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Full Length Research Paper

Planting Sprout Cuttings of Potato (*Solanum Tuberosum* L.) As a Tool for Controlling Plant Diseases in Plateau State

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Studies were carried out on planting sprout cuttings of potato (*Solanum tuberosum*) as a means of controlling potato diseases in Plateau State. Three (3) standard potatoes cultivars (Roslin ruaka and Bertita, Nicola) and three (3) treatments (Healthy tubers, Healthy sprouts and Diseased sprouts) the sprouts from the tubers were cut into single buds and planted in 81 polythene pots using Complete Randomized Design (CRD). Growth parameters were carried out forth nightly (after 2weeks); the crop was raised following cropping practices of fertilizer application and weeding. The crops were harvested at 14 weeks after planting. The numbers of the tubers harvested from the healthy tubers were (271) and weighed (11kg), those from the healthy sprouts were (199), (8.5kg) which when compared with the diseased sprout produced (150) tubers that weighed (7.9kg). The wares or sellable tubers of the diseased tubers were (40) and weighed (5.3kg) which was close to the healthy sprouts which had (48) wares and weighed (6.8kg). The seeds produced by the diseased sprouts (164) and healthy sprouts (221) were more compared to those produced by the healthy tubers (119). The use of sprout cutting techniques as a tool for disease control should be adopted by commercial and subsistent farmers to aid in the loss of yield due to diseases which are serious threats to food security.

Keywords: Growth parameters, healthy tubers, potato, diseased sprout, Plateau State

INTRODUCTION

Potato (*Solanum tuberosum L.*) is globally an important commercial crop grown almost all over the world (Rahman and Akanda, 2009). Potato is known to be infected by as many as 175 diseases besides several physiological disorders (Okonkwo and Ifenkwe, 1988). Traditionally potatoes are propagated by the use of vegetative seed tubers (Karim *et al.,* 2010). Several methods of vegetative propogation of potato are available. Some methods like tissue culture and sprout cuttings required skilled labour and special equipments (Janick *et al.,* 1994). According to Zaag (1986), sprouting simply means to produce new leaves, shoots or buds, it is the emergence of growth. It has been reported that the sprout may be considered as consisting of three zones, the base, correspondent to part

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of the plant which will be underground the bearing rudimentary, adventitious roots and stolons; the stem and growth point surrounded by young leaves initials (Burton, 1989). Best potato crop is obtained when the tuber is first pre-sprouted before planting (Okonkwo *et al.,* 1995). Healthy and sprouted tubers are selected to obtain the cuttings; sprouts are plucked and cut to pieces, each with at least a bud (Okonkwo *et al.,* 1995). It was recorded that in Bangladesh where sprout cuttings techniques were proved to be an effective method of seed potato production against potato virus Y (PVY) and potato leaf roll virus (PLRY) (Karim *et al.,* 2010). Sprout cuttings has also been proved to be effective on the growth yield and multiplication rate of potato (Hussain and Vecchio, 1999).

METHOD

Experimental site

This experiment was carried out at TCNN Staff quarters Bukuru, Jos South, Plateau State, Nigeria

Source of the materials

The seed potatoes used in the studies which are Roslin-ruaka (V1), Bertita (V2) and Nicola (V3) were gotten from national root crop research institute (NRCRI) Vom, Plateau State. These seeds were kept under storage in an on-going research storage facility to enhance sprouting. Other materials used for this research includes nitrogen Phosphorus and Potassium (NPK) 20:10:10 fertilizer, polythene bags, tapes and ruler, weighing balance, three treatments (health sprout, diseased sprouts, and healthy tubers), sterilized blades, plastic baskets, fungicides (Mancozed and red force) and its applicator.

Soil preparation

Sandy-loam soil was collected and mixed uniformly with cattle dung in ratio 3:1 (3 parts top soil and 1 part cattle dung). The prepared soil mixture was filled to a depth of 30cm into 81 polythene bags and afterward watered to allow it settle before planting the cultivars. The 81 polythene pots were arranged into 3 rows, each row containing 27 pots each, after which each variety i.e. varieties 1, 2 and 3 were all planted in each row using Randomized Complete Block Design (RCBD).

Sprouting of the seed potatoes

The seed tubers were brought from National Root Crops Research Institute (NRCRI) vom, plateau state and stored in an ongoing research storage facility at Rantiya, were the seed potatoes begin to produce sprouts. The sprouts developed up to 8-12cm long; within this period of time some of the seed potatoes which had produced sprouts became diseased too.

Cutting and preparation of the sprouts for sowing

About 2-3cm long sprout from healthy and diseased tubers was cut-off from three standard potato cultivars namely Roslin-Ruaka (V1), Bertita (V2) and Nicola (V3), these cultivars are all popular commercial cultivars. Each tuber having sprouts were cut with a sharp sterile blade carefully so that every piece should contain not less than one node on them. The sprout cuttings from healthy tubers (V1-3) were kept in a plastic basket, away from the sprout cuttings of the diseased tubers.

Sowing of the seeds

The sprouts and tubers were planted on the 28th June 2016, with one seed per bag having the spacing between bags and plants 8cm and 28cm respectively. The sprouts and tubers were carefully deepen in the prepared potted soil at comfortable depth and watered. The plants were fertilized as recommended i.e. two weeks after planting, 5 grams per plant. Weeding of the crop was carried out at 6 weeks after planting.

Fertilizer application

Fertilizer application on the field was done two weeks after planting (WAP). Nitrogen, Potassium and Phosphorus (NPK 20:10:10) was applied on the soil using ring application method to help enhance the growth and development of the crop. The application was done on the 7th August, 2016.

Fungicide application

Due to the late planting of the potatoes, they were prone to late blight infection; therefore the spraying of fungicides on the plants was done. Late blight is caused by the fungus like pathogen *Phytophthora infestans*. The pathogen produces two types of asexual spores that can be spread long distances by wind and water from plant to plant.

Selection and application of the fungicides

The products used in treatment against late blight are red force, this product contains its active ingredients as copper -1- oxide 60% + metalaxyl –m 6%WP. These products are a multipurpose protector, curative, contact, systemic, broad spectrum, residual fungicides; it helps in late blight suppression. Another label used is Raksha which has its active ingredients as Mancozed 80%WP this label can be used as broad spectrum, multipurpose, preventive and contact fungicides; it is specially used for the management of seed born late blight. To ensure thorough and complete

Table 1: Mean establishment count for sprout cuttings and seeds of potatoes at 2 and 4 weeks after planting.

Treatments	Time(weeks)	
	2	**4**
Healthy sprout	9.0	9.0
Healthy tubers	9.0	9.0
Diseased sprouts	8.7	8.7
TOTAL	**26.7**	**26.7**

Table 2: Mean number of above ground stem at the different Weeks after Planting

Treatments	Time (weeks)					
	4	**6**	**8**	**10**	**12**	**TOTAL**
Healthy sprouts	32.1	26.9	24.6	21.7	19.7	125
Healthy tubers	48.6	47.6	42.4	30.1	24.6	193.3
Diseased sprouts	26.23	25.4	25.7	18.8	19.5	115.63
Mean	**29.23**	**33.3**	**30.9**	**23.53**	**21.27**	
LSD	**NS**	**1.53**	**1.78**	**0.94**	**0.86**	

fungicide coverage, the fungicides were applied 2-3 times weekly to influence fungicides redistribution on the field. 6.7g of the systemic fungicides with active ingredients copper-1- oxide and metalaxyl were mixed in 2 liters of water and applied on the plant. About 7g of Mancozed (contact and preventive) fungicide were mixed in 2 liters of water and applied 2-3 times weekly to influence the distribution of the fungicides on the field.

Experimental design

This experiment was conducted using a Randomized Completely Block Design (RCBD).

Collection of Data

Data were collected on the establishment count, Number of above ground stems, Number of leaves, Plant height, Plant stands count at harvest, Stem Number at harvest, Total Number and weight of tubers formed, Number and weight of ware tubers and Number of seed tubers

Analysis of Data

Analysis of variance (ANOVA) was used for all the treatments in analyzing the various data collected.

RESULTS

Establishment count

The healthy tubers, healthy sprouts and sprout cuttings from diseased tubers at 2 weeks(14 days) and 4 weeks (28 days After Planting) were fully established (Table 1).

Mean number of above ground stems

The results of this investigation revealed that the healthy tubers resulted in higher mean above ground stem (193.3cm) than the healthy sprouts (125cm) while the diseased sprouts had the least mean number of above ground stem (115.6) at 5 % level of significance. The number of above ground stem of the healthy tubers and healthy sprouts were significantly higher than the number of above ground stem of the diseased sprouts ($P<0.05$). The highest number of above ground stem was recorded for potato seed at 4 weeks after planting, after which a reduction in number of above ground stem was observed as the plants, grows. The three varieties used Roslin Ruaka (V1), Bertita (V2) and Nicola (V3) did not show any significant difference ($P<0.05$) from each other with respect to the number of above ground stem (Table 2).

Table 3: Mean Plant Height (cm) at the different Weeks after Planting

Treatments	Time (weeks)					
	4	**6**	**8**	**10**	**12**	**TOTAL**
Healthy sprouts	175	105.8	134.3	140.4	130.6	686.1
Healthy tubers	234.6	120.2	139.3	143.3	121.4	758.8
Diseased sprouts	152	108.8	127	140.8	127.6	656.2
Mean	**187.2**	**111.6**	**133.5**	**143.8**	**126.51**	
LSD	**6.84**	**2.84**	**2.89**	**4.01**	**3.08**	

Table 4: Mean number of Leaves at the different weeks after planting

Treatments	Time (weeks)					
	4	**6**	**8**	**10**	**12**	**TOTAL**
Healthy sprouts	244.9	390	450.3	383.7	274.8	1743.7
Healthy tubers	460.5	604.4	512	356.5	243.5	2176.9
Diseased sprouts	239.6	368.2	417.4	359.6	251.3	1636.1
Mean	**315**	**371.2**	**420.4**	**366.6**	**256.53**	
LSD	**11.18**	**11.65**	**NS**	**19.14**	**NS**	

Mean plant height

The mean plant height were lower for diseased sprouts (656.2 cm) than the healthy sprouts (686.2 cm), the healthy tubers had the highest (758.8cm) mean plant height. There was significant difference at 5% level of significance for the mean plant heights at the different weeks after planting except week 6 which showed no significant difference at 5% level of significance. The three varieties Roslin Ruaka (V1), Bertita (V2), and Nicola (V3) showed a significant difference at 5% level of significance. The mean plant height was higher at 4 weeks after planting, followed by week 10, 8 and 12 while week 6 had the Least (Table 3).

Mean number of leaves per plant

The mean numbers of leaves per plant were higher for healthy tubers (2176.9) than the healthy sprouts (1743.7) while the diseased sprouts had the least (1636.1) mean number of leaves per plant (Table 4). The mean number of leaves produced by the diseased sprouts showed no significant difference when compared to the number of leaves produced by the healthy sprouts ($P<0.05$). The healthy tubers had significantly higher number of leaves than the healthy sprouts while number of leaves for the diseased sprouts had no significant difference at the 0.05 level of probability. There was increase in the number of leaves in weeks 8 and 12 but this increase was not significant ($P<0.05$) Table 4. However there was significant difference in the number of leaves in weeks 4, 6, and 10 at 5% level of probability. The mean number of leaves per plant varied significantly between the varieties used Roslin Ruaka (V1), Bertita (V2) and Nicola (V3) at 5% level of significance (Table 4).

Mean Plant stands count at harvest

Table 5 shows the mean plant stand count at harvest with the healthy tubers having highest plant stand count (30.4) than the healthy sprouts (22) while the diseased sprouts showed least number of stand count at harvest (19.9). The result also shows that there was significant difference between the treatments (i.e. healthy sprouts, healthy tubers and diseased sprouts) at 0.05 level of probability (Table 5). The mean plant stand count varied significantly between the varieties ($P<0.05$) with Nicola having the least mean plant stand count (19.9) and Bertita (23.8) while Roslin-Ruaka had the highest mean plant stand count at harvest (28.6) Table 5.

Table 5: Mean plant stand count at harvest at the different weeks after planting

Variety	Healthy sprouts	Healthy tuber	Diseased sprouts	Total	Mean
Roslin-Ruaka(V1)	9	14	5.6	28.6	
Bertita (V2)	6.7	8.4	8.7	23.8	
Nicola(V3)	6.3	8	5.6	19.9	
Total	**22**	**30.4**	**19.9**	**72.3**	
LSD		**1.21**			

Table 6: Number of yield at harvest

Treatments	Total tubers	Ware tubers	Seed tubers
Healthy sprout	199	48	221
Healthy tubers	271	36	119
Diseased sprouts	150	40	164
Mean	**206.67**	**41.33**	**168**
LSD	**7.26**	**NS**	**8.65**

Table 7: Weight of Potato Tubers

Treatments	Weight(kg)		
	Total tubers	Ware tubers	Seed tubers
Healthy sprouts	8.5	7.7	6.8
Healthy tubers	11	5.5	5.9
Diseased sprouts	7.9	6.9	5.3
Mean	**9.13**	**6.7**	**6.0**
LSD	**0.41**	**0.39**	**0.19**

Tuber Yield and Sizes

The result of this investigation revealed that the treatments differed significantly for the yield parameters studied (Table 6). The healthy tubers produced more numbers of tubers (271) than the healthy sprouts (199) while the diseased sprouts cuttings had the least number of tubers formed (150), there was significant difference ($P<0.05$) between the number of tubers produced by the healthy sprouts, healthy tubers and diseased sprouts(Table 6). The wares or sellable tubers of the healthy sprouts showed highest mean number of wares (48) this was followed by the diseased sprouts (40) while the healthy tubers had the least mean number of wares; this was significant at 5% level of probability. The healthy sprouts produced highest mean seed tubers (221) than that of the diseased sprouts (164) while the healthy tubers had least number of seeds (119); which was significant at 5% level of probability (Table 6).

Weight of Potato Tubers after harvest

The tuber weight was highest for healthy tubers (11kg), followed by healthy sprouts (8.5kg) while the diseased sprouts weighed less (7.9kg), the tuber weight was also significantly different ($P<0.05$) Table 7. The weight of ware tubers were generally highest in healthy sprouts (7.7k) than the tuber weight of diseased sprouts(6.8kg), while the healthy tubers had the lowest weight of tubers(5.5kg), this was significant at 0.05 level of significance (Table 7). The

weight of wares was significant at 5% level of probability, with the healthy tubers weighing least (5.5kg) then the diseased sprouts (6.9kg) while the healthy sprouts weighed the highest (7.7kg) Table 7. The weight of the seeds tubers produced were highest in the healthy sprouts (6.8kg), which was followed by the healthy tubers (5.9kg) while the diseased sprouts had the least weight in number of seeds(5.3kg); the mean number of seeds tubers varied at 0.05 level of significance (Table 7).

DISCUSSION

Successful attempt have been made in the use of sprout cutting techniques as a way of eliminating potato viruses; these include studies by Rahman and Akanda, (2009) who studied on virus free seed potato through sprout cutting technique under net house. In this study, it was also observed that there were significant differences at certain growth parameters of the different varieties Roslin- ruaka (V1), Bertita (V2) and Nicola (V3); this observed difference may be due to the seed types used in cultivation of potatoes. The result also showed that sprout cuttings from both healthy and diseased potato tubers may yield significant ware tubers and seeds which are in line with what was reported by Ifenkwe and Okonkwo, (1983) that cut seed tubers may also yield as whole tubers if properly maintained in the field. At 4, 6 and 8 weeks after planting, the number of above ground stems, number of leaves and plant height were significantly different at the different treatments used (healthy tubers, healthy sprouts and diseased sprouts). There was no significant difference between the varieties used at 4, 6 and 8 weeks after planting at 0.05% level of significance. However there was a significant difference in the interaction between the treatments and the varieties used at 10 weeks after planting. It also was reported by Hossain and Vecchio, (1999) that sprout cuttings shows early rooting and new shooting, develops maximum number of longest leaves per plant, number of branches and plant height and forage coverage. This was evident in the sprouts cutting of both healthy sprouts and diseased sprouts which yielded high number of leaves, high plant height and more number of above ground stems. It was also observed that the performance by disease sprout cutting obtained higher number of wares tubers, seed tubers which is in line with what was reported by Rahman and Akanda, (2009) that the performance of seed tubers produced from sprout cutting was better in respect to plant growth, tuber number and tuber yield as compared to seed tubers from stem cutting or conventional method. The yield of the sprout cuttings showed that ware tubers and seed tubers can be obtained from sprouts cuttings for the next season planting, this is in line with the studies done by Siddique, *et al*, (1987) and Kushwah and Grewal, (1990), who studied using single eyed seed pieces that developed into single stem plants like the sprout cutting plants, and obtained an almost similar number of the weight of tubers per plant and number and weight of tubers.

CONCLUSSION

This study showed that the diseased tuber sprouts cutting exhibited similar growth and yield characteristics as the healthy sprouts which in turn have similar growth characteristics and yields as the healthy tubers. Also, the performance of the sprout cuttings was better in respect to plant growth, ware tubers and seed numbers. It also showed that diseased sprouts can produce viable wares, and seeds that may be useful to local farmers of potato in Plateau state having problems with tubers being diseased before the next planting season. It also showed that Roslin-ruaka out yielded the other varieties significantly in growth characteristics, these was followed by Bertita while Nicola had the least growth and yield characteristics.

Therefore the use of sprout cutting techniques as a tool for disease control should be adopted by commercial and subsistent farmers to aid in the loss of yield due to bacterial and fungal diseases (Potato Late Blight) caused by *Phytopthora spp* especially in Plateau State in recent times that the production of the crop is facing a serious threat to food security.

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