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Performance of Sweet Potato vine types planted with leaves attached and with leaves removed on yield of tubers in the south eastern lowveld of Zimbabwe

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ABSTRACT

Terminal portion of sweet potato (*Ipomoea batatas* (L .) Lam) vine is reputed to be superior to the middle and basal portions for plant establishment and root yield. A trial evaluating the effect of different vine cuttings planted with leaves attached and with leaves removed on yield of sweet potato tubers was conducted in the South East Lowveld under irrigation during winter season in 2015, 2016 and 2017. Basal, middle and terminal vine cuttings planted with leaves attached and with leaves removed per vine type were used. Results showed that there were significant difference ($p<0.05$) on number of marketable and non marketable tubers. There were significant difference ($p<0.05$) on yield of marketable tubers while treatments interactions on yield of non marketable tubers in t/ha were not significantly different ($p>0.05$).

INTRODUCTION

The sweet potato is an economical source of essential nutrients, including vitamin A whose deficiency blinds thousands of children each year worldwide. It can feed more people per hectare than rice while it also offers small farmers as well as large scale commercial growers an opportunity to increase their income. The tuberous roots and leaves of sweet potato are an excellent source of carbohydrate, protein, iron, vitamins A, C and fibre (Smart and Simmonds, 1995). The fresh tuberous root contains 80 to 90% carbohydrate of dry matter (Dominguez, 1992), 3.6 to 5.4% crude protein, 0.72 to 1.2% fat, 2.5 to 3.25 fibre and 2.5 to 3.2% ash on dry matter basis (Duke, 1983). Sweet potato can easily fit into many multi – cropping systems and can be grown with minimum inputs under rainfed or irrigated conditions. In Zimbabwe, the sweet potato is very acceptable as evidenced by its extensive cultivation all over the country, however the crop , s yield is low under small holder farmers. This could be attributed by poor selection and preparation of sweet potato planting material.

The common practice of sweet potato farmers in Zimbabwe is that, they plant the crop by use of vine cuttings were as in other countries they use both tuber and vine cuttings as planting materials. Cuttings from the shoot apex are often regarded as better planting material than basal or middle vine cuttings (Eronico et al., 1981, Choudhury et al., 1986; Villamayor Jr and Perez, 1988; Schultheis et al., 1994). Apical cuttings may ensure better rooting and establishment and faster shoot growth and there for early canopy closure for weed suppression (Eronico et al., 1981; Hall 1987).

The presence of leaves on vine cuttings greatly increased adventitious root production, presumably due to the presence of active endogenous root promoting substances (Fadl et al., 1978). Ravindran and Mohankumar (1982, 1989) reported that storage root yield was significantly higher in plants from vine cuttings with foliage than in plants from cuttings without foliage. Contrary to this Villamayor Jr (1986) reported that the presence of leaves on vine did not influence storage root number and storage root mass.

The terminal portion of sweet potato vine is reputed to be superior to the middle and basal portions for plant establishment and root yield. Furthermore , vine cuttings planted with leaves is also reputed to be superior to vine cuttings planted without leaves for plant establishment and root yield. However, small holder farmers in the lowveld are not aware of this and surprisingly they are still using mixed vine cuttings (basal, middle and terminal) and some plant vine cuttings with leaves removed before planting. This might be why the yield of sweet potato under small holder farmers is low (6-25t/ha) under irrigation despite using high yielding varieties and fertilizers.

MATERIALS AND METHODS

Sites

The experiments were conducted at Chiredzi Research Station on soil type called paragneis (Sand clay) in the South East Lowveld of Zimbabwe. The mean annual rainfall is 500mm with a seasonal range of 250-1000mm. The Natural Regions are a classification of the agricultural potential of the country from Natural Region I, which represents the high altitude wet areas to Natural Region V, which receives low and erratic rainfall averaging 500mm per annum.

Experimental procedures and treatments

The trial was set up in randomised complete block design (RCBD) replicated three times with sixteen treatments. Plants were spaced 1.0m between rows and 0.3m between plants in a row. Two varieties of sweet potato with three different vines per variety i.e. basal 30cm vine size (taken from the base of the vine), middle 30cm vine size (taken from the middle of the vine) and terminal 30cm vine size (taken from the tip of the vine) vine cuttings on each vine type were planted with leaves attached on the vine or planted with leaves removed before planting. Leaves were manually removed by hand on vines planted without leaves. Basal vine cuttings planted with leaves on Germany 2 (BPWLG2), basal vine cuttings planted with leaves removed on Germany 2 (BPWLRG2), middle vine cuttings planted with leaves on Germany 2 (MPWLG2), middle vine cuttings planted with leaves removed on Germany 2, (MPWLRG2), terminal vine cuttings planted with leaves on Germany 2, (TPWLG2), terminal vine cuttings planted with leaves removed on Germany 2 (TPWLRG2), mixed vine cuttings (basal, middle and terminal) planted with leaves on Germany 2 (BMTPWLG2) (control), mixed vine cuttings (basal, middle and terminal) planted with leaves removed on Germany 2 (BMTPWLRG2) (control), basal vine cuttings planted with leaves of Chingova, (BPWLC) basal vine cuttings planted with leaves removed on Chingova (BPWLRC), middle vine cuttings planted with leaves on Chingova (MPWLC), middle vine cuttings planted with leaves removed on Chingova (MPWLRC), terminal vine cuttings planted with leaves on Chingova (TPWLC), terminal vine cuttings planted with leaves removed on Chingova (TPWLRC), mixed vine cuttings (basal, middle and terminal planted with leaves on Chingova (BMTPWLC) (control) and, mixed vine cuttings (basal, middle and terminal) planted with leaves removed on Chingova (BMTPWLRC) (control) was used as treatments. Control treatments were used for comparison. Gross plots were 4.5m long (length) by 4m wide (width) each and the net plot area of 7.8m2 . Soil analysis was not done because of financial challenges. Two sweet potato varieties (Germany 2 and Chingova) were used in this trial. Basal fertilizer compound at a rate of 400kgs/ ha was uniformly applied to all plots as basal application. Ammonium nitrate at a rate of 100kg/ha was uniformly applied to all plots as top dressing when the crop reached two weeks maturity from planting. The crop was again applied with ammonium nitrate at 100kg/ha to all plots uniformly after reaching one month from date of planting.

Crop establishment, measurements and management

Ridges which were 30cm high and wide were made using tractor drawn ridger after ploughing the land. Planting holes 100cm apart by 30cm were marked on top of ridges by hand hoes, giving a plant population of 33333/ha. Irrigation was applied at field capacity soon after planting. Number of marketable and non marketable tubers, fresh weight of marketable and non marketable tubers and fresh tuber yield per hectare were determined. A net plot of 7.8m2 was used for determination of fresh tuber yield.

Statistical analysis

GenStart 14th Edition a statistical package was used to analyze data that was obtained from the experiments. Least Significant Difference (LSD) test was used to separate means at 5% probability.

RESULTS

Number of marketable and non marketable tubers

Treatment BPWLG2 (86.67) showed significant difference ($p<0.05$) from treatment MPWLG2 (55.00) and treatment BMTPWLRG2 (52.78). All the other treatments did not show significant differences on number of marketable tubers (Table 1.). There were significant differences ($p<0.05$) on treatment TPWLC (58.00) from treatment BMTPWLRG2 (21.11) on number of non marketable tubers. All the other treatments did not show significant differences ($p>0.05$) on number of non marketable tubers (Table 1.).

Fresh yield of marketable and non marketable tubers

There were significant differences ($p<0.05$) on treatment TPWLRC (61.80) from treatment MPWLG2 (38.04), BPWLRG2 (41.21), BMTPWLRG2 (42.64 and BPWLRC (41.81). Treatment BPWLG2 (56.77) showed significant difference ($p<0.05$) from treatment MPWLG2 (38.04) All the other treatments did not show significant difference on fresh yield of marketable tubers (Table 1.). Treatment interactions showed no significant differences ($p>0.05$) on non marketable yield of fresh tubers in t/ha in all the treatments (Table 1.).

DISCUSSION

The increased in number of marketable tubers observed in this study on basal vines planted with leaves attached (BPWLG2) as compared to basal, middle and terminal vines planted with leaves removed (BMTPWLRG2) control treatment agrees with the findings of Fadl et al., 1978, who observed that the presence of leaves on vine cuttings greatly increased adventitious root production, presumably due to the presence of active endogenous root promoting substances.

There were no significant differences ($p>0.05$) in number of marketable tubers on Chingova variety as compared to the control treatments (BMTPWLC and BMTPWLRC) of the same variety and the results disagree with the findings of Fadl et al., who observed that that the presence of leaves on vine cuttings greatly increased adventitious root production, presumably due to the presence of active endogenous root promoting substances.

There were no significant differences ($p>0.05$) in number of marketable tubers on Chingova sweet potato variety planted with leaves and planted with leaves removed as compared to (BMTPWLC and BMTPWLRC) to control treatments. The results agrees with the findings of Villamayor Jr (1986) who reported that the presence of leaves on vine did not influence storage root number and storage root mass.

Yield was not significantly increased ($p>0.05$) by planting terminal vines on Chingova variety as compared to (BMTPWLC and BMTPWLRC) control treatments. The results disagree with the findings of Eronico et al.,1981.,Choudhury et al., 1986; Villamayor Jr and Perez, 1988 ; Schultheis et al., 1994 who observed that cuttings from the shoot apex are often regarded as better planting material than basal or middle vine cuttings.

Yield of marketable tubers from the two sweet potato varieties was not significantly higher ($p<0.05$) in all the treatments with vines planted with foliage as compared to the control treatments of the two varieties. The results is not consistence with the findings of Ravidran and Mohankumar (1982,1989) who reported that storage root yield was significantly higher in plants from vine cuttings with foliage than in plants from cuttings without foliage.

There is no yield benefit in planting only basal or middle or terminal vine cuttings with leaves attached or with leaves removed as compared to control treatments in the production of sweet potato in the south east lowveld of Zimbabwe.

RECOMMENDATION

A mixture of vine cuttings (basal, middle and terminal) from Chingova or Germany 2 planted with leaves attached or with leaves removed is recommended for small holder farmers as planting materials for sweet potato production in the southeast Lowveld of Zimbabwe.

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Table 1: Response of two sweet potato (Germany 2 and Chingova) varieties to different vine types (basal, middle and terminal) planted with leaves attached and with leaves removed on plant attributes and fresh yield of marketable and non marketable tubers under South East Lowveld conditions.

Treatment	No of marketable tubers (000)	No of non marketable tubers (000)	Fresh yield of marketable tubers (t/ha)	Fresh yield of non marketable tubers (t/ha)
BPWLG2	86.67^{b}	39.22^{abc}	56.77^{bc}	7.047
BPWLRG2	60.67^{ab}	32.56^{ab}	41.21^{ab}	5.347
MPWLG2	55.00^{a}	25.11^{ab}	38.04^{a}	6.068
MPWLRG2	66.11^{ab}	37.56^{abc}	50.25^{abc}	6.513
TPWLG2	72.89^{ab}	29.11^{ab}	46.23^{abc}	4.916
TPWLRG2	67.78^{ab}	29.33^{ab}	49.54^{abc}	4.244
BMTPWLG2 control	64.45^{ab}	25.89^{ab}	46.71^{abc}	5.223
BMTPWLRG2 control	52.78^{a}	21.11^{a}	42.64^{ab}	5.056
BPWLC	67.11^{ab}	30.56^{ab}	52.43^{abc}	7.542
BPWLRC	59.22^{ab}	41.00^{abc}	41.81^{ab}	8.056
MPWLC	81.33^{ab}	41.00^{abc}	50.76^{abc}	11.594
MPWLRC	77.33^{ab}	32.45^{ab}	47.45^{abc}	7.535
TPWLC	72.22^{ab}	58.00^{c}	46.42^{abc}	8.706
TPWLRC	79.78^{ab}	43.00^{abc}	61.80^{c}	8.566
BMTPWLC control	73.45^{ab}	45.00^{bc}	46.01^{abc}	13.265
BMTPWLRC control	73.56^{ab}	34.11^{ab}	53.53^{abc}	9.958
Means	69.4	35.3	48.2	7.49
LSD	24.27	19.15	14.17	7.561
SE	14.56	11.48	8.50	4.534
CV%	21.0	32.5	17.6	60.5
P.Value	0.265	0.069	0.154	0.544

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