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Effect of Yam tuber size weight on its yield in Western Oromia, Ethiopia

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ABSTRACT

Yams (*Dioscorea spp.)* are an annual tuber and monocotyledonous crop. The plant Genus comprises of over 600 species with only 10 species producing edible tuber. A field experiment was conducted at Western Oromia to recommend appropriate tuber weight of yam cutting for the farming and its economic feasibility for communities in western Oromia for two consecutive years during the main cropping season of 2017 and 2018 at Bako Agricultural Research Center (BARC) on station and subsite of Gute. Yam variety Bulch, which is adapted to the agro-ecology of the area, was used for the study appropriate tuber weight of yam cutting. Planting was done on April and yam tuber cutting at different gram were planted at a spacing of 80 cm between rows and 30 cm between plants. After cutting up the tuber into mini-setts, takes ash and rub ash onto the freshly cut fresh that are exposed. Nitrogen fertilizer was used 100kg/ha in two splits and 100kg/ha NPS which were used.100kg/ha NPS and half Nitrogen fertilizer applied after emergence and the remaining half a month after first application along the rows of each plot to ensure that N is evenly distributed. The treatment consists of factorial combination of one variety (Bulch) with six treatment ((50-100g/ha), (101-150g/ha), (151-200g/ha), (201-250g/ha), (2501-300g/ha) and (whole size as control)) yam tuber cutting different weight size. The treatments were arranged in randomized complete block design (RCBD) with three replications. Each plot will be 4.8m long and 3m wide (6 rows). Finally, yam tuber plant in the central net plot area (9.6 m^2) was harvested at normal physiological maturity.

Therefore, the result of the economic analysis (partial budget) show that best promising yam tuber cutting size weight 201-250g (78874.3 birr) followed by 151-200g (73096.3birr) and 251-300g (70936.3 birr) and tuber yield tone hectare (57.95 tone/ha, 56.42 tone/ha and 54.45 tone/ha respectively were recommended for farmer or end user in western Oromia of yam production area and similar agroecology.

Key words: Yam tuber cutting, mini-setts

INTRODUCTION

Yams (*Dioscorea spp.)* are an annual tuber and monocotyledonous crop. The plant Genus comprises of over 600 species with only 10 species producing edible tuber. Six of these edible species are cultivated in Africa, West Indies, Asia, South and Central America (Amusa, 2000; Tamirou *et al*., 2008; Bousalem *et al*., 2010; Elsie, 2011; Petro *et al.*, 2011; Ibitoye *et al*., 2013) and only three (3) of them are available in Gabon. The primary species cultivated are the white yam (*Dioscorea. rotundata),* yellow yam (*Dioscorea cayenensis)* and water yam (*Diosorea alata), D. rotundata* and *D. cayenensis* may have been first domesticated in the forest-savannah ecotone of West Africa (Hamon *et al*., 1995; Tostain *et al*., 2003). Yam tubers are important in different domains. Nutritionally, yams are a major source of nourishment to many populations in the world (Craufurd *et al*., 2006). Pharmaceutically, some species of *Dioscorea*, particularly *Dioscorea zingiberensis*, produces high concentration of diosgenin, a chemical used for the commercial synthesis of sex hormones and corticosteroids (Chen *et al*., 2003; Yuan *et al*., 2005; Islam *et al*., 2008). Agriculturally, yams tubers are used as planting material (Odjugo, 2008; Zannou, 2009). Yam also plays vital roles in traditional culture, rituals and religion as well as local commerce of African people (Izekor and Olumese, 2010). The conventional multiplication of *Dioscorea* species is by tuber seeds, a tuber fragment that grows and develops into a new tuber.

The farmers of the area unknowingly cut and use of yam planting materials without recommendation that causes rotting and desiccation for the majority of planting materials which leads to yield reduction. Then it is very essential to recommend appropriate yam tuber size cutting for optimum yield production in the farming communities.

Objective:

To recommend appropriate tuber weight of yam cutting for the farming and its Economic feasibility for communities in western Oromia.

Materials and method

A field experiment was conducted at Western Oromia to recommend appropriate tuber weight of yam cutting for the farming and its economic feasibility for communities in western Oromia for two consecutive years during the main cropping season of 2017 and 2018 at Bako Agricultural Research Center (BARC) on station and subsite of Gute.

Plant materials

Yam variety Bulch, which is adapted to the agro-ecology of the area, was used for the study appropriate tuber weight of yam cutting. Variety Bulch is the most successful variety released by Bako Agricultural Research Centre in 2012. Bulcha variety performed tuber yields of 66.45 t/ha on research fields and 31.4t/ha on farmers' fields.

Experimental Design and plot management

The experimental field was ploughed and harrowed by a tractor to get a fine seedbed and leveled manually before the field layout was made. Planting was done on April and yam tuber cutting at different gram were planted at a spacing of 80 cm between rows and 30 cm between plants. After cutting up the tuber into mini-setts, takes ash and rub ash onto the freshly cut fresh that are exposed. Allow the mini-setts to dry out for one day in cool dry place before placing them in a nursery. This prevents the flesh from being infected whilst in the nursery. The Animal manure (in order to conserve moisture inside tuber cutting) was applied along the rows before planting and mixed with soil then placement yam tubers at recommended spacing was done in hole prepared in the field. Nitrogen fertilizer was used 100kg/ha in two splits and 100kg/ha NPS which were used.100kg/ha NPS and half Nitrogen fertilizer applied after emergence and the remaining half a month after first application along the rows of each plot to ensure that N is evenly distributed.

The treatment consists of factorial combination of one variety (Bulch) with six treatment ((50-100g/ha), (101-150g/ha), (151-200g/ha), (201-250g/ha), (2501-300g/ha) and (whole size as control)) yam tuber cutting different weight size. The treatments were arranged in randomized complete block design (RCBD) with three replications. Each plot will be 4.8m long and 3m wide (6 rows). The inside four rows were set aside for data collection to eliminate any border effects. All the rest agronomic management of the crop were applied according to the recommended methods. Finally, yam tuber plant in the central net plot area (9.6 m^2) was harvested at normal physiological maturity. The yam tubers were harvested manually using by hoeing and hand picking.

Table.1. Yam tuber cutting in different size in gram and the amount of cutting per hectare.

	Treatment	Number Cutting	1kg/cutting	Kg/ha	Quintal/ha
1	50-100g	24	13.33	3751	37.51
2	101-150g	14	9.44	5297	52.97
3	151-200g	10	5.56	8993	89.93
4	201-250g	9	5	10000	100
5	251-300g	7	3.89	12853	128.53
6	whole size/control	1.8kg	1.8kg	25000	250

Figure 1. Yam tuber cutting, their measurement and placement of tuber on appropriate space

Procedure of yam tuber cutting

Five Yam tuber sample randomly taken and measured their average weight (500g+1000g+1500g+ 2000g+ 4000g =9000g/5=1800, 9kg/5=1.8kg) of tuber used to calculated amount of cutting for each treatment and about 50,000 cutting required for a hectare (Table1).

Economics analysis

Net return (NR ha^{-1}) and benefit: cost ratio (B: C) was calculated by considering the sale prices of yam tuber (1kg = 6 birr) and labor for all field activities done. Thus, the economic gains of the different treatments were calculated to estimate the net returns and the cost of cultivation, after considering the cost of fertilizer N, NPS, and the income from marketable yam tubers for economic analysis. Hence, following the CIMMYT partial budget analysis methodology, total variable costs (TVC), gross benefits (GB) and net benefits (NB) will be calculated (CIMMYT, 1988).

Collected Data

Plant height/Vine length (cm), Tuber number per plant, Tuber length per plant (cm), Tuber diameter per plant (cm), Tuber weight per plant in gram, Tuber weight per plot in kilo gram and Tuber yield per ha in tone were collected.

RESULT AND DISCUSSION

Yam tuber tons per hectare, tuber weight per plant in kg and tuber weight per plot in kg

The combination analysis main effect yam tuber tone per hectare, tuber weight kilo gram per plant and tuber weight per plot in kilo gram were showing significant ($P<0.05$) different between yam cutting tuber of Bulch of variety. Similarly, the interaction effect of tuber cutting size weight of yield parameter tuber kilo gram per plant, tuber weight per plot in kilo gram and tuber tone per hectare were significant

influenced by location and years. The maximum yam tuber yield was obtained by whole tuber size/ control (66.12 tons per hectare) and followed by 251-300g (57.95 tons per hectare), 201-250g (56.42 tons per hectare) and 1051-200g (54.4 tons per hectare). (Table 2).

Table .2. Main effect of yield component parameter of yam tuber

Treatment	TWPkg	TWplkg	TTONha
50-100g	2.42d	39.88d	41.54d
101-150g	2.74cd	46.56c	48.5c
151-200g	3.21bc	52.28bc	54.45bc
201-250g	3.15bcd	54.16b	56.42b
251-300g	3.54b	55.63b	57.95b
whole size	5.44a	73.08a	66.12a
Mean	3.41	53.6	55.83
CV%	27.84	13.25	13.25
Year			
2017	2.96b	72.27a	75.28a
2018	3.87a	34.92b	36.37b
Location			
Bako	2.68b	52.28a	54.46a
Gute	4.14a	54.91a	57.2a
TRT	**	**	**
Yr	**	**	**
TRT*yr	**	*	*
TRT*Loc	**	**	**
yr*Loc	**	**	**

***Clue**: TRT= treatment, g = gram, CV%= coefficient of variation in percentage, Yr = year, Loc = location, TTONha= Tuber tone per hectare, TWpkg = tuber weight kilo gram per plant and TWPlkg = tuber weight per plot in kilo gram*

Figure.2. Yam tuber harvesting and their storage

Table.3. Main effect of yam growth parameter

Treatment	PHcm	VNP	TNP	TLPcm	TDPcm
50-100g	2.69 c	3.05d	2.98b	18.03c	8.27ab
101-150g	2.74 c	3.13cd	3.63ab	20.04bc	8.41ab
151-200g	3.17 a	3.87a	3.32ab	18.95bc	8.07ab
201-250g	2.99 c	3.8ab	4.03a	19.41bc	7.79b
251-300g	3.06 b	3.27bcd	3.63ab	21.12b	8.33ab
whole size	3.39 a	3.68abc	4.05a	20.63a	8.85a
Mean	3.01	3.47	3.61	20.2	8.28
CV%	12.48	19.45	25.77	14.61	15.04
Year					
2017	3.22a	3.05b	3.33b	25.42a	9.47a
2018	2.79b	3.88a	3.89a	14.97b	7.1b
Location					
Bako	3.21a	3.69a	4.12a	20.83a	8.2a
Gute	2.80b	3.24	3.1b	19.56a	8.37a
TRT	**	*	*	**	Ns
Yr	**	**	*	**	**
Loc	**	**	**	ns	Ns
Rep	Ns	ns	Ns	ns	Ns
TRT*yr	Ns	*	Ns	ns	Ns
TRT*Loc	Ns	*	Ns	ns	Ns
yr*Loc	**	ns	*	ns	Ns
TRT*yr*Loc	Ns	ns	Ns	ns	Ns

Clue: *TRT= treatment, g = gram, CV%= coefficient of variation in percentage, Yr = year, Loc = location, PHcm = plant height in cm, VNP= vine number per plant, TNP= Tuber number per plant, TLPcm = Tuber length per plant in cm, TDPcm= tuber diameter per plant*

Figure .2. Yam vegetative performance

Table 4. Partial budget analysis

Treatment	Tuber yield tone/ ha	Gross return (Birr ha-1)	Cost of Production (Birr ha-1) or Total Cost vary birr/ha	Net benefit birr/ha or Net return (GR – PC) (Birr ha-1)	Benefit: cost ratio (GR/PC Eth. Birr	Return/Birr Investment (NR/PC) ETB	Net return (Eth. Birr ha-1)
50-100g	41.54	249240	219605	29635	1.134947	0.134947	
101-150g	48.5	291000	231427.7	59572.3	1.257412	0.257412	
151-200g	54.45	326700	253603.7	73096.3	1.28823	0.28823	73096.3
201-250g	56.42	338520	259645.7	78874.3	1.303777	0.303777	78874.3
251-300g	57.95	347700	276763.7	70936.3	1.256306	0.256306	70936.3
whole size	66.12	396720	341543.8	55176.2	1.161549	0.161549	

Yam growth parameter

The combination analysis main effect yam growth parameter such as plant height in cm, vine number per plant, tuber number per plant, tuber length per plant were significantly influenced by yam cutting size weight ($P<0.05$) but tuber diameter per plant not significantly affected by yam tuber cutting size weight. The vigorously of yam vegetative were increasing as tuber cutting size weight in gram increases (figare.3) and the maximum plant height, vine number per plant, tuber number per plant, tuber length per plant and tuber diameter per plant were obtained by yam whole size/ control and followed by 251-300g (Table.3).

Economic analysis

The result of the economic analysis (partial budget) for different yam tuber cutting size presented on (Table. 4.) indicated that the treatment of (50-100g, 101-150g, 151-200g, 201-250g, 251-300g and whole size/control) the best ideal yam tuber cutting size were obtained highest net return (Ethiopia Birr) per hectare from 201-250g (78874.3 birr) followed by 151-200g (73096.3birr) and 251-300g (70936.3 birr).

SUMMARY AND CONCLUSION

The main effect yam tuber tone per hectare, tuber weight kilo gram per plant and tuber weight per plot in kilo gram were showing significant ($P<0.05$) different between yam cutting tuber of Bulch of variety. Similarly, the interaction effect of tuber cutting size weight of yield parameter tuber kilo gram per plant, tuber weight per plot in kilo gram and tuber tone per hectare were significant influenced by location and years. The vigorously of yam vegetative were increasing as tuber cutting size weight in gram increases and the maximum plant height, vine number per plant, tuber number per plant, tuber length per plant and tuber diameter per plant were obtained by yam whole size/ control and followed by 251-300g.

The result of the economic analysis (partial budget) for different yam tuber cutting size presented indicated that the treatment of the best ideal yam tuber cutting size were obtained highest net return (Ethiopia Birr) per hectare from 201-250g (78874.3 birr) followed by 151-200g (73096.3birr) and 251-300g (70936.3 birr). Therefore, the best promising yam tuber cutting size weight 201-250g (78874.3 birr) followed by 151-200g (73096.3birr) and 251-300g (70936.3 birr) and tuber yield tone hectare (57.95 tone/ha, 56.42 tone/ha and 54.45 tone/ha respectively were recommended for farmer or end user in western Oromia of yam production area and similar agroecology.

Competing Interests

Authors have declared that no competing interests exist.

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