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PRODUCTION OF DRY MATTER AND NUTRIENT UPTAKE IN POPLAR NURSERIES

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by

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SUMMARY

In order to determine the production of dry matter and the amount of nutrients removed from the soil by various types of poplar nurseries (S_1R_1, $S_1 + S_1R_2$, S_2R_3), experiments were carried out with Populus x euramericana 'I-214' and 'I-45/51'. Results are summarized in Table 1 for the S_1R_1 nursery, Table 2 for the $S_1 + S_1R_2$ nursery, and Table 3 for the S_2R_3 nursery. Though inadequate for a definitive answer, they give a useful indication for the fertilization of the different types of poplar nursery.

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In order to determine the production of dry matter and the amount of the different mineral constituents, effectively absorbed and removed from the soil by various types of poplar nurseries, experiments were carried out at the Poplar Research Institute of Casale Monferrato in the years 1964, 1965 and 1966. Two clones were employed, viz. P. x euramericana 'I-214' and 'I-45/51'.

The work was carried out on the following types of nurseries:

a) One-year old nursery "Barbatellaio normale" (S_1R_1) (plants with one-year old stem and one-year old roots; spacing cm 120 x 7-8);

b) One-year old cut back nursery "Barbatellaio ceduato" ($S_1 + S_1R_2$) (one-year old stems and two-year old roots; spacing cm 120 x 7-8);

c) Two-year old nursery "Vivaio" (S_2R_3) (plants with two-year old stems and three-year old roots; spacing cm 165 x 65).

The nursery area was divided into various plots and subplots and the following factors were determined:

1) the production of dry matter of leaves, stem, lateral branches and roots in terms of quintals (100 kg) per hectare at 100°C.

2) the nutrient contents of dry matter (N, P_2O_5, CaO, K_2O);

3) the quantity of nutrients absorbed in relation to the total dry matter, and the quantity of the nutrients effectively removed by the plants from the soil, were then calculated assuming that all the leaves and 50% of the roots may remain in the soil in the case of one-year old nursery (a and b), and all the leaves plus 65% of the roots in the case of two-year old nursery (c).

In the case of one-year old nursery "Barbatellai normali" (S_1R_1), the experiment was carried out for two consecutive years (1965 and 1966). The results regarding production of dry matter and absorption of nutrients are based on the average of this period.

In the case of one-year old cut back nursery "Barbatellai ceduati" ($S_1 + S_1R_2$), the observations are based on the dry matter of stems and foliage produced in 1965 and 1966 separately, while production of dry matter by roots is accounted for at the end of the two-year period only.

In the two-year old nursery "vivaio" (S_2R_3), the production of dry matter by leaves was determined at the end of each year for two years, while those by stems, lateral branches and roots were determined at the end of the second year.

As the rooting capacity of clone 'I-214' is greater than that of clone 'I-45/51', the number of plants per unit of area is higher in the case of clone 'I-214' than 'I-45/51'.

In this brief note a summary of the results obtained is given. Details of the method employed in the experiments, the climatic conditions, the quality of the soil and the fertilizers applied, can be found in the literature cited at the end of this paper.

Results

a) One-year old nursery "Barbatellai normali" (S_1R_1) Table 1

The production of dry matter was 19,672 kg/ha for clone 'I-214' and 16,195 kg/ha for clone 'I-45/51'. The nutrients corresponding to the dry matter are as follows:

Clone	N	P_2O_5	K_2O	CaO
'I-214'	253.25	72.56	188.62	260.61
'I-45/51'	225.02	60.40	166.30	207.83

Should all the leaves and 50% of the lateral roots remain in the soil, the quantity of nutrients removed from the soil in kg/ha is as follows:

Clone	N	P_2O_5	K_2O	CaO
'I-214'	126.83	42.61	82.33	120.17
'I-45/51'	102.68	34.61	64.80	80.77

b) One-year old cut back nursery "Barbatellaio ceduato" ($S_1 + S_1R_2$) Table 2

In total, production of dry matter by stems and leaves in the two years and by roots in the end of two years is 43,583.06 kg/ha for clone 'I-214' and 39,646.26 kg/ha for clone 'I-45/51'.

The nutrients absorbed by the plants from the soil are as follows:

Clone	N	P_2O_5	K_2O	CaO
'I-214'	495.66	159.32	402.47	599.87
'I-45/51'	482.93	152.65	392.03	532.37

When all the leaves and 50% of the lateral roots remain in the soil, the quantity of nutrients removed from the soil is as follows:

Clone	N	P_2O_5	K_2O	CaO
'I-214'	245.94	99.72	179.31	285.53
'I-45/51'	225.97	95.50	166.86	231.35

c) Two-year old nursery "Vivaio" (S_2R_3) Table 3

The total dry matter produced after two years was 31,863.1 kg/ha for clone 'I-214' and 31,847.8 kg/ha for clone 'I-45/51'.

The quantity of nutrients absorbed by the plants from the soil is as follows:

Clone	N	P_2O_5	K_2O	CaO
'I-214'	306.43	89.65	268.96	442.60
'I-45/51'	347.43	101.45	286.19	457.11

When all the leaves and 65% of the lateral roots remain in the soil, the total quantity of the nutrients removed in kg/ha will be as follows :

Clone	N	P_2O_5	K_2O	CaO
'I-214'	138.70	50.80	108.01	183.45
'I-45/51'	137.14	57.01	104.39	157.58

It may be noted that there is no significant difference in the quantity of nutrients removed from the soil by the two-year old nursery plants of either clone, except for CaO which is higher in the case of clone 'I-214'.

On the basis of the research carried out, it appears that the quantities of nutrients removed from the two types of nurseries (S_1R_1 and $S_1 + S_1R_2$) are similar to those respectively removed in one or two years by a cereal crop. Poplars, however, need higher quantities of calcium than cerials. The quantities of nitrogen removed from the soil are really a little higher because a part of the nitrogen of the leaves and roots of poplar is lost through microbiological processes of denitrification and leaching of the soil, particularly in sandy soils.

The quantity of nutrients removed in two years by the "Vivaio" (S_2R_3) is less than that removed by the one-year cut back nursery "Barbatellaio ceduato" ($S_1 + S_1R_2$) because the number of plants per unit of area is higher in the latter, with the result that dry matter production is also greater. However, the removal of nutrients by the "Vivaio" is quite appreciable and therefore it is necessary to apply chemical fertilizers in order to sustain a better growth.

The results of the above work are by no means adequate for a definitive answer, yet they give a useful indication for the fertilization of the different types of nursery. The work will be continued to uncover various facets of fertilization in respect of different climatic and edaphic situations. This is essential because the production of dry matter and the removal and uptake of nutrients is highly dependent on the kind of clone used, on the method of cultivation, as well as on the climatic and soil variations.

Literature

FRISON G., 1967 - Asportazioni minerali nel barbatellaio di pioppo Cellulosa e Carta, 18 (12), 10-24

FRISON G., 1968 - Asportazioni minerali nei vivai di pioppi euramericani, Cellulosa e Carta, 19 (4), 27-36.

Table 1

Production of dry matter per hectare, relative nutrient content and quantity of nutrients absorbed by one-year old poplar nursery "barbatellaio normale" (S_1R_1)

		dry matter kg/ha	% of dry matter				nutrients absorbed kg/ha			
			N	P_2O_5	K_2O	CaO	N	P_2O_5	K_2O	CaO
'I-214'	Leaves	4,565.25	2.464	0.541	2.060	2.785	112.48	24.70	94.04	127.14
	Stem:									
	a) wood 66.62%	6,647.15	0.387	0.206	0.177	0.332	25.72	13.69	11.76	22.07
	b) bark 33.38%	3,330.56	1.802	0.442	1.244	1.744	60.01	14.72	41.43	59.08
	Tap root	3,129.14	0.868	0.286	0.540	0.822	27.16	8.95	16.89	25.72
	Lateral root	2,000.00	1.394	0.525	1.225	1.330	27.88	10.50	24.50	26.60
	Total	19,672.10	-	-	-	-	253.25	72.56	188.62	260.61
'I-45/51'	Leaves	4,530.53	2.521	0.500	2.087	2.613	114.21	22.65	94.55	118.38
	a) wood 64.29%	4,829.30	0.440	0.221	0.192	0.296	21.25	10.67	9.27	14.29
	b) bark 35.71%	2,682.45	1.745	0.450	1.202	1.360	46.80	12.07	32.24	36.48
	Tap root	2,929.15	0.905	0.298	0.558	0.728	26.50	8.73	16.34	21.32
	Lateral root	1,223.60	1.329	0.513	1.136	1.419	16.26	6.28	13.90	17.36
	Total	16,195.03	-	-	-	-	225.02	60.40	166.30	207.83

Table 2

Production of dry matter per hectare, relative nutrient content and quantity of nutrients absorbed by one-year old cut back poplar nursery "barbatellaio ceduato" ($S_1 + S_1R_2$)

	dry matter kg/ha	% of dry matter				nutrients absorbed kg/ha			
		N	P_2O_5	K_2O	CaO	N	P_2O_5	K_2O	CaO
'I-214' 1st Year:									
Leaves	4,565.25	2.464	0.541	2.060	2.785	112.48	24.70	94.04	127.14
Stem:									
a) wood 66.62%	6,647.15	0.387	0.206	0.177	0.332	25.72	13.69	11.76	22.07
b) bark 33.38%	3,330.56	1.802	0.442	1.244	1.774	60.01	14.72	41.43	59.08
2nd Year:									
Leaves	5,756.91	2.148	0.508	1.989	2.987	123.66	29.24	114.50	171.96
Stem:									
a) wood 71.83%	11,819.95	0.334	0.231	0.205	0.398	39.48	27.30	24.23	47.04
b) bark 28.17%	4,635.50	1.605	0.516	1.344	2.191	74.40	23.92	62.30	101.56
Tap root	4,581.92	0.715	0.315	0.545	0.885	32.76	14.43	24.97	40.55
Lateral root	2,245.82	1.209	0.504	1.302	1.357	27.15	11.32	29.24	30.47
Total	43,583.06	-	-	-	-	495.66	159.32	402.47	599.87
'I-45/51' 1st Year:									
Leaves	4,530.53	2.521	0.500	2.087	2.613	114.21	22.65	94.55	118.38
Stem:									
a) wood 64.29%	4,829.30	0.440	0.221	0.192	0.296	21.25	10.67	9.27	14.29
b) bark 35.71%	2,682.45	1.745	0.450	1.202	1.360	46.80	12.07	32.24	36.48
2nd Year:									
Leaves	5,963.85	2.211	0.498	1.992	2.848	131.86	29.70	118.80	169.85
Stem :									
a) wood 68.44%	10,231.71	0.409	0.268	0.205	0.413	41.85	27.42	20.97	42.26
b) bark 31.56%	4,718.19	1.484	0.527	1.386	1.799	70.02	24.86	65.39	84.88
Tap root	4,783.30	0.735	0.328	0.568	0.850	35.16	15.69	27.17	40.66
Lateral root	1,906.93	1.142	0.503	1.240	1.341	21.78	9.59	23.64	25.57
Total	39,646.26	-	-	-	-	482.93	152.65	392.03	532.37

Table 3

Production of dry matter per hectare, relative nutrient content and quantity of nutrients absorbed by two-year old poplar nursery "Vivaio" (S_2R_3)

			dry matter kg/ha	% of dry matter				nutrients absorbed kg/ha			
				N	P_2O_5	K_2O	CaO	N	P_2O_5	K_2O	CaO
'I-214'	Leaves	1st and 2nd year	6,907.7	2.273	0.495	2.116	3.559	157.012	34.193	146.167	245.845
	Stem	wood 81.89%	16,326.4	0.265	0.142	0.179	0.357	43.265	23.183	29.224	58.285
		bark 18.11%	3,610.6	1.558	0.407	1.253	2.158	56.253	14.695	45.241	77.917
	Lateral branches	wood 59.53%	2,161.0	0.409	0.187	0.281	0.311	8.838	4.041	6.072	6.721
		bark 40.47%	1,469.0	1.673	0.434	1.328	2.271	24.576	6.375	19.508	33.361
	Lateral root		1,388.4	1.188	0.516	1.639	1.475	16.494	7.164	22.756	20.479
	Total		31,863.1	-	-	-	-	306.438	89.651	268.968	442.608
'I-45/51'	Leaves	1st and 2nd year	8,122.9	2.497	0.498	2.114	3.567	202.828	40.452	171.719	289.744
	Stem	wood 77.84%	15,127.4	0.289	0.184	0.169	0.338	43.718	27.834	25.565	51.131
		bark 22.16%	4,306.6	1.389	0.390	1.142	1.799	59.819	16.796	49.181	77.476
	Lateral branches	wood 55.46%	1,735.4	0.490	0.227	0.291	0.311	8.503	3.939	5.050	5.397
		bark 44.54%	1,393.6	1.513	0.452	1.376	1.314	21.085	6.299	19.176	18.312
	Lateral root		1,161.9	0.988	0.528	1.334	1.296	11.480	6.135	15.500	15.058
	Total		31,847.8	-	-	-	-	347.433	101.455	286.191	457.118