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MANAGEMENT AND RATIONALISED FERTILISATION OF IMPROVED COMMERCIAL PRODUCTION OF POTATO MINI-TUBERS

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ABSTRACT

Potato (*Solanum tuberosum* L.) is an important income earner and food security crop for many communities in sub-Saharan Africa (SSA). In Zimbabwe, mini-tubers are the commonly preferred as planting material, owing to their production under disease-free conditions. The objective of this study was to explore the effects of plant density, frequency of hilling and fertiliser regime, on commercial production of potato mini-tubers. A temperature-controlled greenhouse study was conducted at the Kutsaga Research Station in Zimbabwe; using Diamond potato variety. Treatments included plant density (375, 200 and 100 plants m^{-2}), hilling (4 hilling intervals) and fertiliser regime (2 fertiliser regimes: 1 = supplemented with sulphate of potash; and 2 = supplement ammonium nitrate). The treatments were laid out in a completely randomised design, in a split-spilt plot arrangement; and set up repeated four times. Disease-free 28-day old potato plantlets were obtained from a tissue culture facility at Kutsaga Research Station, and planted in pots filled with Kutsaga soilless Growmix^{ultra} growth media. Plant density had a significant ($P<0.05$) effect on the mini-tuber size, with the highest plant density (375 plants m^{-2}) having the most mini-tubers with sizes < 20 mm. Frequency of hilling only affected mini-tuber size, but not number of mini-tubers produced. Of the two fertiliser application regimes used, fertiliser regime 1 (High C, AN and SOP) had a significant effect on the survival of the potato plantlets and on the size of the mini-tubers. In a nutshell, in order to maximum mini-tuber production, a plantlet population density of 100 plants m^{-2}, with weekly intervals of hilling under fertiliser regime 1, should be maintained to obtain the most viable commercial treatment combination.

Key Words: Hilling, *Solanum tuberosum*, tissue culture

RÉSUMÉ

La pomme de terre (*Solanum tuberosum* L.) est une importante source de revenus et de sécurité alimentaire pour les communautés d'Afrique sub-Saharienne (SSA). Au Zimbabwe, les mini-tubercules sont le matériel de plantation généralement préféré, en raison de leur production dans des conditions contrôlées et exemptes de maladies. L'objectif de cette étude était d'explorer les effets de la densité de plantation, de la fréquence de buttage et du régime d'engrais sur la production commerciale de mini-tubercules de pomme de terre. Une étude en serre à température contrôlée a été menée à la station de recherche de Kutsaga au Zimbabwe ; en utilisant la variété de pomme de terre Diamond. Les traitements comprenaient la densité de plantation (375, 200 et 100 plantes m^{-2}), le buttage (4 périodes de buttage) et le régime d'engrais (2 régimes d'engrais : 1 avec du sulfate de potasse supplémenté ; et 2 avec du nitrate d'ammonium supplémenté). Les traitements ont été disposés selon un plan complètement randomisé, dans un agencement de parcelles divisées-split ; et mis en place répété quatre fois. Des plantules de pommes de terre de 28 jours exemptes de maladies ont été obtenues à partir d'une installation de culture tissulaire à la station de recherche de Kutsaga et plantées dans des pots remplis de milieux de croissance sans sol Growmix^{ultra} de Kutsaga. La densité de plantation a eu un effet significatif ($P<0,05$) sur la taille des mini-tubercules, la densité (375 plantes m^{-2}) de plantation la plus élevée ayant le plus de mini-tubercules de taille < 20 mm. La fréquence de buttage n'a affecté que la taille des tubercules, mais pas le nombre de mini-tubercules produits. Des deux régimes d'application d'engrais utilisés, le régime d'engrais 1 (La concentration élevée de C, AN et SOP) a eu un effet significatif sur la survie des plantules de pommes de terre et sur la taille des mini-tubercules. En bref, afin de maximiser la production de mini-tubercules, une densité de population de plantules de 100 plantes m^{-2}, avec buttage hebdomadaire sous régime d'engrais 1, doit être maintenue car il s'agit d'une combinaison de traitement commerciale potentiellement viable.

Mots Clés: Buttage, *Solanum tuberosum*, culture tissulaire

INTRODUCTION

Potato (*Solanum tuberosum* L.) is a revenue earner and food security crop in sub-Saharan Africa (SSA). In Zimbabwe, the crop has been designated as a strategic national food security crop, whose versatile crop provides a valuable starch alternative to the staple food, mostly cereals and root crops (Svubure *et al.,* 2015).

Obtaining high yields in the commercial production settings of the crop, has been limited by inadequate access to high quality potato seed (Muthoni *et al.,* 2022). A significant quantity of potato seed planted in Zimbabwe is imported or sourced from the preceding season's harvest, leading to concerns of disease proliferation in the fields (Online Reporter, 2024). Considering the cost associated with imported seed and the diseases associated with own produced seeds, it is imperative that the potato industry in Zimbabwe targets designing a more efficient and reliable seed supply system.

Potato cultivation in Zimbabwe, traditionally relies on asexual propagation, using tubers; which unintentionally facilitates the spread of pathogens in cultivated fields (Dimante and Gaile, 2014). Moreover, some infected fields may remain pathogen-infested for up to a decade, rendering them untenable for production of the crop. Moreover, the accumulation of systemic fungi, bacteria and viruses in plants, leads to their degeneration; ultimately affecting potato yields (Thomas-Sharma *et al.,* 2016). To address these challenges, the potato industry has embraced tissue culture as a major innovation for producing disease-free planting materials and rapidly multiplying the materials. Not only does tissue culture address the issue of disease-free seed potato (Pruski *et al.,* 2003), but also ensures clonal reproduction, resulting in genetically identical tubers.

Compared to micro-tubers, potato mini-tubers derived from *in vitro* plantlets, exhibit greater growth vigor, flexibility and ease of transportation; thus making them the preferred option for first generation of seed multiplication (Mohamed *et al.,*, 2018). Mini-tuber production has become the primary strategy for obtaining virus-free seed potatoes in formal seed production systems (Dimante *et al.*, 2022); and acts as a quick bridge between *in vitro* plantlet production and field multiplication of seed tubers (Struik, 2007). The goal of *ex vitro* multiplication is to maximise the number of potato mini-tubers produced from each plantlet (Sharma *et al.*, 2014). However, the limited number of mini-tubers obtained from each *in vitro* plantlet, poses a constraint on production costs, ultimately driving up the final cost of mini-tubers (Balali *et al.*, 2008).

In seed production, maximising yields while controlling tuber development to meet the growers' optimal size requirements is essential (Waterer, 1997). Studies have shown that managing tuber sizes in potato seed production, relies on regulating plant density, which refers to the number of individual plants per unit area. In fact, it has been observed that tuber size is inversely proportional to plant population density (Rex, 1991). Plant density has also been shown to affect the multiplication rate and number of mini-tubers per unit area (Cíž and Komárk, 2022).

Excessively high plant density leads to nutrient competition among plants, resulting in lower potato tuber yield (Allen and Wurr, 1992). Therefore, it is crucial to determine the optimal planting density in seed potato production, to minimise nutrient competition and enhance photo assimilation for tuber formation (Jin *et al.*, 2013).

Hilling or earthing-up is another critical step in seed potato production, which involves mounding soil around young potato plants, to encourage stolons to produce tubers, instead of developing into stems (Dijk *et al.*, 2020). Stolons that remain exposed, result in reduced tuber yield, because potato has a very shallow rooting system and thus requires fertile soils to results in good yields.

Studies have shown that application of nitrogen, phosphorus and potassium increases tuber size and weight (Oliveira *et al.*, 2021); confirming the assertion that N, P, S and boron are limiting factors in potato production in the eastern highlands of Kenya (Mugo *et al.*, 2020). The objective of this study was to explore the effects of plant density, frequency of hilling and fertiliser regime, on commercial production of potato mini-tubers.

MATERIALS AND METHODS

Study site. This study was carried out in a temperature-controlled greenhouse at Kutsaga Research Station, Harare, in Zimbabwe. The station is located at longitude 31° 132 E, latitude. 17 ° 912 S and altitude 1480 m above sea level. Greenhouse conditions were maintained between 22 and 28 ºC, and relative humidity at 50-70%.

Plant material. Virus infection-free plantlets of Diamond Irish Potato variety (20 weeks old), were obtained from the commercial tissue culture laboratory of the Molecular Technologies' Laboratory at Kutsaga Research Station, in Harare, Zimbabwe. Initially, meristem tip culture was utilised to obtain actively growing meristematic tissues that were free of virus infection. Growth of the meristems was monitored in Murashige and Skoog (MS) medium (Murashige and Skoog, 1962), until shoot development occurred. Subsequently, the mature plantlets were cultured under sterile conditions, and routinely multiplied in MS media supplemented with vitamins.

The multiplication process involved sub-culturing of single nodes after every 3 weeks, in fresh MS media. The growth room was maintained at 12:12 hr light-dark cycle; at consistent temperature of 25 °C throughout day and night. Relative humidity ranged from 50 to 70% during the experiment. Fluorescent lamps were used to provide light to maintain an intensity between 400-700 nm. Each culture jar accommodated 20 plantlets, along with 20 ml of the growing media.

During the final sub-culturing, 30 individual nodes were cultured in each jar for a duration of two weeks. Thereafter, the plantlets were hardened to acclimatise them to the outside environment. Hardening involved exposing the plants to cooler temperatures (20 °C), lower humidity (50%), and uninterrupted air circulation. After the hardening process, the plants, consisting of approximately 20 nodes, were planted in pots in the greenhouse.

Experimental. The *in vitro* virus-free plantlets were planted in soilless media, Gromix^{ultra}, in plastic trays (51 cm x 34 cm), lined with perforated black plastic sheet. Gromix^{ultra} is a soilless media free from pests and diseases, used as a growing media for horticultural products. It was developed by Kutsaga Research Station in Harare, Zimbabwe.

To ensure proper drainage and aeration, the trays were lined with perforated black plastic sheet, to allow for air and water circulation. Planting holes of 5 cm deep and 1.5 cm diameter, were pressed into each pot and the number of holes was determined based on the specific treatment being applied.

The pots were immediately hand-watered, in the trays to ensure proper plantlet establishment. The trays with the planted potato plants were then placed in the greenhouse, maintaining favourable temperature and relative humidity conditions. Daytime temperatures were maintained between 19 and 25 °C; while ensuring night temperatures remained above 13 °C. Watering was performed twice a week; by providing at least 0.1 L to maintain optimal moisture levels in the trays.

The plants remained in the greenhouse for a duration of 12 weeks, to permit proper growth and development. After the 12-week period, destructive sampling was done for all plants to gather data and assess the desired parameters for the experiment.

Treatments and design. Treatments included potato population density, hilling and fertilisation regime. The population density comprised of 375 plants m^{-2} (48 plants per tray), 200 plants m^{-2} (26 plants per tray), and 100 plants m^{-2} (13 plants per tray). Hilling was done at three intervals, namely weekly (2,3,4,5 WAP), bi-weekly (2,4,6,8 WAP), and at 4-day intervals (14,18,22,26 days after planting). A total of 4 hillings were done during the whole production cycle, with the first hilling starting two weeks after planting. Hilling was by adding Growmix^{ultra}; the growing media used in the study.

Application of fertiliser involved two distinct fertiliser regimes that were applied as shown in Table 1. The fertiliser rates applied were the rates commonly used in mini-tuber production (Wang *et al.,* 2024), with minor modifications. Fertiliser application regime 1 was administered based on the interval of hilling; while fertiliser regime 2 was applied

TABLE 1. Fertiliser regime, application rate and application period of different fertilisers used in the study

Fertiliser regime	Application rates (kg)	Application period
1	1 High C (6:28:23)	At planting
	1 SOP	1st hilling
	1 AN	2nd hilling
	1 SOP	3rd hilling
	1 kg SOP	4th hilling
2	2 High C (6:28:23)	At planting
	1 AN	2nd WAP
	0.5 AN	4th WAP
	0.5 AN	6th WAP

SOP = Sulphate of Potash, AN - Ammonium Nitrate, WAP -Weeks after planting based on planting time. All fertiliser applications were done using the broadcasting method with basal fertiliser (high C) being applied at planting.

The experiment was laid out in a completely randomised design (CRD), in a split-split plot arrangement; whereby plant density was the main plot, hilling interval as the sub-plot, and fertiliser regime as the sub-sub-plot. Treatments were replicated four times and the study repeated three times.

Data collection. Parameters evaluated included plantlets survival counts, and number and weight of mini-tubers per plant. Plantlet survival was determined at 14 days after planting (DAP), whereby survived plants were enumerated in the trays. Survival rate was then expressed as a percentage of the total number of plants initially planted.

As for number of mini-tubers per plant, destructive sampling was undertaken at physiological maturity (84 DAP), and the number of mini-tubers recorded per plant pot. The mini-tubers were then categorised into three grade sizes; namely < 20 mm, between 20-35 mm, and > 35 mm. Additionally, the total weight of the tubers was taken using an electronic analytical balance.

Data analysis. The data obtained were subjected to analysis of variance (ANOVA), using GenStat version 8.0. Significant treatment means were separated using Fisher's Least Significant Difference (LSD) test at 5% level of significance.

RESULTS

Plantlet survival counts. There was a significant effect of plant density, hilling interval and fertiliser regime on plantlet survival as presented in Table 2. Although non-significant differences were observed in plantlet survival rates at 14 DAP, in the 48 and 26 plants per tray across all the fertiliser treatments and the hilling intervals, there was a remarkable difference in the 13 plants per tray treatment.

Regardless of fertiliser treatment, the plantlet survival percentage at 14 DAP decreased in the 13 plants per tray treatment (Table 2); this however, depended on hilling interval and plant density. A similar trend was observed in plantlet survival percentage at harvest, with the highest survival observed at a density of 13 plants per tray, and weekly hilling interval under the first fertiliser regime; while the lowest count was observed at 13

TABLE 2. Effect of plant density, hilling and fertiliser on plantlet survival

	Density (plants/ tray)	Hilling interval					
		Weekly		Bi-weekly		4-day	
		Fert. 1	Fert. 2	Fert. 1	Fert. 2	Fert. 1	Fert. 2
% survival 14 DAP	48	86.1ab	96.5b	86.1ab	90.3ab	95.1b	83.3ab
	26	92.3ab	80.8ab	92.3ab	85.9ab	97.4b	67.9a
	13	100b	84.6ab	92.3ab	76.9ab	87.2ab	69.2a
% Survival @ harvest	48	81.2abcde	88.9cde	81.9bcde	82.6bcde	91cde	79.9abcde
	26	89.7cde	73.1abc	84.6cde	82.1bcde	93.6de	62.8ab
	13	94.9e	74.4abcd	89.7cde	64.1ab	76.9abcde	61.5a

Means in columns not sharing a common letter differ significantly at P<0.05 probability level; fert 1 = fertiliser regime 1 and fert 2 = fertiliser regime 2 plants per tray, 4-day hilling intervals under the second fertiliser regime.

Total number of mini-tubers per plant. The total number of mini-tubers produced per plant was significantly ($P< 0.05$) influenced by the interaction effect of plant density, hilling interval and fertiliser regime (Table 3). There was an inverse relationship between mini-tubers per plant and plant density; whereby plant density of 13 plants per tray resulted in the greatest number of mini-tubers produced, regardless of fertiliser regime and hilling intervals.

At the weekly hilling intervals, the first fertiliser regime had more mini-tubers per plant than its second fertiliser regime counterpart (Table 3). The reverse was true for bi-weekly and 4-day hilling intervals, whereby the second fertiliser regime had more mini-tubers than the first one. In addition, bi-weekly hilling intervals under the second fertiliser regime, combined with the 13 plants per tray plant density, produced the greatest number of mini-tubers (7.9 mini-tubers); though not significantly different ($P>0.05$) from that of the first fertiliser regime together with weekly hilling and 13 plants per tray (7 tubers).

Mini-tuber size. Regardless of the treatment combinations, mini-tuber size generally increased with the decrease in plant density (Table 4). The greatest number of tubers were observed at 13 plants per tray under the first fertiliser regime and weekly hilling interval; and second fertiliser bi-weekly hilling interval, and 4-day hilling intervals under fertiliser 1, respectively. For the weekly hilling intervals, second fertiliser regime contained fewer tubers across all tuber diameters in contrast with the first fertiliser regime, except for mini- tubers with > 35 mm tubers per plant (0.56, 0.8, 0.66, 0.55, 1.56 and 1.07). The greatest number of mini-tubers (3.64) with sizes 20-35 mm were observed in the treatment with the second fertiliser regime, bi-weekly hilling and density of 13 plants per tray. For number of mini-tubers with diameter size greater than 35 nm per plant, the differences between the highest (48 plants per tray) and the lowest (13 plants per tray) plant density was significant with a range of increase in the numbers of mini-tubers spanning between 63 and 80% across all treatments.

Mini-tuber weight. The interaction effect of plant density, hilling interval and fertiliser on tuber weight was significant (Table 5). The weights were grouped in three categories based on mini-tuber sizes namely < 20 mm, 20 – 35 mm and > 35 mm (Table 5). The treatment with bi-weekly hilling, under the first fertiliser regime (26.6 g) and second fertiliser regime (25.7 g) contained mini-tubers with the

TABLE 3. Effect of plant density, hilling and fertiliser on total number of mini-tubers per plant

	Density (plants/ tray)	Hilling interval					
		Weekly		Bi-weekly		4-day	
		Fert. 1	Fert. 2	Fert. 1	Fert. 2	Fert. 1	Fert. 2
Total # of mini-tubers/ plant	48	2.22ab	1.49a	2.27ab	2.32ab	1.72a	1.74a
	26	3.13abc	3.08abc	3.06abc	3.42abc	2.22ab	3.34abc
	13	7de	3.16abc	4.18bc	7.9e	4.3bc	5.14cd

Means in columns not sharing a common letter differ significantly at $P<0.05$ probability level; fert 1 = fertiliser regime 1 and fert 2 = fertiliser regime 2

TABLE 4. Effects of density, hilling and fertiliser on mini- tuber size

	Density (plants/tray)	Hilling interval					
		Weekly		Bi-weekly		4-day	
		Fert. 1	Fert. 2	Fert. 1	Fert. 2	Fert. 1	Fert. 2
# <20mm mini-tubers/ plant	48	1.03ab	0.56a	1.18ab	0.94ab	0.72a	0.76a
	26	1.41ab	0.8a	1.02ab	1.21ab	0.65a	1.32ab
	13	3.4c	0.66a	1.46ab	2.76bc	1.21ab	1.93b
# 20-35mm mini-tubers/plant	48	0.69a	0.55a	0.77ab	0.83ab	0.64a	0.59a
	26	0.99ab	1.56abc	1ab	1.39abc	0.77ab	1.03abc
	13	2.18c	1.07abc	1.01ab	3.64d	1.24abc	1.92bc
# >35mm mini-tubers/plant	48	0.5a	0.38a	0.46a	0.55a	0.37a	0.4a
	26	0.73abc	0.72ab	0.61ab	0.83abcd	0.81abcd	1abcd
	13	1.42cde	1.43de	1.72e	1.5de	1.85e	1.29bcde

Means in columns not sharing a common letter differ significantly at $P<0.05$ probability level; fert 1 = fertiliser regime 1 and fert 2 = fertiliser regime 2

TABLE 5. Effects of plant density, hilling intervals and fertiliser on mini-tuber weight

	Density (plants/tray)	Hilling interval					
		Weekly		Bi-weekly		4-day	
		Fert. 1	Fert. 2	Fert. 1	Fert. 2	Fert. 1	Fert. 2
Weight (g)/ mini-tuber <20mm	48	4.9a	4.2a	9.9ab	7.9a	9a	4.8a
	26	11.7abc	11.1abc	19abc	16.3abc	8.8a	13abc
	13	8.7a	8.6a	26.6c	25.7bc	15.8abc	14.6abc
Weight (g)/mini-tuber 20-35mm	48	6.75a	4.67a	7.41a	4.1a	8.17a	5.44a
	26	17.66b	7.19a	8.42a	5.93a	5.31a	7.78a
	13	10a	9.56a	9.39a	7.7a	5.7a	4.11a
Weight (g)/mini-tuber >35mm	48	4.44abc	7.91abcd	6.15abcd	3.84abc	5abc	5.71abc
	26	7.04abcd	10.9cd	3.93abc	5.01abc	13.57d	4.78abc
	13	5.68abc	2.2a	2.38a	2.92ab	10.69bcd	3.54abc

Means in columns not sharing a common letter differ significantly at $P<0.05$ probability level; fert 1 = fertiliser regime 1 and fert 2 = fertiliser regime 2

greatest weight at mini-tuber sizes of < 20 mm at 13 plants per tray; although the values were not significantly different (P>0.05) from the 4-day hilling interval.

DISCUSSION

Plantlet survival counts. The significance of the interaction effect of plantlet population density, hilling interval and fertiliser regimes on plantlet survival (Table 2) can be attributed to the plant's dependence on available nutrients, hilling and minimum competition of resources in order to grow and carry out normal metabolism. Higher plant density has been shown to increase plant mortalities; whereas low plant density decreases plant mortality, thus minimising competition between the available resources (Sundar and Lal, 2002).

In the present study, we have demonstrated how plantlet survival at 14 DAP was influenced by plant density, hilling intervals and fertiliser regime. Plantlets take at least 2 to 3 weeks for them to establish new roots, which was consistent with previous studies that showed that at 14 DAP, plantlet survival was substantial (Aarakit *et al.,* 2021). Plant survival is crucial in establishing a good crop and in minimising costs during mini-tuber production. It is necessary to ensure that a high survival rate is established after new roots have formed so that if there is any mortality, replanting is done to minimise a negative impact on yield.

Additional P and K in the high C fertiliser had no influence on plantlet survival (Table 2). This could have been due to the fact that plantlets required optimum amounts of P and K for survival; hence the higher amounts of these nutrients further improved plantlet survival, especially for the small plantlets. High C is a fertiliser that is specially formulated to deliver very high P and K (6:28:23) (Nutrimaster, 2022). Potassium influences the movement of nutrients from the leaf to the tuber; and helps to maintain vigour of the plant (Sharma and Sud, 2001). On the other hand, P functions in cell division, energy generation and storage of starch in tubers and thus helps in influencing tuber size (Fernandes *et al.*, 2015). Thus, P and K are actively required in the early stages of the development of the plantlet when it is forming new roots. Thus, the right amount of fertiliser coupled with optimised plant density and hilling intervals is important for plantlet survival which in turn influences optimum numbers of mini-tubers produced.

The lowest plantlet survival was observed in the treatment with the highest plant density under different hilling intervals (Table 2). Reduction in plantlet survival could be attributed partly to the differences in hilling intervals in which the plantlets could not withstand heavy hilling due to their growth rate affected by the fertiliser regimes and plant density. Therefore, weekly hilling under fertiliser regime one and plant density per tray of 13 produced a 100% survival rate an observation seen in other studies (Dijk *et al.,* 2020). Hilling could result in the Gromix^{ultra} covering the plantlet completely, thus contributing to mortality because the hilling was done manually. In mini-tuber production, hilling is a common practise that has been postulated to increase mini-tuber numbers due to the conversion of stolons to mini-tubers (Dijk *et al.*, 2020).

Number of mini-tubers per plant. The negative relationship of plant density and total number of mini-tubers, irrespective of fertiliser regimes and hilling intervals (Table 3), could be explained by the fact that increasing plant density per unit area in a mini-tuber growing area, usually results in competition between plants for resources; thus, resulting in fewer numbers of mini-tubers. This was consistent with other studies, which showed that as the plant density decreases, the number of mini-tubers increases, hence influencing the amount of tubers produced (Balali *et al.,* 2008). In contrast, very low plant density will result in inefficient use of and eventual wasting away of nutrients (Caliskan *et al.,* 2009).

Optimisation of plant density, is therefore, key in mini-tuber production as it affects the yield, cost and the overall quality of the crop (Allen and Wurr, 1992).

Therefore, plant density should be managed by optimising the space between and within hills in the rows; best under bi-weekly hilling under the second fertiliser rate; the combination that produced the greatest number of mini-tubers (Table 3). Further studies are imperative in order to understand the effects of hilling at the different growth stages of the plant on potato mini-tuber production.

Mini-tuber size. In this study, the mini-tubers produced were grouped into three sizes, small < 20 mm, medium 20-35 mm and large > 35 mm (Table 4). The results obtained indicated that a large number of mini-tubers were produced in the 20 -35 mm size, under the lowest plant density; which could be attributed to the effects of hilling, which ensured the formation of many stolons during the active developmental stages of the crop (Dijk *et al.,* 2020). Previous studies have shown that the larger size mini-tubers (20-25 mm) produce more tubers when used as planting materials, indicating that these tubers are ideal for potato farming (Altaf Hossain, 2015). Thus the mini-tuber sizes of 20-25 mm hold optimum potential for use in commercial potato production.

CONCLUSION

This study has demonstrated that the maximum number of mini-tubers yields can be achieved using a plant population density of 13 plants per tray, under fertilisation using rate/regime two, that contained high C and three applications of AN, with bi-weekly hilling intervals. However, due to the statistically insignificant differences (P>0.05) with treatment with plant density of 13 plants/tray, weekly hilling and fertiliser rate one application, the latter treatment combination can be furthered investigated for optimal mini-tuber production, as it saves on hilling, fertiliser and labour. Further studies need to be done in order to understand whether a decrease in the plant population density will result in an increase in potato mini-tubers yield.

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