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Influence of Selection Criteria of Elite Plants on Micropogation in Asparagus

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Abstract: Male and female plants of Asparagus selected by high total Yield (Y), Spear Number (SN) and mean Spear Weight (SW) are used for hybrids production. In order to establish the influence of the selection criteria on elite plants towards *in vitro* micropropagation, 20 shoot tips each of 27 genotypes selected by high Y (10), great SN (8) and superior SW (9) were cultured on MS medium with NAA (2.5 mg L^{-1}) and Kinetin (2.5 mg L^{-1}). The Induction Rate (IR): explants number induced/total explants cultured, the Prolificity Rate (PR): shoots number developed/explants number induced and the Rooting Rate (RR) were evaluated by the ANOVA nested procedure. The IR of elite plants selected by Y, SN and SM were 64, 51 and 39%, respectively, whereas no significant differences were shown between sexes. On the same way, the PR pointed out significant differences towards the selection criteria. The selected plants by Y showed higher values (3.3) than the ones selected by SW and SN (2.5). Furthermore, no significant difference was found between male and female plants. To sum up, the micropropagation of Asparagus shoots cultured Asparagus *in vitro* established significant differences considering selection criteria and the aim of an efficient micropropagation can be achieved by using elite plants selected by Y.

Key words: Asparagus, *in vitro* culture, elite plants, selection

INTRODUCTION

Asparagus (*Asparagus officinalis* L.) is a perennial and dioecious species. Since years, the improvement of Asparagus cultivars were achieved by cross-pollinitation of selected high-yielding staminate and pistilate plants of the same variety followed of mass selection of the progeny. However, with the aim of increasing yield and uniformity, it has been developed different types of hybrids which allowed the used of heterosis. These materials are F_1 hybrids obtained by the cross of inbred lines or clonal hybrids obtained by the hybridization of two selected plants propagated vegetatively. The only means of asexual propagation available before the advent of tissue culture was crown division, which is very slow and inefficient in producing large number from one plant. Tissue culture, on other hand, has opened avenues of modern Asparagus breeding that otherwise would be closed.

The breeding program always includes an initial stage where the plants are selected by yield and other economically important traits. Bannerot *et al.* (1969) and Bussell *et al.* (1987) established that the market yield of the first two harvest were an indicator of future yield.

Different authors have been studying the phenotypic correlations between vary traits with the yield to identify which variables of easy measure could be employed as selection criteria. Cointry *et al.* (2000) reached the conclusion that the spear number and the spear weight, which is associated with spear diameter, were the most important components of yield. As well as Fallon and Nikoloff (1986) and Cointry *et al.* (2000), concluded that vegetative traits like fern weigh, number stalk and plant height were not significantly correlationated with yield, therefore those variables could not be considered as selection criteria.

Ellison *et al.* (1960) and Ellison (1986) found a high correlation between the spear diameter and the spears number with yield. However, Pandita and Bhan (1990) reached a negative correlation between the spear number with the spear diameter. According to these, it should be necessary to consider both components of yield, in order to avoid fixing negative ones on the population.

Therefore, it should be considered as selection criteria total yield, spear number per plant and spear weight for the selection of elite plants.

The objective of this study was to establish the influence of the selection criteria on the micropropagation of elite plant.

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MATERIALS AND METHODS

Twenty seven genotypes, including male and female plants, were used as experimental material. Ten were selected by a high total Yield (Y), eight were selected by Spear Weight (SW) and nine were selected by Spear Number (SN). The trial was planted in the Experimental Field of the National Rosario University (33°01' S, 60°53' W, 50 m a.s.l.) during the harvest period 2004-2005.

The Murashige and Skoog Medium (1962) supplemented with kinetin (2.5 mg L^{-1}), NAA (2.5 mg L^{-1}) and ancymidol (5 mg L^{-1}) was used. Twenty meristems per genotype and per selection criteria were cultured in two moments (September-March). The spears were immersed for 5 min in 70% ethanol and 5 min in 3% sodium hypoclorite, followed by 3 rinses with autoclaved distilled water.

The trial layout was a complete randomized design and the incubation was carried out in a growth chamber at 25±1 °C with cool white fluorescent lights on a 16: 8 light: dark cycle at a PPF of 50 mmol m^{-2} sec^{-1}. Nodes, after developing shoots, were recultured in fresh medium.

The Induction Rate (IR) explants number induced/total explants cultured, the Prolificity Rate (PR): shoots number developed/explants number induced and the Rooting Rate (RR) were performed. Before analysing, those traits which did not present a normal distribution were transformed by $\sqrt{x} + \sqrt{x+1}$. For the statistical analysis, it was used the SAS´s Program (1982).

RESULTS AND DISCUSSION

Our research team study developing Asparagus clonals hybrids of a high performance and is very important to examine the selective criteria in a breeding program to take into account the micropropagation.

For all the variables analysed it was found that there were not significant differences between sexes. This is an Asparagus characteristic due to that the ability to micropropagate is not related with sex (Thévenin and Doré, 1976; Asprelli *et al*., 2002).

The analysis of the induction rate showed significant differences between the selection criteria ($F = 6.5$; $p<0.01$) (Table 1) and percentages for plants selected by Y, SN and SW were 64, 51 and 39%, respectively. Moreover, the differences between the extraction date of meristem was significant ($F = 3.70$; $p<0.05$) (Table 1) and no interaction between selection criteria and extraction date was found ($F = 1.34$; ns). These establish that the selection criteria on Asparagus plants influenced in the induction of cultured meristems.

The total yield of an Asparagus plant is a complex trait which is determined by spear number and mean spear weight. The correlation between those components of yield is negative (-0.75), therefore an increase in the spear number cause a slightly diminution in the mean spear weight (Asprelli *et al*., 2002). The selection by yield admit a balance between both components and allow to achieve a highly expression in spear number and spear weight all together in one plant. Commonly, female plants produce lower spear number and higher spear diameter than male plants; which produce higher spear number and lower spear diameter. In this framework, both types of plants showed no significant difference due to they were selected by yield and probably the yield components were balanced.

The PR pointed out significant differences towards the selection criteria ($F = 7.12$; $p<0.01$) (Table 1). The selected plants by Y showed higher values (3.3) than the ones selected by SW and SN (2.5) (Table 2). Furthermore, no significant difference was found between sexes.

Table 1: Analysis of Variances for Induction Rate (IR), Prolificity Rate (PR) and Rooting Rate (RR)

		IR		PR		RR	
	df	CM	F	CM	F	CM	F
Date	1	1.91	3.70*	0.74	0.72	0.94	1.41
Criteria	2	3.35	6.50***	7.26	7.12***	5.15	7.74***
Interaction	2	0.69	1.34	0.24	0.24	0.85	1.28
Error	96	0.52		1.02		0.67	

* ($p<0.05$), *** ($p<0.001$)

Table 2: Mean values for Induction Rate (IR), Prolificity Rate (PR) and Rooting Rate (RR)

	IR			PR			RR		
	March	September		March	September		March	September	
Y	2.33±0.36	2.49±0.94	2.41[a]	3.23±0.43	3.41±0.78	3.30[a]	2.87±0.48	3.10±0.78	2.98[a]
SN	1.53±0.56	2.15±0.61	1.82[b]	2.33±0.85	2.66±0.87	2.48[b]	2.02±0.51	2.53±0.74	2.25[b]
SW	1.88±0.90	1.95±0.73	1.92[b]	2.58±0.67	2.57±0.64	2.57[b]	2.45±0.87	2.31±0.85	2.38[b]

The values followed by the same letter are not different at the 5% level

Respecting the rooting rate, it was only found significant differences between the selection criteria ($F = 7.74$; $p<0.01$) (Table 1) and the elite plants selected by yield were the ones with the best ability to take root. Both, PR and RR, showed no significant differences between the extraction date of meristem ($F = 0.72$ and $F = 1.41$ ns, respectively) (Table 1) and no interaction between selection criteria and extraction date was found ($F = 0.24$ and $F = 1.28$; ns, respectively).

To sum up, it should be consider the selection criteria for an efficient micropropagation and the selection towards yield would have the best results for the attainment of clonal hybrid seeds in a lower period of time.

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