahan be a polysaccharide as a food reserve or structural compounds (Gardner *et al*, 1985).

Table.1 High plant two varieties of potatoes with altitude above sea level (above sea level) with methanol applications

Treatment	High Plant			
	2 WAP	4 WAP	6 WAP	8 WAP
V_1 (Granola)	16,87	27,73	68,72 a	79,39
V_2 (Atlantik)	16,56	27,24	66,56 b	78,27
H_1 (±400 m) (30/24ºC)	15,84	26,58 a	67,30 a	77,37 a
H_2 (±600 m) (29/22ºC)	16,84	27,67 ab	67,53 ab	78,01 ab
H_3 (±800 m) (26/21ºC)	17,47	28,21 b	69,25 b	81,64 b

Remarks:- ±800 m(26/21ºC=height of 800 meters above sea level, with temperatures the average daytime and nighttime temperatures 26ºC average 21ºC; The numbers are followed by the same letter in the same row are not significantly different according to DMRT level of 5%; -WAP=Weeks After Planting.

Table.2 Number of tubers, tuber diameter, tuber weight and tuber yield of two varieties of potatoes with altitude above sea level (above sea level) with methanol applications

Parameter	Variety	Altitude Places			Average
		H_1 (±400 m) (30/24ºC)	H_2 (600 m) (29/22ºC)	H_3 (800 m) (26/21ºC)	
Number of tubers (fruit)	V_1	9,10	9,64	10,02	9,59 x
	V_2	7,41	8,21	8,27	7,96 y
	Average	8,26 a	8,93 ab	9,15 b	
Tuber diameter (cm)	V_1	3,87	4,12	4,15	-
	V_2	3,78	3,91	3,90	-
	Average	3,83 a	4,02 b	4,03 b	
Tuber weight (g)	V_1	143,84	144,88	146,18	144,97 x
	V_2	168,46	179,36	178,21	175,34 y
	Average	156,15 a	162,12 b	162,20 b	
Tuber yield (ton/ha)	V_1	29,66	31,65	32,01	31,11 x
	V_2	32,89	34,10	34,75	33,91 y
	Average	31,28 a	32,88 ab	33,38 b	

Remarks: ± 800 m (26/21ºC = height of 800 meters above sea level, with daytime temperatures average 26ºC and night temperatures average 21ºC; Figures followed by the same letter in the same row are not significantly different DMRT according to the level of 5%.

Table.3 Levels of tuber dry matter, Violence bulbs, tubers thickness and carbohydrate content of two varieties of potatoes with altitude above sea level (above sea level) with methanol applications

Parameter	variety	Altitude Places			Average
		H_1 (±400 m) (30/24ºC)	H_2 (600 m) (29/22ºC)	H_3 (800 m) (26/21ºC)	
Tuber dry matter content (%)	V_1	19,54	19,27	18,89	19,23 a
	V_2	20,81	20,46	19,92	20,37 b
	Average	20,18 b	19,87 ab	19,41 a	
Violence bulbs (Psi)	V_1	3,39	3,38	3,37	
	V_2	3,41	3,39	3,39	
	Average	3,40 b	3,39 ab	3,38 a	
Tuber thickness (mm)	V_1	$0,26^{a}_{x}$	$0,27^{b}_{y}$	$0,27^{b}_{y}$	
	V_2	$0,29^{b}_{y}$	$0,28^{a}_{x}$	$0,28^{a}_{x}$	
Carbohydrate content (g/100 /g)	V_1	19,16	19,15	18,62	18,98 x
	V_2	20,38	20,20	19,70	20,09 y

Remarks: ± 800 m (26/21ºC = height of 800 meters above sea level, with daytime temperatures average 26ºC and night temperatures average 21ºC; Figures followed by the same letter in the same row are not significantly different DMRT according to the level of 5%.

Table.4 Percentage of two varieties of potato tuber quality with altitude above sea surface

Treatment		Grede A (>60g/tuber)	Grade B (60-30 g/umbi)	Grade C (20-10 g/umbi)	Grade D (<10 g/umbi)
Granola (V_1)	± 400 m (30/24ºC)	51	40	7	2
	± 600 m (29/22ºC)	27	36	30	6
	± 800 m (26/21ºC)	21	39	37	3
Atlantik (V_2)	± 400 m (30/24ºC)	31	39	23	7
	± 600 m (29/22ºC)	34	52	10	4
	± 800 m (26/21ºC)	21	31	45	3
Average		30,9	39,5	25,3	4,3

Atlantic variety that have a number of tubers and tuber weight much higher because of the distribution of assimilates that spread to every bulb causing competition in obtaining assimilates from source to sink (tuber) is higher because of the weight of tubers affected by the number and diameter of the bulb during generative growth of potato plants (Okazawa, 1983).

Tuber formation process can be interpreted as a storage tissue formation activity in the bottom of the plant that is stolon, while the tuber development process is a continuation of the process of stolon formation, starting from the formation of tubers and followed by storage of foodstuffs until the bulbs reach a certain number and size (Chapman, 1998). The process of tuber formation is closely related to plant growth (Swiezynki et al., 1998) and both processes are still associated with the development of the tuber (Leopold and Kriedman, 1988).

Aspects of quality bulbs

Table 3 shows that the Duncan test Based on Table 3 shows that the dry matter content of tubers on the variety Granola (V_1) is lower than the Atlantic variety (V_2). 800 m altitude above sea level (H_3) produces tuber dry matter content of the highest compared to 400 m above sea level (H_1).

This is related to the accumulation of dry matter in tubers or tuber growth is determined by the total assimilates available and the ability to absorb assimilate bulbs. According Moorby (1998) in addition to the factor intensity of light, nutrient availability is a crucial factor physiological processes of plants, ie photosynthesis, respiration, metabolism and other factors that influence the balance of source and sink in plants which have implications for the high and low levels of tuber dry matter.

Violence tubers (Table 3) on the varieties of granola (V_1) is no different than the Atlantic variety (V_2). 800 m altitude above sea level (H_3) produce tubers hardness lower than 400 m above sea level (H1) but not significantly different from 600 m above sea level (H_2). The high hardness tubers at 800 m above sea level in (H_3) are associated with an increase in tuber carbohydrate. Where carbohydrates that make up the cell walls are composed of, cellulose, pectin, and hemicellulose and other polysaccharides an amplifier between cells in the tuber (Salunkhe and Desai, 1994).

The thickness of the tubers (Table 3) shows that the interaction variety Granola (V_1) and the altitude above sea produce lower skin thickness compared with the interaction of the Atlantic variety (V_2) and the altitude above sea level. Interactions variety Granola (V_1) and altitude H_1 (± 400 m) (30/24ºC) produces the highest tuber skin thickness (0.29 mm) on the interaction significantly different V_2H_1 and V_2H_2 and V_2H_3. The increase in skin thickness at V_2H_1 interactions associated with increased carbohydrate content of tubers, which are building blocks of cell wall carbohydrates are composed of hemicellulose and cellulose that accumulates in the cell wall on the tuber skin. ByPermadi *et al.,* (1989) tuber skin (periderm) potato composed by 6-10 layers of cells in the absence of a rectangular cavity walls between cells and the cells undergo suberisasi. Periderm layer has been taking shape since the end of the stolon swelling which is the initial formation of tubers (Salunkhe and Desai, 1984). The cells in the outer layers of the bulb (the epidermis) splitting the direction of the tubers, whereas the cells in a layer beneath the epidermis (hypodermis) splitting outwards with increasing tuber carbohydrate content (Siswoputranto, 1989). Layer of dividing cells is called phellogen. The new cells are formed (phellem) will constitute components of the periderm (skin) and also experienced suberisasi).

Carbohydrate content (Table 3) shows that the carbohydrate content of the variety Granola (V_1) is lower than the Atlantic variety (V_2). Altitude above sea level, no effect on the carbohydrate content of potato tubers, either on a variety Granola as well as on the variety of the Atlantic. Increased carbohydrate content due to the concentration of 15% methanol can increase the metabolism of carbohydrates potato. This is because CO_2 is the main raw materials of photosynthesis that produces carbohydrates (starch, pectin, hemiselulose, and cellulose (Schunkhe and Desai, 2004). The concentration of methanol 15% (M_3) is able to increase the carbohydrate content, both varieties of granola and the Atlantic compared with the effect of treatment M0 but not significantly different from the M_1 and M_3 treatment effect. Increased carbohydrate content with 15% methanol concentration (M_3), because methanol breaks down into CO_2 as a raw material in the process of photosynthesis (Gardner *et al.,* 1985). in addition, CO_2 is essential elements as part of carbohydrates, proteins and fats (Salisbury and Ross, 1995).

Percentage Quality Bulbs (Table 3) showed that the treatment of varieties (Granola and Atlantic) at different heights above sea level (± 400, ± 600, and ± 800 m above sea level) indicates that the response to the altitude above sea varieties (temperature difference) in grading. Granola varieties have sized tubers> 60 g more at an altitude of ± 400 m (30/24ºC) and tuber size 30-60 g more in height ±600 m (29/22ºC) and ± 800 m (26/21ºC). Atlantic variety have sized tubers> 60 g and 60-30 g more at an altitude of ± 600 m (29/22ºC) and tuber size 20-10 g more at an altitude of ± 800 m (26/21ºC). Production of potato tubers is determined, among others, the start time of the formation of tubers and tuber development speed. The number of bulbs depends on the process of tuber formation, while the tuber grde determined by tuber development process and also interact with a number of tubers per plant during tuber development.

Conclusion

Application of methanol 15% on potato varieties on the plains Granola medium (± 400 m, ± 600 m, and 800 m above sea ±) provide plant height, Total bulbs, tubers and

Weights is higher than the Atlantic variety, but the tuber yield per hectare higher (33.91 t ha^{-1}) in the Atlantic variety.Results of aeroponic technology and Atlantic Granola potato varieties developed at three locations (± 400, ± 600, and ± 800 above sea level) give a different response to the growth, production and quality of potatoes. The results of the two can be used as a basis for correctional use methanol to yield improvement onthe plain medium potato aeroponics.

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