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Comparative performance of true Potato seed (tps) propagated through nursery transplants, tubers and minitubers

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Research Paper

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ABSTRACT

One of the major constraints to potato production amongst resource poor farmers in Kenya is lack of quality and affordable potato seed. Potato seed programmes have been effective in producing only small quantity of quality seed below the demand and repeated use of seed tubers have led to accumulation of pathogens and physiological degeneration resulting to low yields and high cost of production. Providing farmers with access to true potato seed technology provide the farmers with an opportunity to produce quality ware and seed potato at low cost. This experiment was carried out at Njabini Agricultural Training Centre (Njabini ATC) during the period from June 2012 to March 2013 to compare method of propagation of true potato seed. True potato seeds (TPS) of the crosses LT-8 x TS-15, MF-I x C95LB-13.2 and MF-I x TPS-67 were propagated through transplants, tubers, and minitubers and compared to Tigoni, a commercial genotype. Plants propagated by seed tubers had the highest plant height, fresh foliage weight per plant, tuber weight per plant and yields compared with minitubers and transplanted plants in all genotypes. However, transplanted plants gave the most number of tubers per plant in all genotypes but shifted towards production of medium and small grades. Cross MF-1 x TPS-67 gave plants with significantly high plant height, fresh foliage weight, tuber weight, number of tubers and also gave highest yields per hectare in all propagation methods than crosses LT-8 x TS-15 and MF-1 x C95LB-13.2. but not different from those of Tigoni. Seedling tubers derived from TPS from selected genotypes can yield as well as seed tubers of commercially varieties. The use of TPS can be used as initial planting materials for production of either seed or ware potato. From this study, minitubers can be recommended for seed production, transplants for both ware and seed production and seed tuber can be appropriate for commercial ware production.

Key word: True potato seed, Nursery transplants, tubers and Minitubers. income status.

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INTRODUCTION

Potato (*Solanum tuberosum L.*) is an important and second major staple food crop in Kenya (Guyton et al., 1994), whose important contribution towards Kenya's food security, nutrition and overall national economy cannot be underestimated. Kenya is the fifth biggest potato producer in Sub-Saharan Africa, with an output of 790,000 tonnes in 2006 (FAO 2008a and b). Potato is mainly propagated through seed tubers (Malagamba *et al.*, 1983; Struik et al., 1999). However, tubers are usually bulky and expensive accounting for more than half the total production cost (Mahmood, 2005; Woods and Martin, 1987). About 2 tonnes of seed tubers which also represent food is required to plant in one hectare which can be replaced by 100gms TPS (Mahmood, 2005). Moreover, tubers are often the main carrier of diseases and pests (Simmonds, 1997; Zitter and Gallenberg, 1984) that lower yields and tuber quality considerably. In terms of biological quality, poor quality seed potato is believed to be one of the major factors contributing to low potato yield in sub-Sahara Africa (Fuglie, 2007). Loss of potato yields over seasons of seed recycling can be attributed to seed degeneration due to accumulation of seed-borne

diseases (Gildemacher et al., 2007). This has been accelerated by the informal seed distribution system prevailing in most developing countries accounting for more than 90% of the seed tuber used by smallholder farmers (Hidalgo et al., 2009; Lung'aho et al., 2010). These include farm-saved seeds (self-supply), seeds from local markets and from neighbours (Malagamba 1988; Malagamb and Monares,1988; Muthoni et al., 2013).Disease causing organisms that infect potato tubers include several viruses (Zitter and Gallenberg 1984; Burrows and Zitter**,** 2005), fungi including late blight (Martin et al., 1994; Hide, 2008) and bacterial wilt (Ajanga, 1993; Hayward, 1990; Boucher *et al*., 1992; Wang and Jaunet**,** 1999). However, virus diseases and potato bacterial wilt are considered as the most important seed borne potato diseases in Eastern Africa (Gildemacher et al., 2009). Thus, sustainable potato production depends on a constantly renewed supply of disease-free planting materials. True potato seed minimizes problems associated with these tuber transmitted diseases since TPS carries few pathogens especially viruses from season to season (Malagamba et al., 1983; Burrows and Zitter, 2005).

In order to make potato production more attractive, it requires adoption of method(s) which can reduce the cost of production. TPS appears today as a viable and promising alternative potato method of propagation to use of traditional seed tubers for improved potato production in the tropics (Cioloca et al., 2012; Golmirzaie and Ortiz, 2004; Kidane -Mariam et al., 1985; Malagamba, 1988). The obstacles that have prevented the adoption and widespread use of TPS such as late maturity of TPS crop, unreliable germination and non-uniformity of the produce have been removed. Other advances in TPS technology are the use of male sterility to increase hybrid TPS production and incorporation of disease resistance (Muthoni et al., 2013).The crop can be grown from true potato seed (TPS) either by transplanting seedlings or by direct seeding (Almekinders et al., 2009; Muthoni et al., 2010; Shonnard et al., 1991). However, there is a strong opinion to use minitubers 'tuberlets' borne on crowded nursery plants rather than to grow true seedlings (Kidame-Mariam et al., 1985, Muthoni et al., 2013; Simmonds, 1997). In view of the above facts, experiments were conducted to compare the methods of propagation of three crosses of TPS for both growth and yield parameters.

MATERIALS AND METHODS

Seed Source, raising of transplants, minitubers and seed tubers

True potato seeds (TPS) of the crosses LT-8 x TS-15, MF-I x C95LB-13.2 and MF-I x TPS-67 with International Potato Center (CIP) codes 998010, 999002 and 988139 respectively were obtained from CIP, Lima, Peru through CIP Kenya. Seed tubers and minitubers were generated during the period from February to May 2012 at the College of Agriculture and Veterinary Services, University of Nairobi glass house. Propagation media comprised of steam sterilized mixture of forest soil, well decomposed manure, rivers and ballast at a ratio of 4:2:1:1 respectively. Minitubers were generated by sowing two TPS of each cross in 80% full plastic pots of 6cm diameter and 5cm deep. Thinning was done after germination allowing one plant per pot to grow to maturity. More planting medium was added to fullness after 25 day after planting. Dehaulming was done 100 days after sowing followed by harvesting after 10 days. Minitubers of 8 to 12 grams were selected and sprouted. Seed tubers were generated by sowing two TPS in propagation media in plastic trays of pot sizes of 4cm diameter and 4cm deep at a depth of 0.5cm. After germination thinning was done to allow only one seedling per pot. The seedlings were transplanted at 25 days age (4-5 true leave stage) in field plots at a spacing of 75cm between the rows and 30cm within the rows. Dehaulming was done 90 days after transplanting followed by harvesting after two weeks. Potato tubers of sizes (35mm-45mm) were selected and sprouted.

The seedlings were raised by sowing TPS in plastic planting trays of pot sizes 4cm diameter and 4cm deep. The pots were 80% filled with propagation media and two TPS per pot were sown at a depth of 0.5cm. After germination, thinning was done leaving one healthier plant per pot. Seedlings were ready for transplanting at 25 days age or 4-5 true leaves stage. The crop was inspected by Kenya Plant health Inspectorate Service (KEPHIS) and certified free from any viral infection.

Establishment of field trials

The experiment was carried out at Agricultural Training Centre (ATC) Njabini during the period from June 2012 to March 2013. Njabini ATC is located 90km to the north west of Nairobi at an altitude of 2100 metres above sea level. The area receives an average of 1050mm rainfall with temperatures ranging from -4 to 23 degrees celcius. Planting of sprouted tubers and transplants was done on well prepared 3M x 3M field plots at a spacing of 75cm between the rows and 30cm within the rows. Basal application of 450gms of Diammonium phosphate per plot was done during planting. The experiment was laid out as a randomised complete block design (RCBD) with three replications.

Data collection and analysis

Five plants from inner rows of each plot were selected at random and tagged. The plant height of the tagged plants

Table1. Effects of different methods of propagation on growth and yield characteristics of potato genotypes using TPS (Season 1)

Treatments		Plant height at 75 DAS/T (cm)	Fresh weight of foliage/plant at dehaulming (gm)	No. of potato tubers/plant at harvest	Weight of potato tubers/plant at harvest (Kg)	Yield of potato tubers at harvest (T/Ha)
LT-8 x TS-15	Transplanting	66.6	411.7	21.53	1.44	53.51
	Minitubers	58.2	389.2	12.40	1.20	44.57
	Seed tubers	74.5	446.7	14.07	1.55	56.64
MF-1 x C95LB-13.2	Transplanting	65.7	441.7	24.60	1.55	56.50
	Minitubers	60.2	416.7	13.20	1.11	44.12
	Seed tubers	69.7	483.1	14.73	1.80	64.41
MF-1 x TPS-67	Transplanting	67.5	450.0	26.67	1.79	65.52
	Minitubers	60.9	438.3	15.27	1.33	49.40
	Seed tubers	77.1	496.9	17.67	1.84	68.13
TIGONI	Seed tubers	79.2	503.3	17.33	1.91	68.33
$LSD_{0.05(treatment)}$		2.3	11.9	1.35	0.13	3.12
$LSD_{0.05(genotype)}$		2.7	13.7	1.56	0.15	3.67
CV%		5.7	6.7	10.8	12.1	7.9

DAS/T means days after sowing/transplanting

was taken after 75 days after transplanting (DAT) for seedlings transplants and 75 days after sowing (DAS) for tubers and minitubers and recorded. Dehaulming was done after 90 DAS/T and the fresh weight of the tagged plant taken. The crop was harvested two weeks after dehaulming and tubers graded into three grades based on tuber diameter; ware (>55mm), seed (25mm≤55mm) and chatts (<25mm). Their weight was and recorded. The weight of the tubers of the whole plot was also taken.

Data analysis

The data was subjected to Analysis of variance (ANOVA) using the PROC ANOVA procedure of Genstat (Lawes Agricultural Trust Rothamsted Experimental Station 2006, Version 9). Where the treatment was significant, difference among the treatment means were compared using the Fisher's protected LSD test at 5% probability level.

RESULTS

Plant height

The effects of methods of propagation on growth and yields characteristics of potato genotypes using TPS differed significantly ($p<0.05$) in both seasons (Table1 and 2). Plant height at 75 DAS/T exhibited significant difference among treatments and genotypes in both seasons. Plants propagated by seed tubers were tallest in all genotypes in both seasons while those planted through minitubers exhibited lowest height. However, no significant difference was observed among genotypes for transplanted plants height in season 1 but cross MF-1 x TPS-67 was significantly taller (69.13cm) in season 2. Cross MF-1 x TPS-67 also exhibited significantly and highest plant height in both seasons for both minituber propagated (60.9cm and 60.9cm) and seed tuber propagated (77.1cm and 77.0cm) compared to other crosses. The plant heights for seed tuber propagated plants for crosss LT-8 x TS-15 and MF-1 x C95LB-13.2 were significantly lower in both season compared to Tigoni genotype but plant height for cross MF-1 x TPS-67 (77.2cm and 77.0) and Tigoni (79.2 and 79.6cm) did not differ in both seasons.

Fresh foliage weight per plant

Fresh weight of foliage/plant at dehaulming differed significantly ($p<0.050$) among treatments and seasons (Tables 1 and 2). Plants propagated by seed tubers recorded genotypes in both the highest foliage weight per plant in all genotypes in both seasons while those planted through minitubers gave plants with comparatively lowest

Table 2. Effects of different methods of propagation on growth and yield characteristics of potato genotypes using TPS (Season 2).

Treatments		Plant height at 75 DAS/T (cm)	Fresh weight of foliage/plant at dehaulming (gm)	No. of potato tubers/plant at harvest	Weight of potato tubers/plant at harvest (Kg)	Yield of potato tubers at harvest (T/Ha)
LT-8 x TS-15	Transplanting	64.07	381.7	19.27	1.25	48.05
	Minitubers	55.53	365.0	11.80	1.04	39.40
	Seed tubers	67.33	428.3	13.87	1.65	58.52
MF-1 x C95LB-13.2	Transplanting	63.27	391.7	21.03	1.43	51.00
	Minitubers	58.43	381.7	12.80	1.13	43.28
	Seed tubers	67.13	441.7	14.70	1.64	58.74
MF-1 x TPS-67	Transplanting	69.13	415.0	23.93	1.64	61.49
	Minitubers	60.00	403.3	14.07	1.36	50.18
	Seed tubers	77.00	465.0	17.60	1.85	66.19
TIGONI	Seed tubers	79.60	468.3	17.93	1.87	67.00
$LSD_{0.05(treatment)}$		3.13	12.66	1.39	0.08	2.50
$LSD_{0.05(genotype)}$		3.61	14.61	1.60	0.10	2.88
CV%		6.7	4.3	11.8	7.9	6.5

DAS/T - days after sowing/transplanting.

foliage weight in all genotypes except for cross MF-1 x C95LB-13.2 whose foliage weight was same as that of transplanted plants in season 2. Plants from cross MF-1 x TPS-67 had the highest foliage weight per plant in all treatments in both seasons except for seed tuber planted Tigoni genotype whose foliage weight per plant gave no significant difference. Cross LT-8 x TS-15 recorded the lowest foliage weight per plant in all treatments in both seasons.

Number of tubers per plant

Number of potato tubers per plant at harvest exhibited significant difference ($p<0.05$) among treatments and genotypes in both seasons (Tables1 and 2). Transplanted plants produced significantly the most total number of tubers per plant in all genotypes in both seasons compared with other treatments while those counted from plants resulting from minitubers were the lowest. Cross MF-1 x TPS-67 produced significantly the most number of tubers per plant in all treatments in both seasons with the highest registered in transplanted plants (26.67 and 23.93). However, the total number of tuber for crosses LT-8 x TS-15 and MF-1 x C95LB-13.2 in minituber and seed tuber propagated plants did not differ significantly.

The number of tubers of potato grades per plant differed significantly ($p<0.05$) among the propagation methods and genotypes in both seasons (Tables 3 and 4). Seed tuber propagated plants produced the highest number of ware tubers in all genotypes in both seasons except cross LT-8 x TS-15 whose number of ware tubers did not differ significantly with transplanted plants. Plants resulting from minitubers gave the least number of ware tubers in all genotypes in both seasons. The number of seed tubers per plant from transplanted plants was significantly highest in all genotypes in both seasons while plants from Tigoni genotype and cross MF-1 x TPS-67 recorded the lowest with no significant difference in both seasons.

Weight of tubers per plant

The total weight of potato tubers per plant at harvest varied significantly among treatments and genotypes in both seasons (Tables 1 and 2). Plants resulting from seed tuber and minituber propagated crop significantly gave the highest and the lowest total tuber weight per plant respectively in all genotypes in both seasons. Cross MF-1 x TPS-67 gave plants which produced the highest plant tuber weight in both transplanted and minituber propagated plants in both seasons. However, there was no significant difference in the weight of tubers per plant in plants resulting from seed tuber for crosses MF-1 x C95LB-13.2 (1.80 kg), MF-1 x TPS-67 (1.84 kg) and Tigoni

Table 3. Effects of different methods of propagation on the number of tubers of potato grades per plant of potato genotypes using TPS (Season 1).

Treatments	GENOTYPES/CROSSES															
	LT-8 x TS-15				MF-1 x C95LB-13.2				MF-1 x TPS-67				TIGONI			
	Ware	Seed	Chatts	Total	Ware	Seed	Chatts	Total	Ware	Seed	Chatts	Total	Ware	Seed	Chatts	Total
Transplanting	6.60	12.00	2.93	21.53	6.13	14.07	4.40	24.60	6.73	14.47	5.47	26.67	-	-	-	-
Minitubers	3.33	7.13	1.93	12.40	3.53	7.40	2.27	13.20	3.27	9.23	2.77	15.27	-	-	-	-
Seed tubers	7.40	5.40	1.27	14.07	8.13	5.47	1.13	14.73	9.33	6.20	2.13	17.67	10.00	6.27	1.06	17.33
$LSD_{0.05(treatment)}$	0.76	1.63	0.83	1.35	0.76	1.63	0.83	1.35	0.76	1.63	0.83	1.35	0.76	1.63	0.83	1.35
$LSD_{0.05(genotype)}$	0.87	1.88	0.96	1.56	0.87	1.88	0.96	1.56	0.87	1.88	0.96	1.56	0.87	1.88	0.96	1.56
CV%	2.9	4.7	24.7	2.3	2.9	4.7	24.7	2.3	2.9	4.7	24.7	2.3	2.9	4.7	24.7	2.3

Chatts= tubers< 25mm diameter, Seed= tubers ≥25mm≤ 55mm and Ware=tuber >55mm.

Table 4. Effects of different methods of propagation on the number of tubers of potato grades per plant of potato genotypes using TPS (Season 2)

Treatments	GENOTYPES/CROSSES															
	LT-8 x TS-15				MF-1 x C95LB-13.2				MF-1 x TPS-67				TIGONI			
	Ware	Seed	Chatts	Total	Ware	Seed	Chatts	Total	Ware	Seed	Chatts	Total	Ware	Seed	Chatts	Total
Transplanting	5.53	9.47	4.27	19.27	5.47	12.27	3.63	21.03	5.67	15.53	2.73	23.93	-	-	-	-
Minitubers	3.50	5.67	2.63	11.8	3.73	6.13	2.93	12.80	4.33	7.00	2.73	14.07	-	-	-	-
Seed tubers	7.13	4.87	1.87	13.87	7.13	5.57	2.00	14.70	9.40	6.33	1.87	17.60	9.73	6.73	1.47	17.93
$LSD_{0.05(treatment)}$	0.52	1.12	0.31	1.39	0.52	1.12	0.31	1.39	0.52	1.12	0.31	1.39	0.52	1.12	0.31	1.39
$LSD_{0.05(genotype)}$	0.61	1.29	0.36	1.60	0.61	1.29	0.36	1.60	0.61	1.29	0.36	1.60	0.61	1.29	0.36	1.60
CV%	3.1	3.2	9.3	3.8	3.1	3.2	9.3	3.8	3.1	3.2	9.3	3.8	3.1	3.2	9.3	3.8

Chatts= tubers< 25mm diameter, Seed= tubers ≥25mm≤ 55mm and Ware=tuber >55mm.

genotype (1.91 kg) including that from MF-1 x TPS-67 transplants (1.79 kg) in season 1. In season 2, Tigoni genotype and Cross MF-1 x TPS-67 seed tuber propagated, tuber weight per plant had no significant difference and was significantly higher compared to those of transplant of MF-1 x TPS-67 (1.64 kg) and seed tuber propagated of MF-1 x C95LB-13.2 (1.64 kg).The weight of tubers of potato grades per plant differed significantly ($p<0.05$) between treatments and genotypes in both seasons (Tables 5 and 6). Ware tuber weight per plant varied significantly based on both treatments and genotypes in both seasons. The highest and the lowest ware tuber weight per plant were recorded in seed tuber and minituber propagated plants respectively in all genotypes in both seasons. There was no significant difference in ware tuber weight per plant between transplanted and minituber propagated plant in all genotypes in both seasons. However, the weight of ware tubers varied significantly in seed tuber propagated plants with cross MF-1 x C95LB-13.2 (1.40 kg) and Tigoni genotype (1.44 kg) recording the highest while cross LT-8 x TS-15 gave the lowest weight in season 1. The weight of seed tubers per plant did not exhibit significant variation among treatments in both seasons but significant difference was observed among genptypes (Tables 5 and 6). The yields of potato tubers at harvest showed significant variation between treatments and genotypes in both seasons (Tables 1 and 2). Plants planted through seed tubers yielded highest in all genotypes in both seasons compared with other treatments except in cross MF-1 x TPS-67 in season 1 where no significant difference was observed between transplanted plant and seed tuber propagated plants. Crop planted through minitubers gave the

Table 5. Effects of different methods of propagation on the weight of tubers of potato grades per plant of potato genotypes using TPS (Season 1).

TREATMENTS	GENOTYPES/CROSSES															
	LT-8 x TS-15				MF-1 x C95LB-13.2				MF-1 x TPS-67				TIGONI			
	Ware	Seed	Chatts	Total	Ware	Seed	Chatts	Total	Ware	Seed	Chatts	Total	Ware	Seed	Chatts	Total
Transplanting	0.81	0.57	0.06	1.44	0.83	0.61	0.11	1.55	0.84	0.82	0.13	1.79	-	-	-	-
Minitubers	0.55	0.61	0.04	1.20	0.51	0.54	0.06	1.11	0.60	0.69	0.25	1.33	-	-	-	-
Seed tubers	1.16	0.36	0.02	1.55	1.40	0.38	0.02	1.80	1.29	0.50	0.05	1.84	1.42	0.47	0.01	1.91
$LSD_{0.05(treatment)}$	0.09	0.14	0.08	0.13	0.09	0.14	0.08	0.13	0.09	0.14	0.08	0.13	0.09	0.14	0.08	0.13
$LSD_{0.05(genotype)}$	0.11	0.16	0.09	0.15	0.11	0.16	0.09	0.15	0.11	0.16	0.09	0.15	0.11	0.16	0.09	0.15
CV%	4.7	13.3	23.6	3.3	4.7	13.3	23.6	3.3	4.7	13.3	23.6	3.3	4.7	13.3	23.6	3.3

Chatts= tubers< 25mm diameter, Seed= tubers ≥25mm≤ 55mm and Ware=tuber >55mm.

Table 6. Effects of different methods of propagation on the weight of tubers of potato grades per plant of potato genotypes using TPS (Season 2).

TREATMENTS	GENOTYPES/CROSSES															
	LT-8 x TS-15				MF-1 x C95LB-13.2				MF-1 x TPS-67				TIGONI			
	Ware	Seed	Chatts	Total	Ware	Seed	Chatts	Total	Ware	Seed	Chatts	Total	Ware	Seed	Chatts	Total
Transplanting	0.77	0.39	0.10	1.25	0.71	0.74	0.09	1.43	0.81	0.78	0.06	1.64	-	-	-	-
Minitubers	0.46	0.51	0.06	1.04	0.48	0.58	0.06	1.13	0.55	0.75	0.07	1.36	-	-	-	-
Seed tubers	1.09	0.52	0.05	1.65	1.16	0.25	0.06	1.64	1.18	0.62	0.06	1.85	1.44	0.41	0.02	1.88
$LSD_{0.05(treatment)}$	0.10	0.11	0.01	0.08	0.10	0.11	0.01	0.08	0.10	0.11	0.01	0.08	0.10	0.11	0.01	0.08
$LSD_{0.05(genotype)}$	0.12	0.13	0.01	0.10	0.12	0.13	0.01	0.10	0.12	0.13	0.01	0.10	0.12	0.13	0.01	0.10
CV%	7.5	2.4	0.9	6.2	7.5	2.4	0.9	6.2	7.5	2.4	0.9	6.2	7.5	2.4	0.9	6.2

Chatts= tubers< 25mm diameter, Seed= tubers ≥25mm≤ 55mm and Ware=tuber >55mm.

lowest yields in all genotypes in both seasons. The highest yield were recorded from both transplanted (65.52 mm) and seed tuber propagated plants (68.13 mm) for cross MF-1 x TPS-67 and from seed tuber planted Tigoni genotype (68.33 mm) which comparatively yielded the same. Cross LT-8 x TS-15 gave the lowest yields in all treatments in both seasons except for minituber propagated plants in season 1.

DISCUSSIONS

The effects of methods of propagation on growth characteristics of potato genotypes using TPS differed significantly ($p<0.05$) in both seasons. Plant height at 75 DAS/T and fresh weight of foliage per plant at dehaulming exhibited significant difference among treatments and genotypes.Plants propagated by seed tubers were tallest and gave the highest fresh foliage weight per plant in all genotypes compared to minituber planted and transplanted plants. These results were in agreement with Mahmood (2005) findings who observed that planting methods of TPS influenced growth characteristics. El-Amin et al. (1996) also found similar result that plants raised from small size seedling tuber of TPS origin were shorter and less vigorous than those raised from large size tubers. The plant heights and fresh weight for seed tuber propagated plants for cross LT-8 x TS-15 and MF-1 x C95LB-13.2 were significantly lower compared to commercially grown Tigoni genotype while cross MF-1 x TPS-67 gave plants with the same height and foliage weight as Tigoni genotype. This was in tandem with Elias et al. (1997) and Mahmood (2005) who reported significant variation in plant heights of different PTS progenies.

Number of potato tubers per plant at harvest, tuber weight per plant and yields exhibited significant difference among treatments and

genotypes. Transplanted plants produced significantly the most total number of tubers per plant in all genotypes compared with other treatments while those counted from plants resulting from minitubers were the lowest. Cross MF-1 x TPS-67 produced significantly the most number of tubers per plant in all treatments in both seasons with the highest registered in transplanted plants (26.67 and 23.93).The differences between the total number of tubers per plant of seed tuber propagated plants of Tigoni (17.33 and 17.93) and cross MF-1 x TPS-67 (17.67 and 17.60) were not significant.

The number of tubers of potato grades per plant differed significantly among the propagation methods and genotypes. Seed tuber propagated plants produced the highest number of ware tubers in all genotypes compared to those from minitubers and transplants. The number of seed tubers and chatts per plant from transplanted plants was significantly highest in all genotypes in both seasons while plants from seed tuber planted Tigoni genotype and cross MF-1 x TPS-67 recorded the lowest. Plants that gave more number of tubers per plant shifted towards production of more small sized tubers (seed tuber and chats) compared to those that gave less number of tubers per plant. This may be attributed to compensation effect (Mahmood 2005) in nutrients partitioning and space based on the fresh weight of plant foliage.

The total weight of potato tubers per plant at harvest varied significantly among treatments and genotypes. Plants resulting from seed tuber propagated crop significantly gave the highest total tuber weight per plant in all genotypes compared with tuber weight per plants from plants resulting from transplanting and minituber. This is in agreement with Shonnard et al., (1991) found that some families from tubers derived from TPS had substantially higher yields and significantly more uniform than their transplanted plant. Cross MF-1 x TPS-67 gave plants which produced the highest plant tuber weight in seed tuber, minituber and transplanted plants compared to crosses MF-1 x C95LB-13.2 and LT-8 x TS-15 except for seed tuber propagated from crosses MF-1 x C95LB-13.2 (1.80), MF-1 x TPS-67 (1.84) and Tigoni genotype (1.91). These findings can be supported by Almekinders et al. (1996) and Golmirzaie and Ortiz. (2002, 2004) who found that yields from TPS genotypes vary significantly between selected genotypes and competed successfully with clonally cultivated varieties in Egypt and India.

CONCLUSIONS AND RECOMMENDATIONS

In this study, plants propagated by seed tubers had the highest plant height, fresh foliage weight per plant, tubers weight per plant and yields compared with minitubers and transplanted plants in all genotypes. However, transplanted plants gave the most number of tubers per plant in all genotypes but shifted towards production of medium and small grades (seed tubers and chats). Cross MF-1 x TPS-67 also exhibited significantly and highest plant height, fresh foliage weight per plant, tubers weight per plant, number of tubers per plant and yields compared to crosses LT-8 x TS-15 and MF-1 x C95LB-13.2. Plant height, fresh foliage weight per plant, number and weight of tubers per plant and yields of cross MF-1 x TPS-67 were not significantly different with those of Tigoni genotype. Seedling tubers or transplants derived from TPS from selected genotypes can yield as well as seed tubers of commercially varieties.

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