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Effects of removing cuttings from mid-season sweetpotato crops

(Kesan pengeratan batang ubi keledek pada pertengahan musim menanam)

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Key-words: cuttings, planting materials, root yield, sweetpotato

Abstrak

Sepuluh klon ubi keledek diberi perlakuan memotong keratan pada pertengahan musim dalam satu ujikaji yang dijalankan di tanah mineral dan tanah asid sulfat. Batang ubi keledek boleh dipotong pada 2–2.5 bulan selepas ditanam tanpa menjejaskan hasil ubinya; begitu juga dengan ciri agronominya seperti indeks pungutan dan kandungan bahan kering. Ciri-ciri ini bertepatan dengan klon yang diuji, sungguhpun klon tersebut mempunyai ciri morfologi yang berbeza-beza. Antara lima klon yang diperkenalkan dalam ujikaji yang dilaksanakan di dua tapak berasingan dan selama dua musim, tiga menunjukkan potensi iaitu CN 2054-13, CN 941-32 dan CN 2067-7. Semua klon ini setanding dengan varieti bandingan Bukit Naga bagi hasil bahan kering ubi. CN 2054-13, umpamanya, berpotensi menjadi varieti kanji kerana kandungan bahan keringnya yang tinggi dan agak rintang terhadap penyakit keruping (scab) berbanding dengan varieti tempatan. CN 2067-7 mungkin boleh dipertimbangkan sebagai varieti hidangan. CN 941-32 pula menunjukkan kesesuaian terhadap tanah asid sulfat.

Abstract

Ten sweetpotato clones were subjected to removal of cuttings at mid-season in a trial carried out on mineral and acid sulphate soils. Apical cuttings may be removed at 2–2.5 months after planting from standing crops without significantly affecting final root yield nor other agronomic traits such as harvest index and root dry matter content. This holds true even though the clones had different morphological traits. Of the five introduced clones evaluated in the two-location, two-season trial, three showed some potential: CN 2054-13, CN 941-32 and CN 2067-7. All equaled Bukit Naga (a local check) in dry root yield. CN 2054-13, especially, has promise as a starch variety because of its high dry matter content, and appears to be fairly resistant to scab compared to local varieties. CN 2067-7 may be considered for a table variety. CN 941-32 showed particular adaptability to acid sulphate soils.

Introduction

It has been firmly established that apical cuttings make the best planting materials for propagating sweetpotato (de Kraker and Bolhuis 1969; Nzima and del Rosario 1982; Tan 1998; Vu 1998). Past observations and reports (such as Vu 1998) show that the best cuttings for planting materials come from sweetpotato crops of around 2.0–2.5 months old. Planting materials cut from the vines at

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harvest (4 months) are usually of inferior quality, and often infested with diseases or pests. The usual practice is to use these poorer quality cuttings to raise a nursery to supply planting materials at the right age for subsequent production fields.

The purpose of this study was to determine whether taking cuttings from the production fields at 2.0–2.5 months after planting will significantly affect final root yield. As there may be genetic difference in response to this practice, the experiment involved a number of clones – both local and introduced – which varied in morphological traits. The implication is that if root yield was not affected, farmers will be able to cut planting materials from a standing crop at the optimal stage of the crop, without having to resort to nursery production of cuttings – saving time, space and inputs in the process – when planting subsequent crops.

A secondary objective of the trials was to determine the best yielding clones from among the introductions.

Materials and methods

Ten clones of sweetpotato with varying morphological traits (e.g. plant type, leaf shape, shoot colour, root skin and flesh colours), selected from previous yield trials were used in the study. These clones include materials introduced from the Asian Vegetable Research and Development Center (AVRDC), Taiwan in the form of true seed and as meristem tissue cultures, together with some local Malaysian varieties *(*see *Table 1)*. Bukit Naga and Gendut are normally used as checks in varietal evaluations.

Planting materials for the first planting were raised in a nursery and cuttings were taken at 2.5 months to plant the first trial. After crop establishment, two treatments were tested on the 10 clones:

- no cuttings were removed
- apical cuttings were removed from each plant at 2.5 months after planting

Table 1. Sweetpotato clones used in the trials at Serdang and Kuala Linggi

Clone	Origin	Morphological traits				
		Plant type	Leaf shape	Shoot colour	Root skin	Root flesh
Bukit Naga	Local, from Peninsular Malaysia	Spreading	Lobed	Green, purple edge	Purple-red	White
Gendut	Local, released by MARDI (1994)	Spreading	Cordate	Green	Pale yellow	Yellow
Kuala Bikam 2	Local, from Peninsular Malaysia	Spreading	Cordate	Green, purple veins	Light brown, pinkish tinge	Orange
UPMSS5	Local, developed by UPM* (1990)	Erect	Cordate	Purple	Pink	Yellow
CN 2054-13	AVRDC; true seed introduction (1991)	Spreading	Cordate	Green	Cream	Cream
CN 2057-6	AVRDC; true seed introduction (1991)	Spreading	Cordate	Green, purple edge	Purple-red	Cream
AIS 1022-2	AVRDC; meristem tissue culture (1990)	Spreading	Hastate	Slightly purple	Light brown, pinkish tinge	Pale yellow
CN 941-32	AVRDC; meristem tissue culture (1990)	Semi-compact	Triangular	Green, purple edge	Purple-red	White
CN 2067-7	AVRDC; true seed introduction (1991)	Spreading	Lobed	Green, purple edge	Dark red	Cream
SB052	Local, from Sabah	Spreading	Lobed	Green	Light brown	Cream

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A split-plot design was used, where the main plot was represented by Clone, and the subplot by Treatment. The experiment was replicated four times, and repeated over two seasons at two locations. The locations were MARDI Headquarters Station Serdang, Selangor and MARDI Station Kuala Linggi, Melaka. Cuttings (two or more per plant) removed from the treatment plots of the first season trials *(Plate 1)* were used to plant the second season trials, while cuttings from the second season trial at Serdang were used to plant the first season trial at Kuala Linggi. All selected cuttings were apical in origin, uninfested by disease or pest, and measured 30 cm long.

The main plot size was 7 m x 2.5 m, with seven rows spaced 1 m apart. Each 2.5 m row carried 10 plants at 25 cm plant spacing. Two rows were harvested from each subplot, leaving three border rows (one on either side of the main plot and one central row separating the subplots).

The usual agronomic practices for sweetpotato on mineral soils (Tan and Saad 1994) were adopted. At Kuala Linggi station, where the soils are acid sulphate, liming was carried out (at a rate of 8 t ground magnesium limestone/ha) two weeks prior to planting to correct the low soil pHs of 4.1 and 4.15 in the first and second seasons, respectively.

The crops were harvested at 4 months after planting, when the following data were collected from each subplot: weight of vines, total weight of storage roots, harvest index (ratio of total root weight over total plant weight, including root weight), and dry matter content of roots. Secondary data on total fresh and dry root yields were calculated subsequently. Observations were also made on susceptibility of the clones to scab (caused by the fungus *Elsinoe batatas*) and on their cooking quality.

Plate 1. Removal of apical cuttings at mid-season to plant the next trial

Results and discussion

Serdang

The combined data from the two seasons' trials were analyzed *(Table 2)*, and the results show that Treatment (i.e. removal of cuttings) did not have a significant effect on fresh or dry root yield, harvest index nor root dry matter content *(*also, *Table 3)*. Nevertheless, when cuttings were removed, fresh root yield was reduced by 18.6%. Clones produced significant (p = 0.01) effects on these same traits. Season effects were significant for fresh root yield and root dry matter content *(Table 3)*.

The yields at Serdang were low, especially in the first season. It was suspected that allelopathy (Walker dan Jenkins 1986) resulting from the many cycles of growing sweetpotato on the same piece of land may have caused the depressed root yields. Alternatively, the failure to practise crop rotation can also lead to build-up of pests (and indeed a high incidence of the sweetpotato weevil grubs was observed). However, these hypotheses were not tested out. Of the 10 clones, the highest yielders (10.7–11.2 t/ha) were Gendut, Bukit Naga and CN 2054-13 *(Table 3)*. UPMSS5 by virtue of its erect plant type had the highest harvest index at 0.49. The highest root dry matter contents were recorded in CN 2054-13 (38.6%) and CN 2057-6 (37.7%), resulting in the former having the highest dry root yield at 4.10 t/ha.

No Treatment x Clone interaction effects were detected, implying that Treatment did not cause differential significant effects on individual clones either.

Table 2. Analyses of variance for various traits of agronomic importance at Serdang and Kuala Linggi

Source	df	Mean squares at Serdang				Mean squares at Kuala Linggi			
		Fresh root yield	Harvest index	Root DMC[1]	Dry root yield	Fresh root yield	Harvest index	Root DMC	Dry root yield
Season	1	355.38**	0.0117 ns	601.03**	5.48 ns	1 594.54**	0.0112 ns	47.47**	67.13**
Replicate (Season)	6	31.39 ns	0.0104 ns	4.95 ns	3.74 ns	310.90**	0.0468**	68.92**	26.38**
Clone	9	206.61**	0.3366**	322.76**	22.60**	680.87**	0.1302**	174.46**	24.37**
Treatment	1	55.84 ns	0.0034 ns	1.64 ns	5.47 ns	65.66 ns	0.0001 ns	1.65 ns	5.47 ns
Season x Clone	9	26.41 ns	0.0322**	23.10**	1.10 ns	88.29 ns	0.0192*	18.43**	4.79 ns
Season x Treatment	1	31.18 ns	0.0003 ns	21.43 ns	2.53 ns	68.78 ns	0.0002 ns	11.43 ns	1.45 ns
Treatment x Clone	9	7.82 ns	0.0111 ns	11.21 ns	0.64 ns	11.59 ns	0.0018 ns	3.78 ns	0.93 ns

[1]Dry matter content *significant at p <0.05

ns : not significant at p= 0.05 **significant at p <0.01

Table 3. Clonal performance at Serdang and Kuala Linggi

Clone	Fresh root yield (t/ha)		Harvest index		Root DMC* (%)		Dry root yield (t/ha)	
	Serdang	K. Linggi	Serdang	K. Linggi	Serdang	K. Linggi	Serdang	K. Linggi
Bukit Naga	10.7a	33.3a	0.28c	0.63a	29.3f	21.4ef	3.34ab	7.09a
Gendut	11.2a	23.4bcd	0.42b	0.54cd	30.4ef	24.2cd	3.52ab	5.63bc
Kuala Bikam 2	2.2d	12.1e	0.11e	0.40e	32.0de	22.7de	0.80de	2.78e
UPMSS5	9.1ab	25.1bc	0.49a	0.65a	30.9def	21.0f	2.79bc	5.18cd
CN 2054-13	10.7a	21.4bcd	0.32c	0.49d	38.6a	28.9a	4.10a	6.11abc
CN 2057-6	3.9cd	19.1d	0.12e	0.39e	37.7abc	28.7a	1.57de	5.57bc
AIS 1022-2	3.0cd	20.1cd	0.08e	0.51cd	36.2c	26.3b	1.08de	5.25cd
CN 941-32	7.4b	33.6a	0.21d	0.62ab	25.7g	19.3g	2.01cd	6.52ab
CN 2067-7	6.2bc	25.4b	0.20d	0.57bc	33.0d	24.9bc	3.22abc	6.27abc
SB052	1.9d	19.9d	0.07e	0.54cd	25.3g	21.4ef	0.52e	4.22d
Season 1	5.3b	20.2b	0.24a	0.54a	34.1a	24.4a	2.13a	4.82b
Season 2	8.3a	26.5a	0.23a	0.53a	30.0b	23.3b	2.52a	6.11a
Intact	7.3a	24.0a	0.24a	0.54a	31.8a	24.0a	2.49a	5.65a
Cuttings removed	6.2a	22.7a	0.23a	0.53a	31.9a	23.8a	2.17a	5.28a

Note: Figures within the same column in the same group bearing the same letter are not significantly different from one another according to the L.S.D. test at p =0.05

*DMC = Dry matter content

Kuala Linggi

As in the case of Serdang, Treatment had no significant effects on the traits studied. Absolute reduction in fresh root yield amounted to only 5.3% when cuttings were removed at mid-season. Clonal effects were significant for all the four traits, while Season produced significant effects for fresh and dry root yields as well as root dry matter content. Again, no significant effects were detected for Treatment x Clone *(Table 2).*

Root yields at Kuala Linggi were high, indicating that acid sulphate soils can support good crops of sweetpotato given the correct agronomic practices. In the first season, the soil pH had risen to 5.02 two weeks after liming, i.e. at planting. Two months later, the soil pH had dropped to 4.70. In the second season, soil pH was 4.92 at planting and 4.85 two months after.

The highest yielding clones at Kuala Linggi were CN 941-32 and Bukit Naga with more than 33 t/ha fresh root yields. CN 2054-13 had a much lower yield at 21.4 t/ha, similar to Gendut *(Table 3)*. Again, UPMSS5 scored highest for harvest index together with Bukit Naga and CN 941-32 (0.62–0.65). Root dry matter contents were highest in CN 2054-13 (28.9%) and CN 2057-6 (28.7%) as was the case at Serdang. By contrast, CN 941-32 had the lowest dry matter content at 19.3%. This resulted in Bukit Naga, CN 941-32, CN 2067-7 and CN 2054-13 having dry root yields (6.11–7.08 t/ha) which were not significantly different.

Combined analyses

The combined analyses showed that Treatment did not produce any significant effects on the four agronomic traits as opposed to Location and Clone, while Season had significant effects on fresh and dry root yields and dry matter content. Location x Clone had significant interaction effects for all four traits as may be expected from the different ranking of high yielders at Serdang and Kuala Linggi. Season x Location interaction effects were also significant for root dry matter content as well as dry root yield *(Table 4)*.

Over the two locations and over two seasons of testing, Bukit Naga (22.0 t/ha), followed by CN 941-32 (20.5 t/ha), produced the highest fresh root yields. Gendut and CN 2067-7 produced moderately high yields (16.5–17.3 t/ha). Harvest index was highest for UPMSS5, while dry matter content was highest in the roots of CN 2054-13 (33.7%) and CN 2057-6 (33.0%). Moderately high root dry matter contents of around 27% boosted the dry root yields of Gendut and CN 2067-7 to be on par with Bukit Naga and CN 2054-13 (ranging from 4.58 to 5.28 t/ha) *(Table 5).*

Susceptibility to scab

Observations on scab infection were made in the second season trials at both Serdang and Kuala Linggi. As may be seen from *Figure 1*, the least infection was found in UPMSS5, AIS 1022-2 and CN 2054-13, while CN 2057-6 and CN941-32 also had low infections compared to all the local clones.

Cooking quality

Preliminary observations showed CN 2067-7 and CN 941-32 to have good eating quality (roots cooked by boiling). CN 2067-7 has attractive yellow flesh, but CN 941-32 has unattractive greyish flesh after cooking. CN 2054-13, on the other hand, does not appear to have any promise as a table variety, having poor eating quality on account of its dry texture and poor taste (low palatability). Owing to its high dry matter content, it also took longer to cook.

Conclusions

The results from the trials showed that apical cuttings may be removed at mid-season from standing crops of sweetpotato without significantly affecting final root yield nor other agronomic traits such as harvest index and root dry matter content. Thus, a farmer who practises staggered planting of sweetpotato (for continuous supply to the market) will be able to get

Table 4. Combined analyses of variance for various traits of agronomic importance over two locations and two seasons

Source	df	Mean squares			
		Fresh root yield	Harvest index	Root DMC[1]	Dry root yield
Season	1	1 863.17**	0.0157 ns	385.50**	46.32**
Location	1	21 432.61**	7.0900**	4 857.96**	735.50**
Replicate (Location)	6	49.53 ns	0.0159 ns	23.55**	8.11*
Clone	9	623.50**	0.3303**	476.79**	37.10**
Treatment	1	106.22 ns	0.0009 ns	1.71 ns	6.90 ns
Season x Clone	9	52.48 ns	0.0246*	16.72*	3.72 ns
Season x Treatment	1	6.18 ns	0.0018 ns	2.26 ns	0.44 ns
Season x Location	1	86.74 ns	0.0072 ns	263.00**	26.29**
Location x Clone	9	266.98**	0.1372**	22.84**	9.79**
Location x Treatment	1	10.40 ns	0.0011 ns	0.21 ns	2.20 ns
Treatment x Clone	9	14.87 ns	0.0066 ns	11.67 ns	0.58 ns
S x C x T	9	11.64 ns	0.0039 ns	3.66 ns	1.66 ns
L x C x T	9	5.63 ns	0.0064 ns	6.14 ns	1.13 ns
S x L x C x T[2]	19	38.22 ns	0.0143 ns	13.38*	1.43 ns

[1]Dry matter content
[2]S : Season; L : Location; C : Clone; T : Treatment
ns : not significant at p= 0.05
*significant at p <0.05
**significant at p <0.05

Table 5. Clonal performance over two locations over two seasons

Clone	Fresh root yield (t/ha)	Harvest index	Root DMC* (%)	Dry root yield (t/ha)
Bukit Naga	22.0a	0.46bc	25.2e	5.28a
Gendut	17.3bc	0.48b	27.3cd	4.58abc
Kuala Bikam 2	7.8e	0.27ef	26.2cde	2.02g
UPMSS5	17.1c	0.57a	25.9de	3.99cd
CN 2054-13	16.0c	0.40d	33.7a	5.10ab
CN 2057-6	11.5d	0.25f	33.0a	3.63de
AIS 1022-2	11.5d	0.29ef	31.2b	3.16f
CN 941-32	20.5ab	0.42cd	22.4f	4.34bcd
CN 2067-7	16.5c	0.40d	27.8c	5.17ab
SB052	11.2de	0.31e	23.3f	2.50fg
Season 1	20.2b	0.54a	24.4a	4.82b
Season 2	26.5a	0.53a	23.3b	6.11a
Intact	15.8a	0.39a	27.7a	4.14a
Cuttings removed	14.7a	0.39a	27.6a	3.84a
Serdang	6.8b	0.23b	31.9a	2.34b
Kuala Linggi	23.3a	0.54a	23.9b	5.46a

Note: Figures within the same column in the same group bearing the same letter are not significantly different from one another according to the L.S.D. test at p = 0.05
*Dry matter content

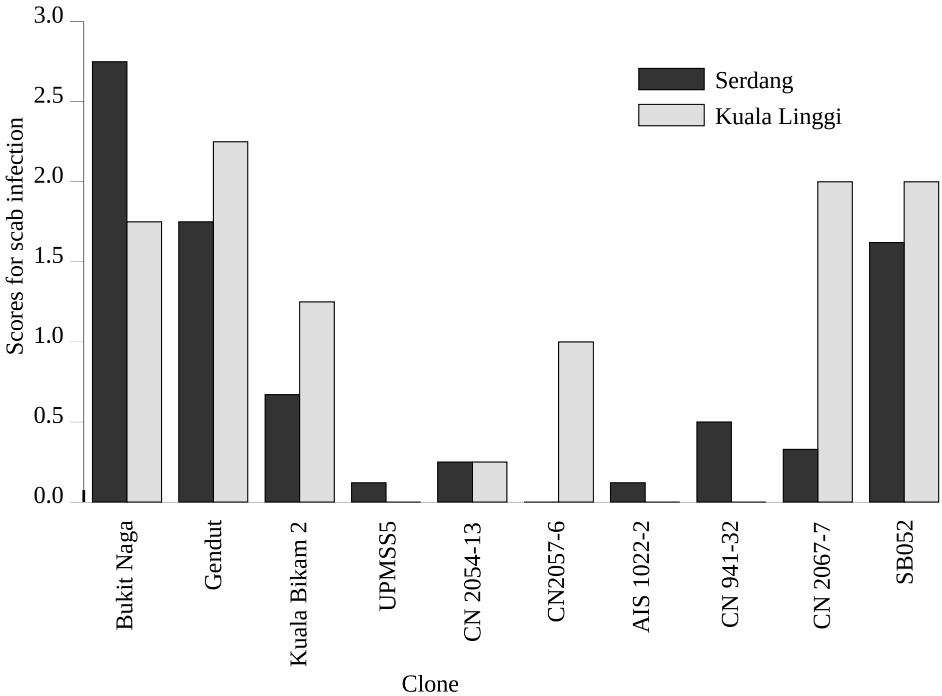

Figure 1. Scab infection scores (0=no infection; 5=highly infected) of the 10 sweetpotato clones at Serdang and Kuala Linggi stations

fresh and good quality planting materials from his existing crops, without having to worry about drastic yield reductions, nor to bother about establishing a separate nursery to multiply planting materials.

Of the five introduced clones, three showed potential: CN 2054-13, CN 941-32 and CN 2067-7 which equaled Bukit Naga in dry root yield. CN 2054-13, especially, has promise as a starch variety on account of its high dry matter content, and appears to be fairly resistant to scab compared to local varieties. CN 2067-7 may be considered for a table variety. CN 941-32 showed particular adaptability to acid sulphate soils.

The poorer yields at Serdang compared to Kuala Linggi were suspected to have been caused by allelopathy and the failure to practise crop rotation. These possible factors should be investigated further.

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References

de Kraker, J. P. and Bolhuis, G. G. (1969). Propagation of sweetpotato with different kinds of cuttings *Proc. International Symp. Tropical Root Crops*, 2–8 April 1967, St. Augustine, Trinidad (Tai, E. A. et al., ed.) Vol. I, Section III (Agronomy) p. 131–5 St. Augustine, Trinidad: Univ. West Indies and Intern. Soc. Trop. Root Crops

Nzima, M. D. S. and del Rosario, D. A. (1982). Physiological basis of low tuber yield from basal sweetpotato *[Ipomoea batatas* (L.) Lam.*]* cuttings *The Philippine Agriculturalist* ***65(2):*** 119–29

Tan, S. L. (1998). Agronomic modifications for mechanized planting of sweetpotato *J. Trop. Agric. and Fd. Sc.* ***26(1):*** 25–33

Tan, S. L. and Saad, M. S. (1994). Sweetpotato varieties for fresh consumption *Proc. National Seminar on Tuber Crop Production and Utilization*, 5–7 Sept. 1994, Kuantan (Tan, S. L. et al., ed.) p. 120–31 Serdang: MARDI, UPM and Malays. Soc. Hort. Sci.

Vu, D. H. (1998). Sweetpotato production and research in Vietnam. *Proc. International Workshop on 'Sweetpotato production system toward the 21st Century'*, 9–10 December 1997, Miyakonojo, Japan (LaBonte, D. R., Yamashita, M. and Mochida, H., ed.), p. 109–27 Miyakonojo: Kyushu National Agric. Exp. Sta.

Walker, D. W. and Jenkins, D. D. (1986). Influence of sweetpotato plant residue on growth of sweetpotato vine cuttings and cowpea plants *HortSci.* ***21(3):*** 426–8

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