Evaluation of clones originating from true potato seeds (TPS) at Maseru in Lesotho

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Abstract

Nine clones originating from TPS, a local check variety and a commercial check variety were compared in a randomised complete block design with three replications at Maseru during the 2003-growing season. The objective of the study was to compare the performance of clones originating from TPS with one local and one commercial check variety with respect to total tuber yield, number of stems per plot, number of tubers per plot and relative tuber size and identify the best clone for possible use by farmers.

Results revealed a highly significant difference in total yield, number of stems per plot, number of tubers per plot and its separation into small and large tubers per plot. Clones A133, A136 and the local check variety, Basotho 1, were the preferable clones. Basotho 1 was one of the better adaptable and stable but not preferred for commercial production because of its shape and many deep eyes. On the other hand the commercial check variety, BP 1, was one of the low yielding candidates. On the basis of data collected and analysed, A133 and A136 were as good as Basotho 1 in tuber yield with more desirable tuber shape and size for commercial use. The same clones were significantly higher in tuber yield than the commercial check variety, BP 1. These results further suggest that better clones could be developed by starting from TPS and selecting specific clones with desirable traits.

Keywords:

1. Introduction

To increase potato yield and reduce unit cost in developing countries, some technological improvements in cultivars and seed systems are needed. In view of the time involved and high costs for cultivar development and subsequent efforts required to maintain varietal purity, a new approach that uses true potato seed is emerging (Horton and Sawyer, 1985; Malagamba and Monares, 1988; Portillo, 1997). There is a clear need to study and evaluate the new approach in Lesotho. Being mainly a vegetatively propagated crop, potato accumulates diseases over generations. The accumulation of diseases reduces yield and clones have to be cleaned using tissue culture techniques in the laboratory (Mohammed et al., 2001).

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Potato is a cool season crop and because of this Lesotho with its cool highlands can produce good quality potatoes, which could be used as seed tubers. Above all Lesotho could extend its virus free seed tuber production to supply other countries in the Southern African Development Community (SADC) region. The easiest method of producing virus free potato is to start production from true seed or to start pre-basic seed cleaned by means of tissue culture. Potato production from true seed can thus be used locally as well as for export (Mohammed et al., 2001).

Efforts made by research to increase agricultural productivity are greatly hindered by a lack of understanding of specific needs of farmers, their local problems and conditions under which they operate (Almy et al., 1990). Lesotho is no exception in this regard, but it is encouraging that at present some efforts are being made to take farmers needs into account in a cooperative potato research (Mohammed et al., 2002).

2. Materials and methods

2.1 Source of planting materials for the study

The true seeds from F_2 of 982002 cross, which were obtained from Mokhotlong, were sown in trays during 1999 in greenhouse, and were later transplanted to the field. After four months all genotypes were harvested and evaluated. The seed tubers from selected clones were used as propagating materials along with one local and four commercial varieties at one location on observation plots. Agronomic data collected were subjected to statistical analysis where means of clones were compared. An evaluation of the results led to selection of ten high yielding clones (Letuma, 2001).

In the current study nine of the ten selected clones were compared with one local check and one commercial check variety for yield, number of stems per plot, number of tubers per plot and its separation into small and large tubers per plot.

2.2 Study site

The trial was conducted in Maseru using a complete randomized block design with three replications. Compound fertilizer 2:3:2 (25) +Zn was applied at planting, at the rate of 500kg/ha. Planting was done on the 16th of September 2002, on ridges of 4m length x 1m apart, with 0.25m spacing between plants in rows, making a plot size of 4m^2. The size of each block was 11m x 4m; a borderline was planted at the end of each bloc*k*.

2.3 Data collection and Analysis

The number of stems at soil level ("above ground stems") per clone/variety, this was recorded on the 3rd January 2003. Harvesting was on the 25th February 2003. Counting and weighing of tubers followed immediately after harvest. Harvested tubers were graded in the sizes of 30-50g, small, and > 50g, large, (Wiersema and Cabello, 2000).

Statistical computations were performed using MSTAT statistical package. Treatment comparisons were made using analysis of variance (ANOVA). Where effects were significant in ANOVA (P= 0.05 and 0.01), means were separated using the least significant difference (LSD) method of mean separation.

3. Results and Discussion

The clones produced significantly different number of stems (Table 1). Four clones originating from TPS (namely B5, B23, A133, A136) and the local check variety (Basotho 1) resulted in significantly ($p < 0.05$) higher number of stems than other tested clones. One of the clones, C7, produced 22 stems per plot as compared to the mean of 32 stems per plot (Table 1). Iritani and Jeoung (1983) and Fredericton (2003), stated that the number of tubers produced in the field is largely affected by number of stems per unit area. Selection for high stem number could be a possible tool for selection for improved tuber yield in this group of 96 tubers per plot.

Tested clones showed a highly significant difference in total tuber numbers produced. Basotho 1 and A133 produced significantly ($P < 0.01$) more number of tubers per plot than other tested clones. All other clones were not different from each other. A positive correlation though not high was noted on stem number and total tuber numbers produced per plot (Tables 1 and 3). Contrasting to this observation is the fact that A133 which had 43.00 stems/plot and produced 162.33 tubers/plot. On the other extreme is B23 which had 41.00 stems/plot and yet it produced significantly less tubers than the four clones (Basotho1, B5, A133 and A136). This observation is in agreement with the findings of Upadhya et al. (1996), who reported that cultivars differ in the number of tubers they produce per stem. It can, therefore, be said that B23 produced relatively fewer number of tubers per stem than the other clones, and the difference was statistically significant. It was also, noted that the same clones that produced a higher total tuber number also produced a significantly ($P < 0.01$) higher total tuber weight (Tables 1 and 2). This is in agreement with Harrington (2001) and suggests that by selecting for higher number of stems, one can also improve number of tubers and consequently improve tuber yield.

Clones/varieties showed a highly significant difference in small tuber numbers/plot. Basotho1 and A133 produced significantly more small tubers/plot than the other clones. Similar to this observation is the findings by Sadik and Engels (1985); Bishop and Wright (1989); Burton (1989); Gemmel (1994) and Fredericton (2003), who reported that the higher the total tuber numbers the smaller the average tuber size.

The clones produced significantly different number of large tubers. Again, Basotho1 out performed the rest of the clones with 63.33 tubers/plot as compared to the trial mean of 37.8 tubers per plot (Table 1). Most of the clones including the commercial check variety

(BP1) were not different from each other and produced large tuber numbers similar to the general mean of 37.8 tubers/plot. It is worth noting that Basotho1 had the highest total tuber number, small and large tuber number. This observation is not in agreement with the findings of Burton (1989); Bishop and Wright (1989); Gemmel (1994); and Fredericton (2003) who observed that the greater the total tuber numbers the lower the average tuber size i.e. relatively more smaller tubers. The commercial check variety, BP1, which is believed to produce larger tubers (Lepheane, 1997), was not significantly higher than any of the tested clones, suggesting that all of the tested clones were equally good as the commercial check variety.

Total tuber yield and its separation into small and large are summarized in Table 2. The mean tuber yields were 14.3, 5.7 and 8.5 t/ha for total, small and large tubers, respectively. Tested clones produced significantly different total tuber weight. Basotho1, with 21.18t/ha, A136 with 19.38t/ha, A133 with 17.58t/ha and B5 with 16.83t/ha yielded significantly ($P < 0.05$) higher than BP1, the commercial check variety, with the lowest yield of 9.33t/ha (Table 2). The two clones that produced significantly high yield were the same ones, which had significantly high tuber numbers. The results of this study concur with the findings of Harrington (2001), who reported that increased number of tubers/plot resulted in a lower mean average tuber weight, with such reductions usually compensated for by increased tuber numbers. Again Onwueme (1978) reported a general relationship between tuber weight and tuber number in which mean tuber weight increased as tuber numbers decreased. The behaviour of some clones in the present study concur with Onwueme`s (1978) results. For instance, the clones A136 with 88.00 tuber/plot and B5 with 97.33 tubers/plot, produced relatively fewer tuber numbers and these clones resulted in production of significantly high total tuber weight (yield), 19.38t/ha and 16.83t/ha, respectively (Table 2).

Clones showed a highly significant ($P < 0.01$) difference in weight of small tubers. A133 (10.50t/ha), Basotho1 (9.83t/ha) and A136 (7.83t/ha) produced significantly higher weights of small tubers than most of the clones including the commercial check variety, implying that most of the tested clones were equally good as the commercial check variety. These two clones (Basotho1 and A133) were found to produce the higher number of small tubers. This confirms earlier results by Harrington (2001), who reported that the more the tuber number per plot the lower the mean average tuber weight and increased tuber numbers usually compensates for such reductions. In contrast to this observation is the fact that A136 produced a lower number of tubers although total tuber weight was significantly high. The behaviour of this clone (A136) supports earlier research by Onweume (1978), who stated that mean tuber weight increased as tuber number decreased (Table 1 and 2).

Most of the tested clones showed a highly significant difference in yield of large tubers. Note worthy were B5 with 11.83t/ha, A136 with 11.50t/ha, Basotho1 with 11.35t/ha, A54 with 9.33t/ha, C6 with 9.08t/ha and B23 with 8.83t/ha. These clones produced

significantly higher commercial tuber yield than the commercial check variety plus four other clones. This observation is in contradiction with the findings of Menzel (1981); Manrique et al. (1989); Burton (1989); Schaupmeyer (1997); and Ghassan et al. (2001) who stated that yield (weight) of large tubers depends on the number of tubers produced.

It was found that all the clones, which showed significantly high yield of large tubers, were not significantly high in production of large tuber numbers except for Basotho1. The tendency of these five clones (B5, A136, A54, C6, and B23) for producing the least tuber number, which resulted into higher tuber weight, confirms earlier research by Onwueme (1978). The high yields for Basotho1 in this study are due to compensation, which came as a result of high stem number that encouraged production of higher tuber numbers per plot. This is a desirable trait that should be taken into account in future improvement work.

Correlations between different tuber yield components studied are summarized in Table 3. The number of stems and number of tubers produced were positively and significantly correlated at Maseru with r = 0.427. This suggests that an increase in the number of stems will increase the number of tubers. Similar to this observation was the findings of Horton and Sawyer, 1985; Sadik and Engels, 1985; Bishop and Wright, 1989; Bleasdale, 1995; Fredericton, 2003, who reported that total yield (tuber number) increases up to a certain point, with further increase of stem density yield remains more or less the same. However, the average tuber size decreases. Again total tuber number and small tuber number were positively and significantly correlated with r = 0.772. This observation is in line with the findings of Sadik and Engels, 1985; Bishop and Wright, 1989; Gemmel, 1994; Burton, 1989; Frederiction, 2003. There was also a positive and significant correlation between tuber number and tuber weight with r = 0.752. This implies that an increase in total tuber number will improve tuber yields, but then this is not always the case as tuber weight is dependent on the cultivar; on growing conditions; on soil fertility; and spacing of the plants (Burton, 1989; Manrique *et a*l., 1989; Schaupmeyer, 1997; Ghassan *et al*., 2001). There was also a positive and significant correlation between stem number and small tuber number with r = 0.462. This observation suggests that stem number could be used to manipulate tuber size in order to suite farmers needs (Bohl *et al*., 1990).

4. Conclusion and recommendations

On the basis of data collected and analyzed, A133 and A136 were as good as Basotho1 and better than the commercial check variety. These results further show that clones originating from TPS offer wide choices in that one can select for any of the traits considered and come up with a better clone.

Table 1: Agronomic data for potato clones included in a yield trial at Maseru during 2002/2003

Treatments	Total number of stems/plot	Total tuber number/plot	Small tuber number/plot	Large tuber number/plot
BP1(Commercial	26.00	77.67	41.00	34.67
check)	39.67	177.33	114.00	63.33
Basotho1(local check)	26.33	73.33	32.00	41.33
A54	25.00	75.00	43.00	28.00
C6	22.00	74.33	42.33	31.67
A7	26.33	65.67	27.00	30.33
A31	32.67	97.33	52.67	44.33
B5	41.00	80.33	41.00	36.67
B23	27.00	87.67	49.67	35.37
Clone #89	43.00	162.33	128.00	34.33
A133	39.33	88.00	51.67	36.00
A136				
Grand mean	*31.72*	*96.27*	*56.58*	*37.82*
LSD 5%	*5.84*	*58.31*	*28.90*	*17.61*
LSD 1%	*NS*	*79.39*	*39.35*	*NS*
CV	*26.05%*	*24.97%*	*31.60%*	*28.80%*

Table 2: Total yield and its separation into small and large tubers for potato clones tested at Maseru during the 2002/2003 growing season.

Treatment	Total tuber weight (t/ha)	Weight of Small tubers (t/ha)	Weight of large tubers (t/ha)
BP1 (commercial check)	9.33	3.33	6.00
Basotho1 (local check)	21.18	9.83	11.35
A54	12.83	3.50	9.33
C6	13.83	5.43	9.08
A7	11.08	3.43	7.65
A31	11.58	4.25	7.33
B5	16.83	5.25	11.83
B23	13.33	4.50	8.83
Clone #89	10.50	5.25	5.50
A133	17.58	10.50	7.08
A136	19.38	7.83	11.50
Grand mean	14.30t/ha	5.70t/ha	8.55t/ha
LSD 5%	6.78	3.35	3.20

LSD 1%	NS	NS	NS
CV	29.24%	36.29%	28.57%

Table 3. Correlation between different tuber yield components at Maseru during 2002/2003.

Traits	StemNr	STBRNr	STBRWt	LTBRNr	LTBRWt	TTBRNr	TTBRWt
TTBRWt	r =0.395 (.023)	r =0.685 (.000)	r = 0.685 (.000)	r =.628 (.000)	r =0.702 (.000)	r =0.752 (.000)	
TTBRNr	r =0.427 (.013)	r =0.772 (.000)	R =0.772 (.000)	r =0.752 (.000)	r =0.351 (.045)		
LTBRWt	r =0.279 (.116)	r =0.296 (.094)	R =0.254 (.053)	r =0.352 (.045)			
LTBRNr	r =0.116 (.521)	r =0.716 (.000)	R =0.601 (.000)				
STBRWt	r =0.388 (.025)	r =0.716 (.000)					
STBRNr	r =0.462 (.007)						
StemNr							

KEY:

r = *Correlation coefficient*
( ) = *Probability*
TTBRWt = *Total Tuber Weight*
TTBRNr = *Total Tuber Number*
LTBRWt = *Large Tuber Weight*
LTBRNr = *Large Tuber Number*
STBRWt = *Small Tuber Weight*
STBRNr = *Small Tuber Number*
StemNr = *Stem Number*

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