www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(6): 1520-1524

www.thepharmajournal.com
Received: 17-03-2022
Accepted: 28-05-2022

Raghavendra Naik
Department of Horticulture, University of Agricultural Sciences, GKVK, Bengaluru, Karnataka, India

NC Narase Gowda
Department of Horticulture, University of Agricultural Sciences, GKVK, Bengaluru, Karnataka, India

B Mohan Raju
Department of Crop Physiology, University of Agricultural Sciences, GKVK, Bengaluru, Karnataka, India

Srinivasappa KN
Department of Horticulture, University of Agricultural Sciences, GKVK, Bengaluru, Karnataka, India

Srikant Tengli
Department of Crop Physiology, University of Agricultural Sciences, GKVK, Bengaluru, Karnataka, India

Corresponding Author:
Raghavendra Naik
Department of Horticulture, University of Agricultural Sciences, GKVK, Bengaluru, Karnataka, India

Effect of season, root zone cooling and shading on growth and seed-tuber yield of potato through aeroponic technique

Raghavendra Naik, NC Narase Gowda, B Mohan Raju, Srinivasappa KN and Srikant Tengli

Abstract
Production of early generation potato seed-tubers from virus free planting materials through aeroponics help to supply quality seed materials for commercial growers wherever seed tuber production was not possible. Aeroponics production of seed tubers mainly depends on nutrients, season, environmental factors etc. Potato seed tuber production in *kharif* by encountering the minimum environmental standards help to produce additional seed-tubers for cultivation (15.06 tubers per plant in *kharif* as against 22.94 tubers per plant in *rabi*). Root zone cooling helps to increase the seed-tuber production (22.22 mini-tubers per plant in root zone cooling as compared to 15.78 seed-tubers per plant in control). The reduction of light by shade treatment adversely affected on plant growth, tuberization and nutrient uptake. The number of tubers per plant was reduced to 17.55 in shade treatments as compared to 20.45 tubers per plant in without shade (control). The interactions among season × shading and root zone cooling × shading were studied.

Keywords: Aeroponics, Hoagland solution, mini-tuber, misting, shading, root zone cooling

Introduction

Potato (*Solanum tuberosum* L.) is one of the major staple food crops, with high production per unit area, short growing season and good demand throughout the year helps in continuous increase in area. Potato as main source of energy at lowest cost to human diet and hence called as ‘Poor man’s food’. In recent year adoption of advanced production technologies, use of improved varieties, quality seed material, good storage facility and transportation helps to increase area, production and productivity in India.

Potato is Vegtatively propagated crop and hence disease-free seed tubers for commercial production is important. The production of seed tubers in hills and sub-tropical plains of India during low aphid population period and transport it to all over India for commercial fresh tuber production is the present scenario. This leads to high transportation, storage and handling cost, subsequently farmer should incur more cost for seed tubers alone. In the mean while the multiplication rate of potato in conventional cultivation is low (*i.e.*, 5-7 tubers/plant); for this reason a large area should be devoted for potato seed tuber multiplication.

From the above, it clearly shows that rapid multiplication (high multiplication rate/unit area) of early generation quality seed tuber production technology is necessary to meet the farmer demand with low cost of certified seed tubers. In this regard, aeroponic production of mini-tubers by using early generation planting material in controlled condition is one of the potential methods.

Aeroponics is a soil less culture, comprising root system enclosed in a dark chamber and nutrients are supplied to the roots through misting continuously at regular intervals. This technique allows the roots to absorb much needed oxygen, thereby increasing root metabolism and rate of growth, reportedly up to 10 times of that in soil. Aeroponics reduces the cost of maintenance requirements such as fertilizer, chemicals, disease and insect control, staff and more. The main advantages of aeroponics is that it drastically reduces the quantity of water and fertilizer usage (reduce water usage by 80% and fertilizers usage by 60%), and still maintains higher root metabolic activity thereby increasing yield.

Potato mini seed-tuber production through aeroponics has several advantages, including high multiplication rate (up to 1:45), high production efficiency per unit area (>900 mini tubers/m^2), savings in water, chemicals and energy are positive economic indicators (Chang *et al*., 2012, Sumarni *et al*., 2019 & Tessema *et al*., 2017) [2, 8, 9].

In aeroponic production of potato mini-tubers, various factors are involved in maximizing growth and mini-tuber yield. Temperature and light also play a major role in maximizing growth and mini-tuber yield of potato in aeroponics. Potato is a cool season crop and both day and night temperatures determines the tuberization. The low temperature ranging between 18 to 22 ^{0}C favourable for good growth and development of potato crop. Root zone cooling helps to produce potato mini-tuber in non-traditional area also (Sumarni *et al*., 2019) [8]. Optimum light intensity leads to maximizing photosynthetic assimilation. In this regard, optimization of light requirement for aeroponic mini-tuber production of potato is one of the important research areas.

Materials and Methods

The experiment was conducted during *Kharif* and *rabi* of 2019-20. Early generation certified potato tubers of variety Kufri Jyoti were collected from certified source and cut pieces were treated with carbendazim fungicide @ 2 g^{-1} for 10 minutes. *Kharif* season sowing was taken up on 13th June 2019 and *rabi* season sowing was taken up on 25th September 2019. Healthy and vigorous potato seedlings were used for planting in aeroponic chamber after washing in fresh water to remove adhered soil and other materials at a distance of 15 cm X 15 cm in the holes made on high density polystyrene sheet covers over the top by using rubber cork to hold the plant at stem region in the aeroponic chamber with dimension of 1 m height X 1.5 m width X 1 m breadth are made by thermal insulated material to avoid the loss of regulated root zone temperature and the entry of light in to root zone area. Before transplanting seedling root were dipped in 0.2 per cent carbendazim fungicide for 10 minutes. Temperature regulated chambers (with root zone cooling), the nutrient solutions are stored in chiller and chill the nutrient solution at 18^{0}C and for chambers of without root zone cooling nutrient solution temperature were not regulated.

Nutrient solution misting intervals was regulated through timer connected to pump in such a way that plant roots are misted with fine mist of nutrient solution for every 30 seconds spray duration for every 6 minutes off time were fixed. For temperature regulated chamber, maximum control over root zone temperature was achieved by using side cooling jacket and same cooled solution was passed through perforated pipes.

Nutrient solution concentration and its management

Modified Hoagland solution (MHS) with 50 per cent increase of all nutrients was prepared by altering the modified Hoagland solution by addition of all nutrient elements by 50 per cent extra that required for the potato crop in aeroponics based on previous work. Nutrient salts with nutrient element and final nutrient concentration of modified Hoagland solution with 50 percent extra are presented below.

Table 1: Details of nutrient salts, elements supplied by stock and strength of each nutrient at final concentration

<table>
<tr><th>SI no.</th><th>Nutrient salt used</th><th>Nutrient elements available</th><th>Final concentration (mg/l) of modified Hoagland solution</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Potassium nitrate (KNO_3)</td><td>N</td><td rowspan="26">N-356.78
P-23.23
K-614.25
Ca-149.51
Mg-72.46
S-96.51
Bo-0.36
Fe-3.75
Mn-0.75
Cl-53.5
Zn-0.0675
Cu-0.096
Na-34.53
Mo-0.0825
Co-0.03</td></tr>
<tr><td>K</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Calcium nitrate ($Ca(NO_3)_2 4H_2O$)</td><td>Ca</td></tr>
<tr><td>N</td></tr>
<tr><td>3</td><td>Fe EDDH</td><td>Fe</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">Magnesium sulphate ($MgSO_4 7H_2O$)</td><td>Mg</td></tr>
<tr><td>S</td></tr>
<tr><td>5</td><td>Ammonium nitrate (NH_4NO_3)</td><td>N</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Potassium phosphate (KH_2PO_4)</td><td>K</td></tr>
<tr><td>P</td></tr>
<tr><td>7</td><td>Boric acid (H_3BO_3)</td><td>B</td></tr>
<tr><td rowspan="2">8</td><td rowspan="2">Manganous chloride ($MnCl_2 4H_2O$)</td><td>Mn</td></tr>
<tr><td>Cl</td></tr>
<tr><td rowspan="2">9</td><td rowspan="2">Zinc sulphate ($ZnSO_4 7H_2O$)</td><td>Zn</td></tr>
<tr><td>S</td></tr>
<tr><td rowspan="2">10</td><td rowspan="2">Copper sulphate ($CuSO_4 5H_2O$)</td><td>Cu</td></tr>
<tr><td>S</td></tr>
<tr><td rowspan="2">11</td><td rowspan="2">Sodium molybdate (Na_2MoO_4)</td><td>Na</td></tr>
<tr><td>Mo</td></tr>
<tr><td rowspan="2">12</td><td rowspan="2">Sodium chloride (NaCl)</td><td>Na</td></tr>
<tr><td>Cl</td></tr>
<tr><td rowspan="2">13</td><td rowspan="2">Cobalt chloride ($CoCl_2$)</td><td>Co</td></tr>
<tr><td>Cl</td></tr>
</table>

Initially nutrient solutions were completely changing in 10 to 15 days once because of slow initial growth of plant and less nutrient absorption of plants up to 30 days after transplanting. After 30 days of transplanting nutrient solution was changed at 7 to 10 days interval. On daily basis checked the nutrient solution level and refilled to the original level whenever it was necessary with a pre-fixed concentration of nutrients.

Once in every 2 to 3 days, the nutrient solution was checked for pH and electrical conductivity (EC) by using pH and EC meters and adjust the pH by using hydrochloric acid (to decrease the pH) and potassium hydroxide (to increase the pH). The pH of nutrient solution was maintained between 6.5 to 7 and electrical conductivity of nutrient solution lies between 1.2 to 1.6 dsm^{-1}; it was in the acceptable limit hence there was no adjustment needed throughout the experiment period.

Experimental treatments

Experiment comprised of eight treatments with four replications.

The treatments included two seasons *viz.*, *Rabi* (S_1) and *Kharif* (S_2), two root zone coolings *viz.*, without root zone cooling (C_1) and with root zone cooling (C_2)] and two shading levels *viz.*, without shade (L_1) and with shade (L_2). The experiment was conducted in insect proof net house and used four aeroponic chambers for growing of crop in each season. Modified Hoagland nutrient solution with fifty percent increase of all nutrients was used commonly thought the experiment as detailed in table 1. Nutrient solution was provided to root zone in the form of mist through misting units which were fixed at bottom of aeroponic chamber. The nutrient solution after drenching the root zone was collected and cooled in chilling unit to 16 ^{0}C and re-circulated throughout the day and night at regular intervals. The nutrient solution was cooled with chiller and circulated to aeroponic chamber for misting.

The same nutrient solution from chiller was used to cool the chamber by passing it inside cooling jacket in the aeroponic chamber. Small holes present in this side cooling jack*et al*lows cooled water to drop in chamber all along the side of the aeroponic chamber. There was no temperature regulation for other chambers those having no root zone cooling treatment.

Shade regulation was achieved by using additional 50 per cent green shade net above the aeroponic chamber. There was no shade regulation for those aerophonic chambers having no shade regulation and it was directly placed in net house by using 50 per cent green shade net.

Experimental results on growth, yield and nutrient uptake were analyzed in factorial completely randomized design (FCRD).

Observation on plant growth, yield and plant nutrient uptake were studied.

Results and Discussion

Growth parameters

Potato is a cool climate crop which requires specific environmental requirements. Among two seasons, favorable climatic condition in *rabi* lead to higher vegetative growth parameters. Generally potato was grown in *rabi* season, but kharif season cultivation was forcing the crop to get additional mini-tuber by encountering minimum environmental standards for crop growth, development and tuberization. Highest plant height (101.14 cm), number of leaves per plant (56.40), maximum root length (99.64 cm), total leaf area (4067.60 cm^2), plant fresh and dry weight (225.79 and 44.26 g, respectively) were recorded in *rabi* (S_2) grown crop.

Because of favourable environmental condition in *rabi*, potato plants absorb more nutrients compared to *kharif* crop. Congenial climatic conditions favours to more activity of root metabolic process. Higher root metabolic process was observed in root zone temperature regulated plants; absorbed more nutrient elements and translocated to aerial part of plant. Significant effect on plant height, number of leaves per plant, maximum root length, total leaf area per plant, fresh and dry weight per plant were observed at the final stage. Highest plant height (101.92 cm), number of leaves per plant (56.51), maximum root length (101.87 cm), total leaf area (4187.38 cm^2), plant fresh and dry weight (226.94 g and 44.06 g, respectively) were recorded in root zone cooling plants.

Shading levels showed significant effect on plant height, number of leaves per plant, maximum root length, total leaf area, fresh and dry weight per plant at the end of crop duration. Highest plant height (100.46 cm) was recorded in plants received shade (L_2) and highest number of leaves per plant (55.81), maximum root length (100.60 cm), total leaf area per plant (4051.82 cm^2), plant fresh and dry weight per plant (214.73 g and 42.01 g, respectively) were recorded where plants did not have shade (L_2).

Highest values for plant growth parameters were recorded in *rabi* season without shade net. In both the seasons reduction in light levels adversely affected on most of the plant growth parameters. Potato plants showed maximum growth response especially without shade in both seasons. In optimum light condition (without shade) helps to produce more photosynthesis there by plants showed higher growth rates (Fernandes *et al*., 2012, Masengesho *et al*., 2012, Bag *et al*., 2015 and Mobini *et al*., 2015) [3, 4, 1, 5].

Potato is known to be a shade tolerant crop. As a C-3 plant, potato crop needs moderate irradiance condition. Its light saturation point for photosynthetically active radiation (PAR) is considered to be around 14.86 MJm^{-2}day^{-1}. Especially in tropical and sub tropical zones where potato can be grown throughout the year and radiation up to 30 MJm^{-2}day^{-1}. This experiment reveled that, Bengaluru condition was ideal for potato mini-tuber production through aeroponics in *rabi* and kharif seasons without interruption of light or without shade. Interaction effect of season X shading levels (S X L) showed significant effect on total leaf area. Highest leaf area was recorded in S_2C_1 (4186.39 cm^2) and S_2C_2 (3948.82 cm^2) interactions at final stage of crop growth.

Harvesting and yield parameters

Because of congenial growing conditions in both the seasons, higher values for yield *viz.*, total number of tubers per plant (22.94), total tuber weight per plant (87.43 g), average tuber weight per plant (6.98) and total duration of crop (111.60) was recorded in *rabi* season. Maintaining optimum root zone cooling helped to increased yield parameters *viz.*, total number of tubers per plant (22.22), total tuber weight per plant (84.19 g) and total duration of crop (111.03) in potato. Potato plant which received additional shade (with shade net) adversely affected on yield parameters. Mainly shade upon potato plants decreased the number of tubers from 20.45 (without shade) to 17.55 (with shade).

Number of tubers, tuber weight, average tuber weight etc., are determined by the metabolic activity taken place in plant tissues, such as photosynthesis, respiration and assimilate translocation. These metabolic activities take place at a higher rate if all the factors are favourable. The present study clearly indicated the importance and profitability by increasing mini tuber yield by regulating the root zone cooling and shade in both *rabi* and *kharif* seasons. Similar results were reported by Wang *et al*., 2017, Muhibuddin *et al*., 2018 and Schulz *et al*., 2019 [10, 6, 7].

Plant nutrient uptake

Because of favourable environmental condition in *rabi*, potato plants absorb more nutrients compared to *kharif* crop. Congenial climatic conditions favours to more activity of root metabolic process. Higher root metabolic process was observed in root zone temperature regulated plants; absorbed more nutrient elements and translocated to aerial part of plant. Higher quantity of N (3.42%), P (0.49%), K (3.12%), Ca (0.69%), Mg (0.36%) and S (0.33%) uptake was recorded in *rabi* (S_2) season.

Among two different root zone cooling *i.e.*, without root zone cooling (C_1) and with root zone cooling (C_2), where C_2 recorded higher uptake of N (3.79%), P (0.61%), K (3.27%), Ca (0.8%), Mg (0.43%) and S (0.39%).

Two shading levels *i.e.*, without shade (L_1) and with shade (L_2), where plants grown under without shade condition indicated higher uptake of N (3.53%), P (0.52%), K (3.16%), Ca (0.74%), Mg (0.38%) and S (0.36%).

Interaction effect of root zone cooling X shade levels (C X L) were found significant for uptake of N, Ca and S. Highest quantity of N uptake was recorded in C_2L_1 (4.01%) and C_2L_2 (3.57%), Ca in C_2L_1 (0.89%) and C_2L_2 (0.71%) and S in C_2L_1 (0.44%) and C_2L_2 (0.34%).

Plants grown under shade recorded less uptake of nutrient clearly showed that for maximum uptake of nutrients light plays a major role in aeroponics production.

Table 2: Effect of season, rot zone cooling and shade on plant height, number of leaves per plant, root length, total leaf area, fresh and dry weight per plant grown in aeroponics

	Plant height (cm)	Number of leaves per plant	Root length (cm)	Total leaf area/plant (cm^2)	Fresh weight/plant (g)	Dry weight/plant (g)
Seasons (S)						
S_1	95.28	53.46	94.55	3799.57	189.21	39.65
S_2	101.14	56.40	99.64	4067.60	225.79	44.26
F-test (p=0.05)	*	*	*	*	*	*
S.Em±	1.26	0.28	0.69	20.46	3.89	0.63
C.D. (p=0.05)	3.68	0.83	2.03	59.75	11.37	1.85
Root zone cooling (C)						
C_1	94.50	53.35	92.33	3679.79	188.06	39.84
C_2	101.92	56.51	101.87	4187.38	226.94	44.06
F-test (p=0.05)	*	*	*	*	*	*
S.Em±	1.26	0.28	0.69	20.46	3.89	0.63
C.D. (p=0.05)	3.68	0.83	2.03	59.75	11.37	1.85
Shading (L)						
L_1	95.97	55.81	100.60	4051.82	214.73	42.01
L_2	100.46	54.04	93.60	3815.35	200.26	41.90
F-test (p=0.05)	*	*	*	*	*	NS
S.Em±	1.26	0.28	0.69	20.46	3.89	0.63
C.D. (p=0.05)	3.68	0.83	2.03	59.75	11.37	-

Table 3: Interaction effect of season and shading levels (S × L) on total leaf area per plant at the end of crop growth

	Without shading (L_1)	With shading (L_2)
Kharif (S_1)	3917.26	3681.87
Rabi (S_2)	4186.39	3948.82
F-test (p=0.05)	*	
S.Em±	28.94	
C.D. (p=0.05)	84.50	

S_1: *Kharif*
S_2: Rabi
C_1: Without root zone cooling
C_2: With root zone cooling
L_1:Without shade
L_2: With shade

DAT: Days after transplanting
NS: Non-significant
*: Significant

Table 4: Effect of season, rot zone cooling and shade on days to first tuber harvest, total number of tubers per plant, total tuber weight per plant, average tuber weight and duration of crop of potato grown in aeroponics

	Total number of tubers per plant	Total tuber weight per plant (g)	Average tuber weight (g)	Duration of crop
Seasons (S)				
S_1	15.06	60.34	4.04	104.48
S_2	22.94	87.43	3.83	111.60
F-test (p=0.05)	*	*	*	*
S.Em±	0.33	1.44	0.07	0.48
C.D. (p=0.05)	0.97	4.19	0.20	1.40
Root zone cooling (C)				
C_1	15.78	63.58	4.07	105.06
C_2	22.22	84.19	3.80	111.03
F-test (p=0.05)	*	*	*	*
S.Em±	0.33	1.44	0.07	0.48
C.D. (p=0.05)	0.97	4.19	0.20	1.40
Shade (L)				
L_1	20.45	80.48	4.01	109.68
L_2	17.55	67.29	3.86	106.41

F-test (p=0.05)	*	*	NS	*
S.Em±	0.33	1.44	0.07	0.48
C.D. (p=0.05)	0.97	4.19	-	1.40

S_1: *Kharif* DAT: Days after transplanting
S_2: Rabi NS: Non-significant
C_1: Without root zone cooling *: Significant
C_2: With root zone cooling
L_1: Without shade
L_2: With shade

Table 5: Effect of season, rot zone cooling and shade on plant nutrient uptake of potato grown in aeroponics

	N (%)	P (%)	K (%)	Ca (%)	Mg (%)	S (%)
Season						
S_1	3.31	0.42	2.99	0.64	0.30	0.30
S_2	3.42	0.49	3.12	0.69	0.36	0.33
F-test (p=0.05)	*	*	*	*	*	*
S.Em±	0.02	0.01	0.02	0.01	0.01	0.01
C.D. (p=0.05)	0.06	0.03	0.07	0.03	0.03	0.01
Root zone cooling						
C_1	2.94	0.30	2.84	0.53	0.23	0.24
C_2	3.79	0.61	3.27	0.80	0.43	0.39
F-test (p=0.05)	*	*	*	*	*	*
S.Em±	0.02	0.01	0.02	0.01	0.01	0.01
C.D. (p=0.05)	0.06	0.03	0.07	0.03	0.03	0.01
Shade						
L_1	3.53	0.52	3.16	0.74	0.38	0.36
L_2	3.20	0.39	2.95	0.60	0.27	0.27
F-test (p=0.05)	*	*	*	*	*	*
S.Em±	0.02	0.01	0.02	0.01	0.01	0.01
C.D. (p=0.05)	0.06	0.03	0.07	0.03	0.03	0.01

Table 6: Interaction effect of root zone cooling and shade on plant nutrient uptake of potato grown in aeroponics

Shading (C× L)						
	N (%)		Ca (%)		S (%)	
Root zone cooling	L_1	L_2	L_1	L_2	L_1	L_2
C_1	3.06	2.82	0.58	0.48	0.27	0.21
C_2	4.01	3.57	0.89	0.71	0.44	0.34
F-test (p=0.05)	*		*		*	
S.Em±	0.03		0.02		0.01	
C.D. (p=0.05)	0.08		0.05		0.01	

S_1: Kharif DAT: Days after transplanting
S_2: Rabi NS: Non-significant
C_1: Without root zone cooling *: Significant
C_2: With root zone cooling
L_1:Without shade
L_2: With shade

Conclusion

Aeroponic production of potato mini-tubers mainly depends on season of cultivation, appropriate temperature and light. Growing of *kharif* crop to achieve additional production of potato mini-tubers was possible in subtropical condition. Root zone cooling and crop exposure to direct sun in controlled condition helped to maximize the potato mini-tuber yield in aeroponics.

References

1. Bag TK, Srivastava AK, Yadav SK, Gurjar MS, Diengdoh LC, Rai R, *et al*. Potato (*Solanum tuberosum*) aeroponics for quality seed production in north eastern Himalayan region of India. Indian J of Agri. Sci. 2015;85(10):112-116.
2. Chang DC, Park CS, Kim SY, Lee YB. Growth and tuberization of hydroponically grown potatoes. Potato Research. 2012;55:69-81.
3. Fernandes AM, Soratto RP. Nutrition, dry matter accumulation and partitioning and phosphorus use efficiency of potato grown at different phosphorus levels in nutrient solution. R. Bras. Ci. Solo. 2012;36:1528-1537.
4. Masengesho J, Nshimiyimana JC, Senkesha N, Sallah YK. Performance of Irish potato varieties under aeroponic conditions in Rwanda. Rwanda J. 2012;28:84-94.
5. Mobini SH, Ismail MR, Arouiee H. The impact of aeration on potato (*Solanum tuberosum* L.) minituber production under soilless conditions. Afri. J Biotech., 2015;14(11):910-921.
6. Muhibuddin A, Razak Z, Salam S, Syamsia, Boling J. Nutrients formulation for improving production and quality of potato minitubers using aeroponic system in Indonesia, Adv. In Envi. Bio. 2018;12(12):38-42.
7. Schulz VS, Munz S, Stolzenburg K, Hartung J, Weisenburger S, Honninger SG. Impact of different shading levels on growth, yield and quality of potato (*Solanum tuberosum* L.). Agronomy. 2019;9:1-21.
8. Sumarni E, Farid N, Darjanto D, Ardiansyah A, Soesanto L. Effect of electrical conductivity (EC) in the nutrition solution on aeroponic potato seed production with root zone cooling application in tropical lowland, Indonesia. Agric. Eng. Int. 2019;21(2):70-77.
9. Tessema L, Chindi A, Giorgis G, Solomon A, Shunka E, Seid E. Determination of nutrient solution for potato (*Solanum tuberosum*) seed production under aeroponics production system. Open Agri. 2017;2:155-159.
10. Wang K, He W, Ail Y, Hu J, Xie K, Tang M, *et al*. Optimizing Seed Potato Production by Aeroponics in China. Philippine J Crop Sci. 2017;42(1):69-74.