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Techniques for using sprouts for potato production in the tropics *

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Abstract

A series of experiments were conducted in Vietnam to develop a system whereby detached sprouts from physiologically old green sprouted seed tubers could be used to grow potatoes. Three node segments from the mid or basal portion of the detached sprout produced the greatest percentage of shoots and roots. Growth was best in a medium of equal parts of sub-soil, pig manure and brick kiln ash. Sprout cuttings produced plantlets ready for transplanting in 14 – 20 days with mean daily temperatures of 22 to 24 °C. When transplanted in mid-November, yields from sprout cuttings in field experiments were 10 to 18 t/ha which were 33 % lower than from healthy seed tubers but more than the national average yield using degenerated seed tubers. Tubers produced by plants grown from sprout stored well and gave good yields when replanted the following year.

Introduction

In tropical developing countries seed tubers are the major production expense in potato production. Often, as in Vietnam, good quality seed is not available. In the Red River Delta (RRD) diffuse light storage (DLS) has enabled seed tubers to be stored between growing seasons, a period of about nine months. This results in physiologically old tubers for planting with a fresh weight loss of about 50 %. Tissue culture, a method successfully employed in the highlands (Uyen & Vander Zaag, 1985), is not an alternative in the RRD as potato production is seasonal and temperatures are too hot during the monsoon season to establish and maintain plants in vitro at ambient temperatures.

Tubers stored in DLS have sturdy green sprouts. Sprout cuttings have been used successfully for rapid multiplication. Scientists in Nepal have successfully grown rooted sprouts, dipped in a rooting hormone, from recently planted seed tubers (Shrestha, 1986). Sprouts could be used to rapidly multiply limited quantities of clean seed tubers if a workable system could be developed.

The objective of this work was to determine if detached sprouts could be useful in potato production.

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Materials and methods

Over 20 experiments were conducted from 1983 – 87, mostly in the RRD at the National Institute of Agricultural Sciences located at 21 °N latitude and 5 m above sea level. Minimum and maximum monthly temperatures fell from 24/31 °C in September to 9/24 °C in January and increased to 24/32 °C by May. Daylength is 10.45 hours on December 21. Rainfall is high from April to October (1600 mm) while from November to March it is sparse.

The seed tubers used for obtaining sprouts and for comparisons in the field trials came from first or second generation crops grown from imported certified seed. The seed tubers were stored in DLS starting from late February to early April at ambient temperatures. Sprouts were potted in late September – October and transplanted during November. Sprout cuttings were gently pressed into the media but not covered. They were placed in diffused light until shoots initiated and they were then placed in full sunlight. Unless indicated otherwise, seed tubers of cv. Mariella, from the Democratic Republic of Germany, were used with four replications per experiment. Experiments 1 – 3 (Tables 1 – 3) were conducted using a medium of one third each alluvial subsoil of the RRD, pig manure and ash from coal-fired brick kilns. In Experiment 4 (Table 4) different media combinations were tested, including river sand. Experiments 5 – 7 (Tables 5 – 7) were conducted in the field with a recommended fertilizer rate of 120 kg N, 32 kg P, 66 kg K and 15 t pig manure/ha in double row beds. Irrigation was done manually as needed. Unless specified otherwise, plant density was 5.5 tuber hills/m^2 and 11 sprout cuttings/m^2. Rooting was defined to have been initiated when one root per sprout cutting was at least one cm in length on 5 of 10 sprout cuttings examined daily. Rooting was observed by carefully removing the rooting media around each of the cuttings. Shoots were defined as growing when there was at least one cm of shoot growth on 50 % of the shoots/treatment. Survival was the percentage of sprout cuttings that developed healthy plants with vigorous shoots. Transplanting was done when plantlets had developed 4 to 6 leaves and were 8 to 10 cm in height. Tuber yield was the total weight of all tuber sizes per treatment. Other experimental details are given in the tables.

Results

Sprout management. Three-node sprout segments developed roots and shoots equiva-

Table 1. Influence of sprout cutting size on days to rooting, shoot growth and emergence. Each treatment was 50 sprout cuttings. The experiment was conducted in late September.

Sprout cutting size	Rooting (days)	Shoot growth (days)	Shoot emergence (%)
Whole	3.0	8.4	94
3 nodes	3.0	8.9	93
2 nodes	3.0	9.8	87
1 node	3.7	10.3	78
LSD (0.05)	0.6	1.1	4

lent to whole sprouts (Table 1). The single node cutting was slower, particularly in shoot development. After 9 months of storage most sprouts had 8 to 12 nodes. When 9-node sprouts were cut into 3 segments of 3 nodes each, the basal and middle portions rooted and developed shoots at an equal rate while the apical portions were slow and of doubtful use (Table 2). Temperature affected the rate of root and shoot growth. Sprout cutting establishment was best in the period October 15 to November 15 (Table 3). By December, when the minimum temperature had fallen to 9 °C, growth was slow, the

Table 2. Percentage rooting and shoot growth of cuttings from 3-node sprout pieces on different days after the experiment was initiated. Each treatment consisted of 50 sprout cuttings. The experiment was conducted in late September.

Sprout segment	Rooting on day:			Shoot growth on day:			
	2	4	6	3	5	7	9
Apical	65	70	100	11	20	50	63
Middle	85	100	100	25	57	83	100
Basal	75	100	100	21	53	80	100

Table 3. Effect of date of sprout cutting establishment in pots on growth. Minimum air temperature is for the 15 days after the date the treatment was initiated.

Date	Minimum temperature (°C)	Shoot growth (%)	Survival (%)	Days to transplanting
Sep 15	24.0	90	70	25
Oct 1	22.5	99	95	15
Oct 15	20.3	100	98	14
Nov 1	19.8	100	99	18
Nov 15	17.5	100	98	20
Dec 1	14.3	96	96	32
Dec 15	9.0	90	90	41

Table 4. Performance of sprout cuttings in various growing media. Each treatment consisted of 25 cuttings.

Medium	Rooting (days)	Shoot emergence (days)	Survival (%)
Sand	3.0	9.8	81
Alluvial subsoil	3.8	7.5	14
1/3 subsoil + 2/3 pig manure	2.8	5.5	96
1/3 subsoil + 1/3 pig manure + 1/3 brick kiln ash	2.0	7.3	97
LSD (0.05)	ns	0.7	21

Table 5. Influence of three different planting materials on the yield (t/ha) of 2 cultivars at Manh Tru Cooperative, RRD, planted on November 8, 1984 with 20 m^2/treatment.

Planting material	Cultivar	
	Ackersegen	Mariella
Tuber	21.2	25.0
Whole sprout direct field planted	11.3	13.9
Rooted 3-node sprout cuttings	14.1	17.8
LSD (0.05) Planting material	2.8	
Cultivar	3.8	
Interaction	ns	

Table 6. Effect of plant density on yield components for 2 planting dates. Trial 1 was rooted on November 9, transplanted November 22; Trial 2 was rooted on November 23 and transplanted on December 2, 1985. Treatment size was 1.2×4.2 m^2.

Density plants/m^2	Number of tubers/m^2 in Experiment		Yield (t/ha) in Experiment		Size (% > 20 mm) in Experiment	
	1	2	1	2	1	2
6	41	35	12.6	10.3	69	77
8	53	48	16.0	14.0	60	59
12	67	62	18.5	18.4	55	58
15	103	85	17.0	15.5	52	51
LSD (0.05)			3.0	8.0		

Table 7. Yield performance (t/ha) of seed tubers of various sizes from sprout-grown plants. The experiment was planted November 7, 1986 and harvested January 7, 1987. Plot size was 1.2×4.2 m.

Seed tuber size (mm)	Density (hills/m^2)		
	5	8	10
< 20	12.6	15.4	16.1
20 – 30	15.3	15.8	16.8
30 – 40	16.0	14.7	15.1
> 40	19.0	19.1	20.3

LSD (0.05): Size, 4.6; Density, 2.0; Interaction was not significant.

shoots taking up to 41 days before being ready to transplant. The best medium for rooting and sprout cutting establishment contained equal parts of alluvial subsoil, pig manure and brick kiln ash (Table 4). This provided the right combination for aeration and fertility. Sand and pure subsoil treatments gave unacceptable results.

Comparative field performance of tubers and sprouts. Seed tubers planted on November 8 gave much higher yields than rooted sprouts which, in turn, gave higher yields than direct planted sprout cuttings (Table 5). In a density trial the highest yields of over 18 t/ha were obtained with 12 plants/m^2 (Table 6). Average tuber size decreased with more plants/m^2 while tuber number increased markedly. Tubers from sprout cuttings were stored in DLS for 9 months. When replanted they gave acceptable yields (Table 7). Yields increased significantly with larger seed size. Only with the smallest size did yields improve with a density greater than 5 hills/m^2. Enhanced branching at lower densities and with smaller seed permitted good canopy development, a prerequisite for obtaining acceptable yields.

Discussion

Seed tubers stored for 7 to 9 months in DLS produced good sprouts for the establishment of transplants using 3 node cuttings from the middle or basal portion of the sprout. Data from other experiments (data not presented) showed that young sprouts from newly sprouted tubers were not as easy to root and did not easily produce shoots. Sprouts from tubers over 9 months of age also tended to develop slowly. Due to high rainfall and hot temperatures during October and unfavorably cool temperatures and short day length in December the plantlets must be transplanted in November (mean temperature 22 °C) (Table 3).

The cvs. Mariella and Ackersegen were both selected under long day European summer conditions. If cultivars better adapted to short day cool conditions were identified a more flexible programme using sprouts could be developed. Sprouts could be established as mother plants from which apical cuttings could be taken, rooted and transplanted to the field for several months. This would permit a greater multiplication rate as mother plants grown from sprout cuttings can produce 3 to 5 cuttings/month.

The potential for sprout cuttings is still relatively unexplored. We believe that there is a great potential for sprouts to provide a means of reducing planting material costs and more effectively utilizing small quantities of clean seed tubers.

References

Shrestha, G. K., 1986. Effects of growth regulators on the growth and yield of detached and transplanted potato (*Solanum tuberosum* L.) sprouts. *Potato Research* 29: 173–175.

Uyen Nguyen Van & P. Vander Zaag, 1985. Potato production using tissue culture in Vietnam: The status after four years. *American Potato Journal* 62: 237–241.