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Rooting Behaviour Studies in Selected Clones of Casuarinas

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ABSTRACT

The materials for the present study consisted of four clones in each of *Casuarina equisetifolia* and *Casuarina junghuhniana* and one seed source in each of the same species. The category "A" type rooting pattern was observed in FC&RI-9, MTP-CJ-27 and MTP-CJ-28. These clones can be utilized for Agroforestry or interplanting as they have exhibited deep rooting system. Two clones viz., FC&RI-7 and MTP-CJ-29 have "B" type category of rooting pattern and can be utilized for afforestation in physically degraded land. The "C" type of rooting pattern was prevalent in MTP-CJ-26 and the clones may be utilized for block planting purposes. The clone FC&RI-8 has observed to consist of 'D' type of rooting pattern which could be suitable for coastal afforestation programme because of abundant rooting pattern. The clone FC&RI-6 showed category "E" type of rooting pattern and suitable for Agroforestry system due to non presence of horizontal rooting pattern. Among the various selected clones of *C.equisetifolia* and *C. junghuhniana*, the variation was observed in their root characteristics at 30, 60, 90, 120,150 and 180 days interval. It was observed that among Casuarina clones the maximum root characteristics were found in clones MTP-CJ-28, MTP-CJ-27, MTPCJ-29 and FC&RI-8 respectively. These clones were found to be effective and superior as compared to others in their root characteristics. The root behaviour was normally found to stabilize at 150 days after planting of cuttings, which is considered as the optimum time for observation and determining the root pattern of a particular clone to decide about its utility in a particular edaphic or Agroforestry requirement.

Key words:

Agroforestry, Casuarina, clones, rooting behavior, rooting pattern

INTRODUCTION

The population pressure manifest, itself in many ways, out of these wood scarcity is one which is accentuated by the increasing demands of the population for its multifarious needs. Among currently used fast growing species in different countries, the Casuarinas have emerged as the most suitable for Agroforestry, plantation forestry and industrial plantations. The population increase has put enormous pressure on the forests, resulting in devastation of the forest area for timber, fuel and other value added products. Casuarinas have a sustained market as fuel, poles, props and wood chips for the production of pulp and paper. Casuarinas are mainly utilized a soil conservation species for sand dune stabilization and also as an

excellent fuelwood species since it contains high calorific values of 4950 calories when green and the ashes retain the heat for a long time when used for burning (Anon, 1992). Poles are also in great demand for use as mats, scaffoldings, fence posts and beams etc. Now a days, Casuarinas are being used as a raw material for paper and pulp wood industries. So there is a great need to improve the planting stock of this versatile species.

The roots also play an important role in the ecological and biological competitions which in turn are expressed by the vigour and growth of trees. Also from soil conservation point of view, length and thickness of plant roots in binding the soil particles is very important, as fibrous roots have greater binding capacity. In Agroforestry systems, farmers may prefer tree species that have deep and less dense roots and do not compete strongly with agricultural crops for water and nutrients. It has been shown that for some species combinations, in some circumstances, roots of trees and crops planted in Agroforestry systems will be drawing nutrients and water from different depths, thereby reducing competition for resources and the tree roots will act as trap for nutrients leached out of the top soil. An understanding of the rooting pattern of tree species used in Agroforestry systems is essential for the development and management of systems involving them.

In Casuarinas related Agroforestry systems, priority of research has been given mostly to above ground productivity while the below ground root competition remained in the darker side. Hence, rooting pattern is an important criteria in selecting a clone for particular area under a specific situation and this study will be helpful in improving management systems for optimizing the production of Agroforestry systems in a particular region. Thus keeping in view the importance of below ground root competition in various growth aspects of this species and also because of presence of variation in the rooting pattern of different clones of Casuarinas, the present investigation was planned with the objectives to study the rooting pattern of selected clones of *Casuarina equisetifolia* and *Casuarina junghuhniana* and to find out the appropriate period in which the rooting pattern stabilizes in selected clones of Casuarinas.

MATERIALS AND METHODS

The present investigation was carried out in the nursery of Department of Tree Breeding at Forest College and Research Institute in Mettupalayam (Tamil Nadu) during the year 2009-2010. The experiment was conducted at Forest College and Research Institute, Mettupalayam, located at 11° 19'N latitude and 77°56'E longitudes and an altitude of 300m above mean sea level.

The mean annual rainfall of the region is 895 mm, distributed over 49 rainy days with North east monsoon contributing to 60 percent and summer showers to 20 percent of the total rainfall. The mean maximum and minimum temperatures are 30°C and 20.5°C, respectively. The materials for the present study consisted of 4 clones in each of *C. equisetifolia* and *C. junghuhniana* and one seed source in each of the same species. The experiment for the selected clones of two species viz., *C. equisetifolia* and *C. junghuhniana* were conducted individually at Forest College and Research Institute, Mettupalayam during the year 2009-2010. The experiment was carried out in the Complete Randomized Design (CRD) with 10 treatments (8 clones and 2 seed source) and the treatments were replicated thrice.

The forest soil was collected from nearby forest and used as a rooting media for all the experiments without adding FYM or any other chemical fertilizer since the forest soil contained enough organic matter. After filling the rooting media in polythene sacks of size 44 x 22 inches (600 gauge) the rooted cuttings of the selected clones of *Casuarina equisetifolia* and *Casuarina junghuhniana* were planted and the observation were recorded periodically. The cuttings were taken out from poly bags after an interval of 30, 60, 90,120,150 and 180 days and the type of rooting system of the clones were observed on the basis of pattern and based on classification given by Khurana (1994) and clones were categorized into following five different categories.

Category A: Profused rooting throughout the length of cutting with many small horizontal roots and a dominant vertical plunging (sinker) root at

the base of the cutting.

Category B: Profused rooting throughout the length of cutting with many horizontal roots but without a dominant plunging root system.

Category C: Profused rooting in the lower portion i.e. about 1 /3rd region of the cutting with one to many vertical roots and few horizontal roots. Dominant plunging root not distinct.

Category D: Many small roots with majority of them in lower half region of the cutting. More than one vertical plunging root at the base of cutting along with few horizontal roots.

Category E: Sparse rooting throughout the length of the cutting. Roots mostly of horizontal spreading type with no plunging roots.

RESULTS AND DISCUSSION

The selected clones of Casuarinas showed a variable pattern of rooting. From the Table 1,2,3,4,5 and Fig. 1,2 and 3 it is evident that the rooting pattern within a clone was uniform and no variation in pattern was observed throughout the study period viz., three clones FC&RI-9, MTP-CJ-27 and MTP-CJ-28 exhibited category "A" type root pattern, while clones FC&RI-7 and MTP-CJ-26, MTP-CJ-29 showed category "B" type root pattern. The category "C" type root pattern was prevalent in clone MTP-CJ-26. The clone FC&RI-8 showed category "D" type root pattern and category "E" was observed in clone FC&RI-6. The seed sources exhibited tap root rooting system and there was no similarity in the rooting pattern defined.

Rooting ability of Casuarinas is a variable character which changes from clone to clone and has been found to range from 0 to 100 percent in different species and their clones (Dickman and Stuart, 1983). Besides rooting ability, root pattern and root characteristics are the factors which govern the behaviour of a clone and its suitability to a particular Agroforestry system. These factors have not been studied for selection of suitable intercrops, recommendation of suitable clone for afforestation in eroded areas and selection of suitable clones for higher yield without impairing yield of agriculture crops. All the root patterns normally conformed to the classification given by Khurana (1994) and Bhrot (1995) i.e. Category A, B, C, D and E types. Variation in rooting pattern is a desirable character for the multiple utility of the clone and has also been reported by Dickman and Stuart (1983), Khurana and Chandrasekhar (2000).

In the selected clones of FC&RI-9, MTP-CJ-27 and MTP-CJ-28 exhibited category "A" type of rooting pattern which were suitable for Agroforestry systems with minimum root competition. Because these clones have profused rooting throughout the length of the cutting with many smaller horizontal roots and dominant plunging roots at the base of the cuttings. While the clones FC&RI-7 and MTP-CJ-29 have profused rooting throughout the length of cuttings with many horizontal rooting but without dominant plunging root system. So it falls under "B" category of rooting pattern and can be utilized for afforestation in physically degraded land. A similar study was carried out and classified the rooting pattern into "A" and "B" category which is used for Agroforestry and afforestation purposes in *Populus spp*. by Chandrasekhar (2000).

Category "C" type of rooting pattern was prevalent in MTP-CJ-26 in which rooting in the lower about 1/3rd region of cuttings with one to many vertical and few horizontal roots but dominant plunging root was not distinct. So this clone may be utilized for block plantation purposes. The clone FC&RI-8 showed category "D" type of rooting pattern with many small roots and majority of them in the lower half region of the cuttings, and more than one plunging root at the base of cuttings along with few horizontal roots, which may be utilized for afforestation programme in the coastal areas with loose soils. Clone FC&RI-6 showed sparse throughout the length which are mostly spreading type with no plunging root falls under category "E" type of rooting pattern is not suitable for Agroforestry system because of maximum competition in available nutrient and moisture.

Ramesh and Khurana (2006) also reported the same in *Populus alba* which showed category "C" and "D" rooting pattern and they are recommended for block plantation and cold desert areas respectively. The present findings were also in

Table.1 Root pattern in selected clones of Casuarinas

Sl. no	Species	**Clone details**	**30DAP**	**60DAP**	**90DAP**	**120DAP**	**150DAP**	**180DAP**
1.	*C.equisetifolia*	**FC & RI -6**	E	E	E	E	E	E
2.		**FC & RI -7**	B	B	B	B	B	B
3.		**FC & RI -8**	D	D	D	D	D	D
4.		**FC & RI -9**	A	A	A	A	A	A
5.		**Seed source**	TAP ROOT	TAP ROOT	TAP ROOT	TAP ROOT	TAP ROOT	TAP ROOT
6.	*C. Junghuhniana*	**MTP -CJ -26**	C	C	C	C	C	C
7.		**MTP -CJ -27**	A	A	A	A	A	A
8.		**MTP -CJ -28**	A	A	A	A	A	A
9.		**MTP -CJ -29**	B	B	B	B	B	B
10.		**Seed source**	TAP ROOT	TAP ROOT	TAP ROOT	TAP ROOT	TAP ROOT	TAP ROOT

Table 2. Length of roots (cm) in selected genotypes of Casuarinas at different growth stages

Sl. no	Species	Clone details	Observation interval in days						
			0 days	30 DAP	60 DAP	90 DAP	120 DAP	150 DAP	180 DAP
1.	*Casuarina equisetifolia*	FC&RI -6	8.130	17.56	36.90	39.70	47.50	65.40	73.60
2.		FC&RI -7	11.43	13.90	28.33	42.60	58.90	77.50	92.60
3.		FC&RI -8	9.300	17.20	26.73	75.96	83.80	93.30	119.0
4.		FC&RI -9	10.16	14.20	26.70	46.10	55.40	65.30	76.00
5.		CE-SS	3.260	3.830	10.20	21.76	26.56	27.63	37.20
6.		MTP-CJ-26	8.630	17.36	39.90	57.10	66.60	71.56	91.60
7.	*Casuarina Junghuhniana*	MTP-CJ-27	3.160	8.800	32.33	54.36	65.60	81.33	99.50
8.		MTP-CJ-28	8.000	16.36	43.30	57.40	77.60	95.83	120.0
9.		MTP-CJ-29	8.800	15.73	46.03	54.10	59.33	73.60	83.30
10		CJ-SS	2.630	3.830	11.10	21.30	23.06	24.53	42.30
		Mean	7.350	12.88	30.20	47.05	56.44	67.62	83.54
		S.Ed	2.599	9.173	6.931	14.93	13.77	11.13	16.85
		CD(0.05)	5.423	12.88	14.45	47.05	28.32	23.22	35.16

Table 3. Collar diameter (mm) in selected genotypes of Casuarinas at different growth stages

Sl. no	Species	Clone details	Observation interval in days						
			0 days	30DAP	60 DAP	90 DAP	120 DAP	150 DAP	180 DAP
1.	*Casuarina equisetifolia*	FC&RI-6	1.45	1.77	2.13	2.31	3.87	4.21	5.49
2.		FC&RI-7	1.35	3.30	1.92	2.36	3.86	4.50	6.60
3.		FC&RI-8	1.38	3.39	2.14	2.74	3.88	4.62	6.90
4.		FC&RI-9	1.51	3.73	2.62	3.16	3.90	4.20	4.62
5.		CE-SS	0.08	0.61	0.98	1.10	1.92	2.90	3.46
6.	*Casuarina junghuhniana*	MTP-CJ-26	1.40	3.69	3.40	3.89	5.46	7.59	10.8
7.		MTP-CJ-27	1.15	3.78	2.70	3.78	4.06	5.82	7.46
8.		MTP-CJ-28	1.13	4.25	3.56	3.77	5.72	7.03	9.70
9.		MTP-CJ-29	1.26	3.49	1.89	2.32	4.32	6.52	8.76
10.		CJ-SS	0.09	0.71	0.94	1.33	1.84	3.73	4.60
		Mean	1.082	1.36	1.871	2.447	3.350	5.081	6.842
		S.Ed	0.114	0.235	0.305	0.356	0.800	0.751	0.828
		CD(0.05)	0.239	0.490	0.636	0.744	1.670	1.566	1.728

Table 4. Fresh shoot weight (gm) in selected genotypes of Casuarinas at different growth stages

Sl. no	Species	Clone details	Observation interval in days						
			0 days	30 DAP	60 DAP	90 DAP	120 DAP	150 DAP	180 DAP
1.	*Casuarina equisetifolia*	FC&RI-6	0.290	0.720	3.360	4.530	6.760	9.010	12.43
2.		FC&RI-7	0.250	0.760	1.880	3.340	6.560	17.20	31.40
3.		FC&RI-8	0.290	0.610	2.410	3.690	6.340	22.03	27.60
4.		FC&RI-9	0.250	0.450	3.690	3.620	7.190	10.32	16.60
5.		CE-SS	0.013	0.140	0.590	0.890	2.330	4.670	6.200
6.	*Casuarina junghuhniana*	MTP-CJ-26	0.490	1.910	4.230	8.220	15.86	35.80	52.82
7.		MTP-CJ-27	0.360	1.220	5.820	7.660	15.40	34.53	51.76
8.		MTP-CJ-28	0.570	2.030	8.720	12.13	23.97	65.25	82.50
9.		MTP-CJ-29	0.340	1.530	3.960	8.150	23.30	48.96	69.16
10.		CJ-SS	0.026	0.140	0.630	1.060	6.180	13.86	24.40
		Mean	0.2903	2.200	3.402	5.334	11.38	25.98	37.50
		S.Ed	0.115	5.539	1.539	0.998	2.087	3.990	7.087
		CD(0.05)	0.241	11.55	3.402	2.083	4.353	8.323	14.78

Table 5. Fresh root weight (gm) in selected genotypes of Casuarinas at different growth stages

Sl. no	Species	Clone details	Observation interval in days						
			0 days	30 DAP	60 DAP	90 DAP	120 DAP	150 DAP	180 DAP
1.		FC&RI-6	0.090	0.130	0.480	1.143	1.510	3.500	4.290
2.	*Casuarina*	FC&RI-7	0.070	0.150	0.290	0.590	2.260	3.930	4.660
3.	*equisetifolia*	FC&RI-8	0.070	0.160	0.450	0.640	2.100	3.070	3.820
4.		FC&RI-9	0.096	0.190	1.010	0.860	3.420	2.570	3.020
5.		CE-SS	0.019	0.070	0.190	0.480	0.980	1.030	1.920
6.		MTP-CJ-26	0.090	0.270	0.590	0.780	2.770	9.670	12.30
7.	*Casuarina*	MTP-CJ-27	0.206	0.340	0.540	1.320	8.760	8.720	13.43
8.	*junghuhniana*	MTP-CJ-28	0.320	0.410	0.790	1.370	5.230	9.480	12.67
9.		MTP-CJ-29	0.120	0.180	0.560	1.330	5.000	8.860	12.07
10.		CJ-SS	0.026	0.070	0.200	0.670	2.250	3.320	6.060
		Mean	0.113	0.2033	0.495	0.920	2.930	5.264	7.397
		S.Ed	0.051	0.039	0.152	0.294	0.546	1.018	1.247
		CD(0.05)	0.107	0.081	0.317	0.615	1.140	2.124	2.601

line with the findings of Dabral *et al*. (1987) in *Eucalyptus spp*. In that he also classified and observed in four types of root habits: tap roots with lateral roots emerging, tap root branching at the bottom, middle or upper parts of the root production of laterals penetrating as deeply as tap roots and no tap root but a well formed selfed cluster. During the present studies, rooting pattern was found more or less uniform both at 150 and 180 days after planting. Similar reports were given by Bhrot (1995) and Ramesh (2002) who found that the rooting behaviour normally used to stabilize at 120 days after planting. So it may be considered as the optimum time for determining root pattern of particular edaphic or intercropping requirements.

CONCLUSION

From the results it can be concluded that the rooting behaviour was normally found to stabilize at 150 days after planting of cuttings, which is considered as the optimum time for observation for determining the root pattern of a particular clone to decide about its utility in particular edaphic or Agroforestry requirements. Deep rooted category "A" type clones MTP-CJ-28, MTP-CJ-27 and FC&RI-9 respectively can be utilized for Agroforestry Systems to reduce the competition among the field crops and woody components under the various environmental conditions. The clones MTP-CJ-29 and FC&RI-7 respectively having category "B" type rooting pattern and can be utilized for afforestation in physically degraded land. Category "C" type of rooting pattern was prevalent in MTP-CJ-26 and can be utilized for block plantation purposes. The clone FC&RI-8 showed category "D" type of rooting pattern with many small roots which can be utilized for coastal area afforestation programme.

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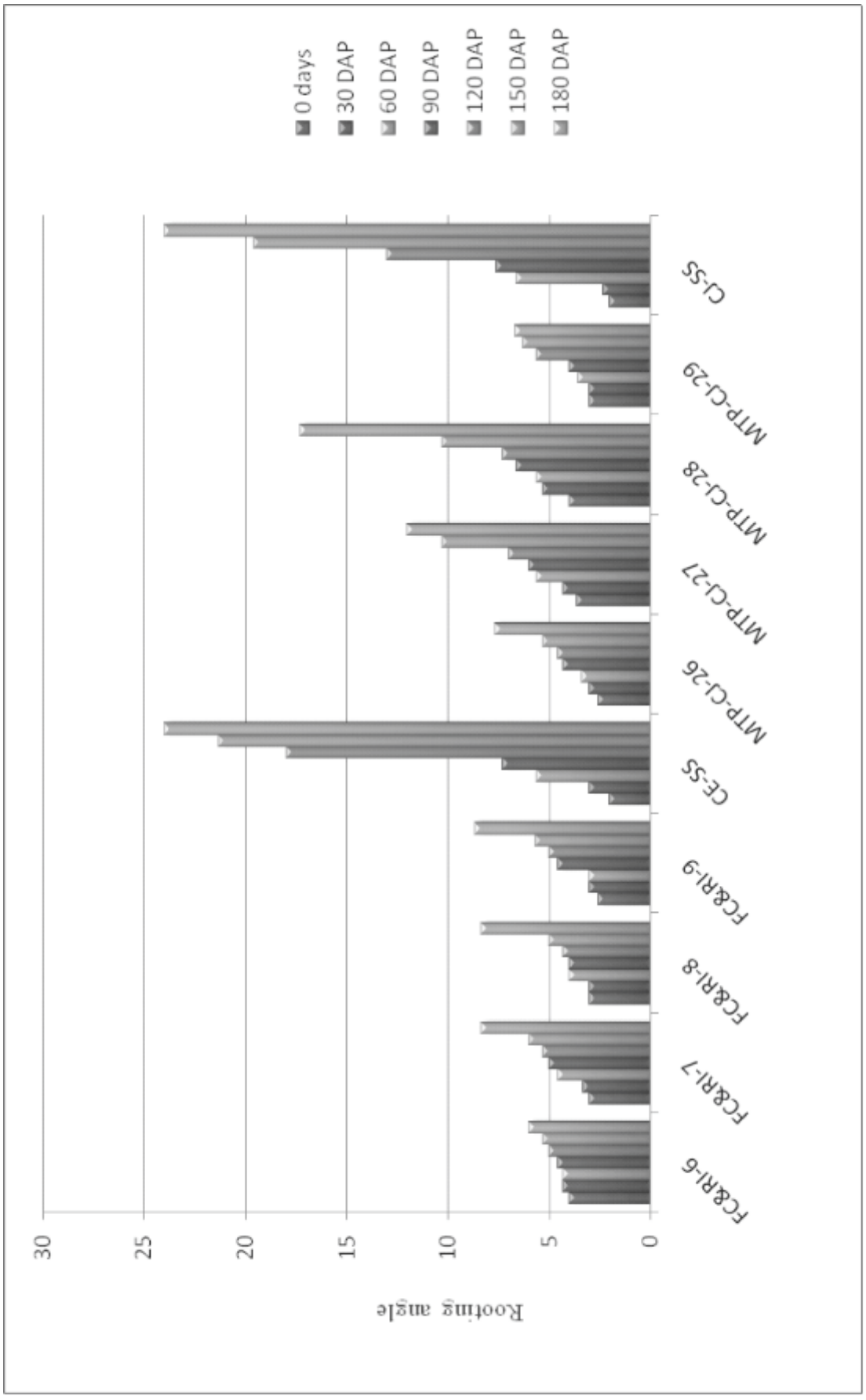

Fig.1 Rooting angle in selected genotypes of Casuarinas at different growth stages

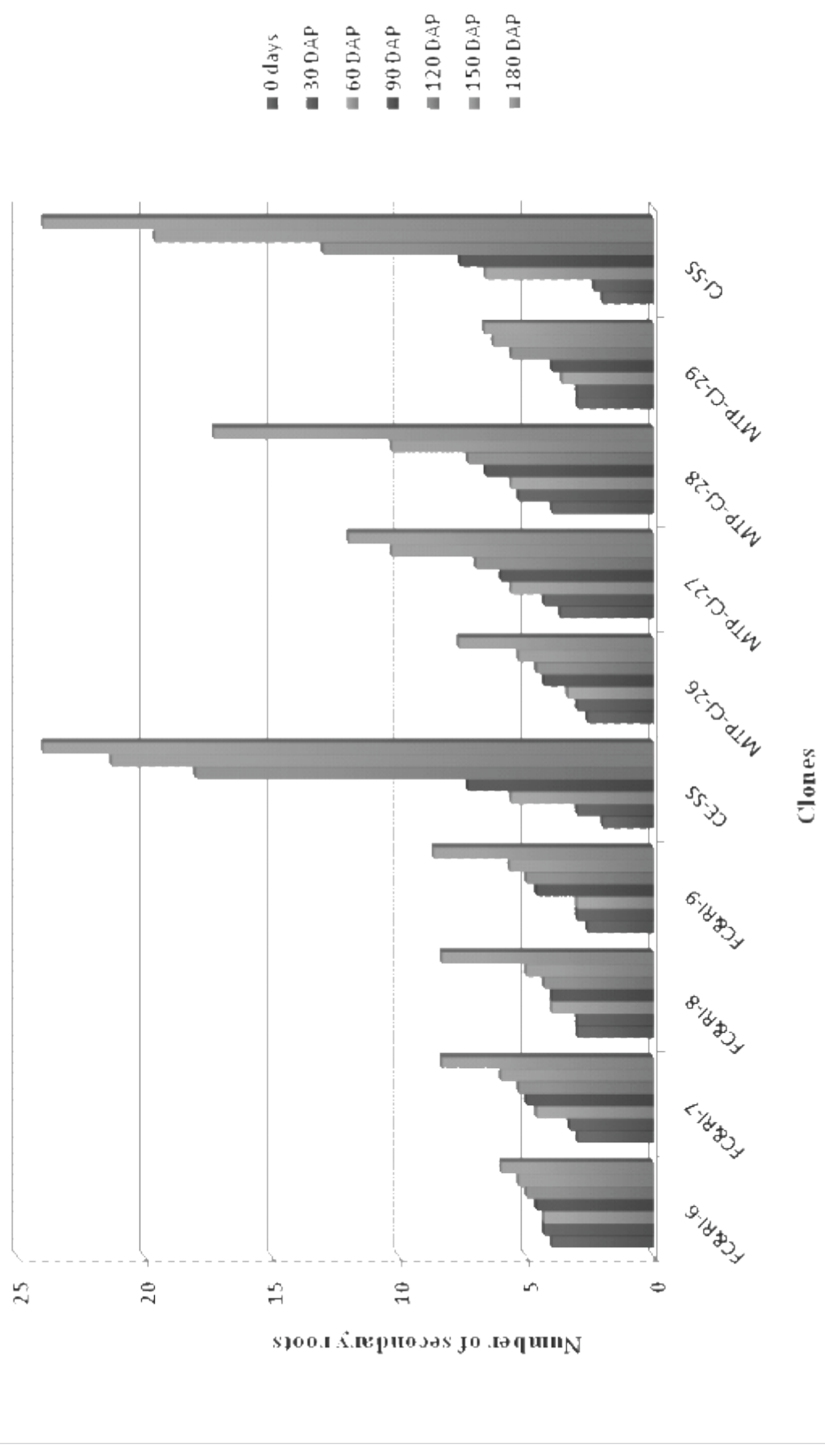

Fig.2 Number of secondary Roots in selected genotypes of Casuarinas at different growth stages

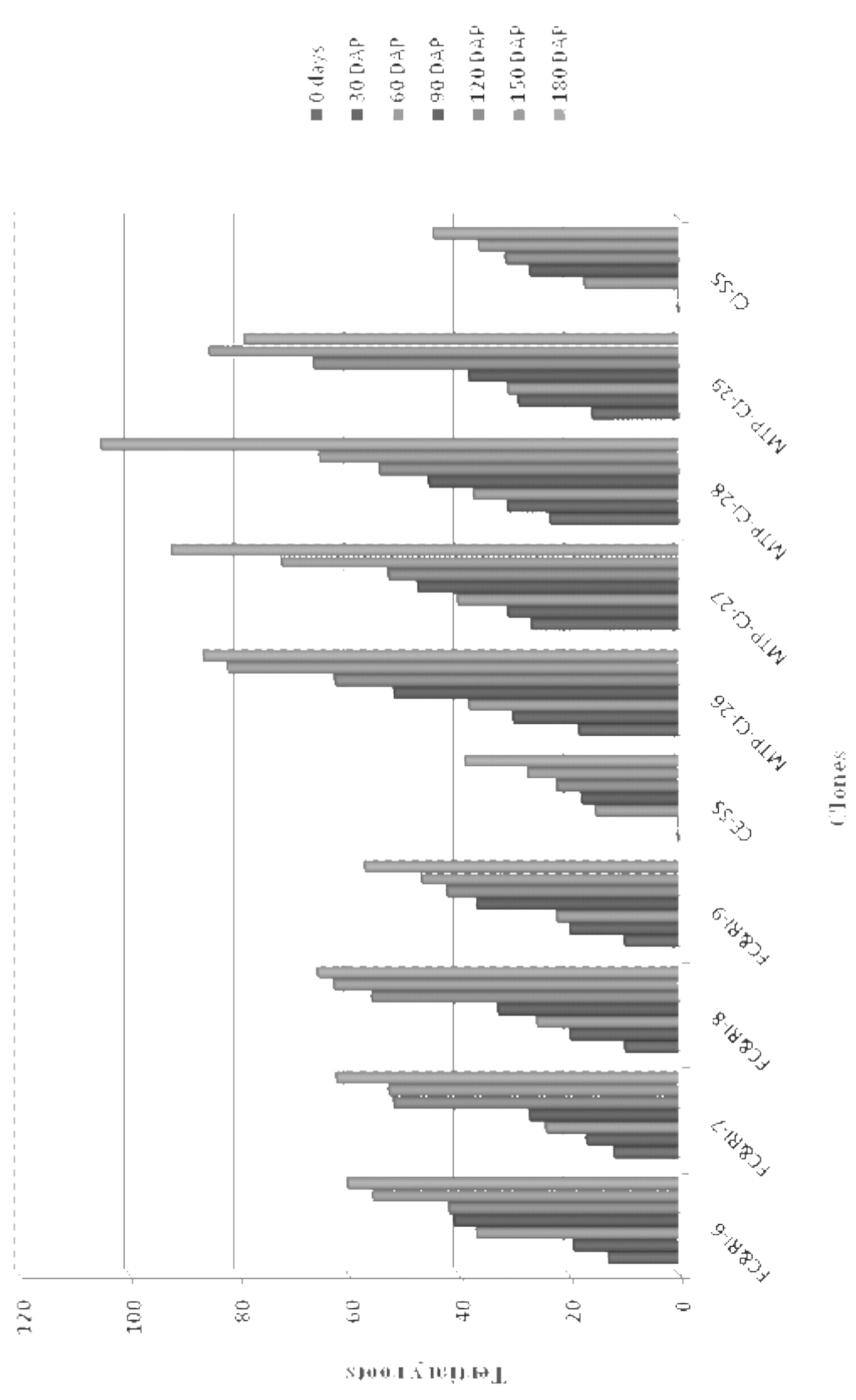

Fig.3 Number of tertiary Roots in selected genotypes of Casuarinas at different growth stages

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