A CHECK-LIST ON THE INVASIVE SPECIES OF FORESTRY PLANTATIONS IN LOWER AMAZON, NW [1].

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RESUMO

Foi feito um levantamento das plantas invasoras ocorrentes durante os primeiros seis meses de plantações florestais em segunda e terceira rotação, na região do Jari, NW Pará. A lista resultante mostrou dois tipos de plantas invasoras: (1) **plantas daninhas propriamente ditas** - aquelas espécies cosmopolitas típicas de ambientes perturbados; e (2) **espécies pioneiras** - aquelas prováveis remanescentes da vegetação original da área estudada.

INTRODUCTION

In the present paper we equate the term ''invasive plants'' with ''weeds'' **lato sensu**, loosely defined as any plant growing where it is not wanted. In the scope of this paper we divide the invasive plants into two categories: i) the true ''**weeds**'' (ervas daninhas) - those cosmopolitan species of large distribution which tend to occur in man-made or ecologically disturbed environments such as plantations, pastures, gardens, abandoned fields and roadsides; ii) **pioneers or colonizing species** - those species that are natural to a region and tend to grow on forest gaps or in the early stages of the natural forest succession.

Plantation forests are defined here as forest crops or stands raised artificially either by seed sowing or by seedling planting. The plantation forestry in the region of the jari river basin started in 1969 by the Jari Project, in areas previously covered by natural Amazon rain forest. Its aim was to produce bleached pulp to supply a worldly demand that had been forecasted to occur in 1985. The Jari Project has been considered the first large scale silviculture enterprise in the Amazon. Today it has some 120 thousand hectares of planted forests of the fast growing exotics **Gmelina arborea** Roxby, **Pinus caribaea** Morelet var. **hondurensis** Barr. & Golf. and **Eucalyptus** spp. For information on the fitogeography and vegetation of Jari a book is being released (Coutinho, unpublished), while the soil survey of the plantation areas was published by Companhia Florestal Monte Dourado (Corrêa **et al.** 1989).

A check-list on the invasive species of silvicultural areas is important for the following reasons: (1) - **Weed control.** In forestry plantations weeds compete with tree seedlings for light and nutrients and diminishes the rate of inicial growth of seedlings. There are reports of allelopatic effect of certain weeds such as a grass referred by the foresters as ''pangola'' (not collected or identified) which has as negative effect on the development of **Pinus** seedlings. Knowledge of the invasive species of an area under cultivation is very important when deciding the best method of weed control; (2) - **Disease control.** Many weeds are natural hosts of disease carrying viruses, bacteria and fungi as well as of insect pests (Sewell, 1981; Smith

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et al. 1989). A good example is given by the bacteria **Pseudomonas sonanacearum** (Smith) Smith which is responsible for causing the wilt disease in many crops including the eucalypt (**Eucalyptus** spp.) (Smith **et al.** 1989). This bacteria is hosted by solanaceous plants as well as by several weeds of euphorbs and composites, as well as by the Amazon genus **Heliconia**; (3) - **Ecological information**. The importance of the fast reproducing "true weeds" for microadaptation and evolutionary studies have been pointed out by authors such as Baker (1974). The greatest ecological significance of the present paper has to do with the invasive pioneer spcies listed at Table 1. This information may be important for studies in natural forest regeneration and secondary succession.

MATERIALS AND METHODS

The work consisted of collecting and recording the invasive plant species found in sampling plots of 100 x 100 m placed in 16 different areas recently planted with tree seedlings. After collecting on the first three areas the check-list of the weeds was almost complete and allowed the checking for the presence or abscence of the species in each of the remaining plots. Voucher materials were deposited in the JARI herbarium, Monte Dourado and duplicates were sent to the MG and INPA herbaria. The species of Asteraceae (Compositae) were also sent to the RB herbarium.

Although the major objective was to make a check-list of the invasives that occur in the areas of plantation forestry, an estimation of their relative frequency was made based on their presence or absence in the sixteen areas surveyed. The species that occurred in less than three areas were considered being of low density (L), those which ocurred between four and seven were placed in the class of medium density (M), and those which occurred in eight or more areas were placed in the high density category (H). A further classification separated the invasives into two categories: W = true weeds, P = pioneer species.

RESULTS

Table 1 gives the check list of the invasive plants found in the plantation forestry studied in the Jarim river basin. About 180 species were found, of which 70 were considered "true weeds", while the remaining were pioneer species from a secondary succession of the natural vegetation.

As far as relative density is concerned it was found that the great majority of the species in the medium and high frequency classes were "true weeds" while the pioneer belonged mostly to the low frequency class.

Fifty plant families (the ferns were counted here as one family, for practical reason) and about 180 species were found in the sixteen areas surveyed. The Poaceae (grasses) has the greatest number of different species (28), followed by Cyperaceae (sedges), Asteraceae and Leguminosae (each with 13 species) and Euphorbiaceae and Solanaceae (with 10). The families **Rubiaceae**. **Lamiaceae** e **Molluginaceae** had few species but some of the most noxious of the "true weeds" belonged to them: **Borreria verticillata, Hyptis mutabilis** and **Mollugo verticillata.**

CONCLUSION

The check-list of Table 1 seems to have a much larger numer of species than other lists found in the literature, such as in Dantas & Rodrigues (1980) and Gonçalves **et al.** (1974). This can be explained by the

Table I.
Check list of the invasive plants of plantation forestry in the region of Jari, lower Amazon.

Family Species (Synonyms)	Type(a)	Frequency(b)		Voucher (M.J.Pires, Col. nº)
ACANTHACEAE				
Ruellia inflata Rich	W	-	M	(1305,1324)
Ruellia pipericaulis Rizzini	P	-	L	(1148)
AMARANTHACEAE				
Alternanthera brasiliana Kuntze	W	-	L	(1289)
Cyathula prostrata Blume	W	-	L	(1017)
(C. geniculata Lour).				
APOCYNACEAE				
Anartia flavicans Miers	P	-	L	(752,938,1218)
(Tabernaemontana flavicans Willd.				
ex. Roem. & Schult.)				
Bonafousia undulata A.DC.	P	-	L	(1019)
(Tabernaemontana undulata Vahl)				
Condylocarpon pubiflorum Muell. - Arg Tabernaemontana angulata Mart..	P	-	L	(1125)
ex Muell. - Arg	P	-	L	(1088,1226)
ARACEAE				
Dieffenbachia humilis Poepp. & Endl.	P	-	L	(983)
ARECACEAE/PALMAE				
Bactris cf. sphaerocarpa Trail	P	-	L	(985,1207)
Desmoncus polyacanthos Mart.	P	-	L	(998)
Maximiliana martiana Karst	P	-	L	(924)
(M. regia Mart.)				
Orbignya sagotii Trail ex Im Thurm	P	-	M	(1626)
ARISTOLOCHIACEAE				
Aristolochia sp.	P	-	L	(1206)
ASCLEPIADACEAE				
Blepharodon sp.	P	-	L	(1087)
ASTERACEAE (COMPOSITAE)				
Acanthospermum australe Kuntze	W	-	H	(958,1110,1164)
(A. brasilum Schrank).				
Ageratum conyzoides L.	W	-	L	(1035,1210)

Cont.

Family Species (Synonyms)	Type(a)	Frequency(b)		Voucher (M.J.Pires, Col. nº)
Bidens pilosa L.	W	-	H	(1066,1300)
Emilia sagittata DC.	W	-	H	(793,1073)
(E. flammeae Cass).				
Emilia sonchifolia Benth.	W	-	H	(1149,1151)
(E. flammea Cass.)				
Erechthites hieracifolia				
Rafin, ex DC.	W	-	H	(908,1085,1165)
(E. praealta Rafin.)				
Eupatorium macrophyllum L.	W	-	L	(967,1213)
Eupatorium odoratum L.	W	-	L	(1304)
(E. conyzoides Vahl)				
Eupatorium spp.	W	-	M	(1074,1101,1312)
Porophyllum ellipticum Cass.	W	-	M	(950,1050,1238)
(P. ruderale Cass.)				
Rolandra fruticosa Rottb.	W	-	M	(929,1129)
(R. argentea Rottb.)				
Unxia camphorata L	W	-	L	(1225)
Melampodium camphoratum Benth. & Hook. (f.)				
Vernonia cinerea (L.) Less.	W	-	B	(1038,1119)
Vernonia spp.	W	-	B	(1042)
BIGNONIACEAE				
Arrabideae spp.	P	-	B	(1167,991,1161)
Memora racemosa A. Gentry	P	-	L	(1314)
Unknown	P	-	L	(1162)
BORAGINACEAE				
Cordia scabrida Mart.	P	-	L	(1122)
BROMELIACEAE				
Ananas ananosoides (Baker)				
L.B. Smith	P	-	L	(914,1625)
CAMPANULACEAE				
Centropogon comutus Druce	P	-	L	(973)

Cont.

Family Species (Synonyms)	Type(a)	Frequency(b)		Voucher (M.J.Pires, Col. nº)
CLUSIACEAE (GUTTIFERAE)				
Vismia baccifera Tr. & Pl.	P	-	L	(1157,1203)
(V. panamensis Duchass & Walp.;V. Ferrugineae H.B. & K.)				
COMMELINACEAE				
Dichorisandra hexandra (Aubl.) Stand.	P	-	L	(1010)
CONVOLVULACEAE				
Ipomoeae phillomega House	P	-	L	(923)
Ipomea sp.	P	-	L	(992)
Jacquemontia tamnifolia Griseb.	P	-	L	(1281)
Merremia glabra Hallier	P	-	L	(1298,1340)
(Ipomoeae glabra Choisy)				
Merremia macrocalyx				
(Ruiz & Pavon O'Donell	P	-	L	(1014)
COSTACEAE				
Costus arabicus Aublet	P	-	L	(982)
(Costus spicatus Sw.)				
CUCURBITACEAE				
Cayaponia jenmanii C. Jeffrey	P	-	L	(997)
Gurania cissoides Cogn.	P	-	L	(976)
Gurania spinulosa Cogn.	P	-	L	(994,1299)
Melothria pendula L.	P	-	L	(1216)
CYCLANTHACEAE				
Carludovica latifrons Drude	P	-	L	(993)
CYPERACEAE				
Becquerelia cymosa Brongn.	P	-	L	(1174)
Cyperus diffusus Vahl.	W	-	M	(978,1011,1034)
Cyperus ligularis Hort.(C. congestus Vahl)	P	-	M	(1031,1060)
Cyperus sphacelatus Rottb.	P	-	L	(1241)
Cyperus spp.	W/P	-	M	(1098,1253)

Cont.

Family Species (Synonyms)	Type(a)	Frequency(b)		Voucher (M.J.Pires, Col. nº)
Dichromena ciliata Vahl	P	-	L	(930,1202)
Dichromena pubera Vahl	P	-	L	(1332)
Fimbristylis dichotoma (L.) Vahl	P	-	L	(1194,1260)
Fiurena umbellata Rottb.	P	-	L	(942)
Rhynchospora graminea Uitt.	P	-	L	(1188)
Rhychospora sp.	P	-	L	(1195)
Scleria bracteata Cav.	P	-	L	(514)
Scleria melaleuca Reichb. ex Schlecht. & Cham.	W	-	B	(1193)
Scleria pterota Presl.	P	-	L	(1252,1255)
DILLENIACEAE				
Davilla kunthii St. Hil.	P	-	L	(1072,1310)
EUPHORBIACEAE				
Acalypha arvensis Poepp. & Endl.	P	-	L	(1006,1302)
Aparisthmium cordatum Baill. (Alchornea cordata Muell. Arg.	P	-	L	(1000)
Croton lobatus L.	P	-	L	(961,1013)
Croton miquelensis Ferg.	W	-	H	(1021,1145)
Croton tomentosus Link. (C. flavens L.)	W	-	L	(518)
Mabea angustifolia Spruce ex Benth.	P	-	L	(1178)
Manihot brachyloba Muell. Arg.	P	-	L	(1090)
Manihot sp.	P	-	L	(1083)
Phyllanthus carolinensis Walt.	W	-	M	(939,969,1239)
Phyllanthus orbiculatus Rich.	W	-	M	(1092,1103)
Sebastiania comiculata Muell. Arg.	P	-	L	(1240)
GENTIANACEAE				
Chelonanthus chelonoides Gilg. (Lisianthus chelonoides L.)	W	-	B	(911,1186)

Cont.

Family Species (Synonyms)	Type(a)	Frequency(b)		Voucher (M.J.Pires, Col. nº)
HELICONIACEAE				
Heliconia acuminata A. Rich.	P	-	L	(824,1201)
(H.ballia Rich.)				
Heliconia bihai L.	P	-	L	(980)
(Stralitzia augusta Salisb.				
LAMIACEAEA (LABIATAE)				
Hyptis gaudichaudii Benth.	W	-	M	(966,1146,1328)
Hyptis suaveolens Poit	W	-	M	(944,1269)
Hyptis atrorubens Poit	W	-	L	(1179,1284)
LEGUMINOSAE - CAESALPINIOIDEAE				
Bauhinia bicuspidata Benth.	P	-	L	(984b)
Bauhinia sp.	P	-	L	(1271)
Cassia chrysocarpa Desv.	P	-	L	(1327)
Cassia latifolia G.F.W. Mey	P	-	L	(1272)
Cassia nictitans L.	P	-	L	(960)
Cassia tora L.	W	-	L	(965)
LEGUMINOSAE - PAPILIONOIDAE				
Aeschynomene americana L.	P	-	L	(1250)
Centrosema grazielae V.B. Barbosa	W	-	L	(1209)
Desmodium barbatum Wall.	W	-	L	(1141)
(D. confertum DC.)				
Machaerium aureiflorum Ducke	P	-	M	(1089)
Machaerium ferox Ducke	P	-	L	(999,1222)
Vigna luteola Mart.	P	-	W	(1084,1295)
(V. glabra Savi)				
Zornia diphylla Pers	W	-	M	(957,1022)
LEGUMINOSAE - MIMOSOIDEAE				
Mimosa camporum Benth.	P	-	L	(1200)
Marmaroxylon racemosum (Ducke) Killip	P	-	L	(1070)
(Pithecellobium racemosum Ducke)				

Cont.

Family Species (Synonyms)	Type(a)	Frequency(b)		Voucher (M.J.Pires, Col. nº)
MALPIHIACEAE				
Banisteriospsis schwannioides				
(Grisebach) B. Gates	P	-	L	(1152,1370)
Banisteriospsis sp. (1267)				
Mascagnia multiglandulosa Niedenzu	P	-	L	(907)
Mascagnia sepium Griseb.	P	-	L	(956,1264)
(Hiraea sepium A. Juss.)				
Stigmaphyllon sp.	P	-	L	(1266)
MALVACEAE				
Cienefuegosia sp.	W	-	L	(963)
Sida cordifolia L. Medic.	W	-	L	(1321)
Sidastrum micranthum (A.St.Hil.) Fryxell	W	-	L	(1317)
Sida rhobifolia L.	W	-	M	(1144,1228)
Urena lobata L.	W	-	H	(1254,1279)
MARANTHACEAE				
Ischnosiphon gracilis Koern.	P	-	L	(1217)
Monotagma plurispicatus K. Schum.	P	-	L	(931)
(Ischnosiphon plurispicatus Koern.)				
MENISPERMACEAE				
Cissampelos sp.	P	-	L	(990)
MOLLUGINACEAE				
Mollugo verticillata L.	W	-	H	(1166,1326)
MORACEAE				
Cecropia obtusa Tréc.	P	-	H	(910,1004,1331)
Ficus hebetifolia Dugand	P	-	L	(1077)
MYRTACEAE				
Eugenia sp.	P	-	L	(1127)
ONAGRACEAE				
Jussieua sp.	P	-	L	(1008)
Ludwigia torulosa (Arn.) Hara	P	-	L	(922,1143,1242))

Cont.

Family Species (Synonyms)	Type(a)	Frequency(b)		Voucher (M.J.Pires, Col. nº)
PASSIFLORACEAE				
Passiflora glandulosa Cav.	P	-	L	(523,1160))
PIPERACEAE				
Piper hispidum Mart. & Gal.	W	-	L	(1019b)
(P. mexicanum C.DC.)				
Piper marginatum Jacq.	W	-	L	(1012,1205,1293)
Piper spp.	P	-	L	(921,1219,1493,1494)
Pothomorphe peltata Miq.	P	-	L	(1016)
(Piper peltatum Ruiz & Pavon)				
POACEAE (GRAMINEAE)				
Andropogon bicornis L.	W	-	H	(933,1069)
Axonopus sp.	W	-	L	(1080,1309)
Digitaria insularis (L.) Fedde	W	-	M	(1059,1259)
Eleusine indica (L.) Gaertn.	W	-	L	(1176)
Eragrostis ciliaris (Kunth)	W	-	M	(1132,1155,1306)
Eragrostis maypurensis (H. & B.) Steud.	W	-	L	(1134)
Homolepis aturensis (H. & B.) Chase	W	-	M	(1296,1319)
Ichnanthus breviscrobs Doell	W	-	L	(728,915)
Leptochloa filiformis Beauv.	W	-	L	(1111,1248)
(L. cyanosuroides Roem. & Schult.)				
Leptochloa Virgata (L.) Beauv.	W	-	L	(955,1026)
Leptochloa spp.	W	-	L	(1099,1135)
Melinis minutiflora Beauv.	W	-	L	(1051,1093)
Olyra micrantha H.B. & K.	P	-	L	(1168)
Panicum bolivense Hackel	W	-	L	(916,1047,1078)
Panicum laxum Sw.	W	-	L	(1247)
Panicum maximum Jacq.	W	-	L	(1138,1211,1318)
Panicum milleflorum Hitchc. & Chase	W	-	L	(1212)
Panicum rivulare Trin.	W	-	L	(1124)
Panicum sp.	W	-	L	(1213)

Cont.

Family Species (Synonyms)	Type(a)	Frequency(b)		Voucher (M.J.Pires, Col. nº)
Pariana nervata Sw.	P	-	L	(1181)
Paspalum conjungatum Berg.	W	-	L	(1045,1177)
Paspalum conspersum Schrad. ex. Schult.	W	-	L	(947)
(P. virgatum L.)				
Paspalum decumbens S.W.	W	-	L	(1208)
Paspalum multicaule Poir	W	-	L	(906,1133,1189)
Paspalum paniculatum L.	W	-	L	(1025)
Paspalum plicatum Pers.	W	-	L	(1199)
Paspalum virgatum L.	W	-	L	(1030,1235)
Paspalum sp	W	-	M	(1325,1338)
POLYGALACEAE				
Trichachne insularis				
Polygala sp.	P	-	L	(1224)
Securidaca sp.	P	-	L	(1126)
RUBIACEAE				
Borreria latifolia K. Schum.	W	-	H	(1262,1330)
(Spermacoce latifolia Aubl.)				
Borreria verticillata G.F. Mey	W	-	H	(1079,1320)
(Spermacoce verticillata Spreng.)				
RUTACEAE				
Zanthoxylum rhoifolia Lam.	P	-	L	(1175)
Moniera sp.	P	-	L	(1261)
SCHROPHULARIACEAE				
Lindernia crustaceae F. Muell.	W	-	L	(1007)
(Vandellia crustacea Bentham; V. irosinensis Elmer ex Merril;				
Antirrhinum hexandrum Forsk.; Capraria crustaceae L.)				

Cont.

Family Species (Synonyms)	Type(a)	Frequency(b)		Voucher (M.J.Pires, Col. nº)
Lindernia diffusa Wettst.	W	-	L	(926,1192)
(Vandellia diffusa L.)				
Scoparia dulcis L.	W	-	L	(1215)
SMILACACEAE				
Smilax sp.	P	-	L	(1123)
SOLANACEAE				
Physalis viscosa L.	W	-	M	(996,1244)
Solanum coarense Sendt.	P	-	L	(1220)
Solanum grandiflorum Ruiz & Pavon	P	-	M	(1076,1128)
Solanum granuloso-leprosum Dun.	P	-	L	(1283,1323)
Solanum leucocarpon Dun.	P	-	L	(1291
Solanum rugosum Dun.	P	-	L	(1102,1140)
Solanum salvifolium Lam.	P	-	M	(1118,1159,1180)
(S. Radula Vahl)				
Solanum schlechtendalianum Walp.	P	-	L	(977)
Solanum subinerme Jacq.	P	-	L	(1075)
Solanum surinamense Steud.	P	-	L	(1020,1170)
STERCULIACEAE				
Melochia melissifolia Benth	W	-	H	(1150,1236,1333)
THEOPHRASTACEAE				
Clavija lancifolia Desf.	P	-	L	(945)
TILIACEAE				
Corchorus hirtus L.	W	-	L	(1251)
TURNERACEAE				
Piriqueta cistoides C.F.W. Mey ex Steud.	W	-	M	(1223,1243)
(P. villosa Aubl.)				
ULMACEAE				
Trema micrantha Blume	P	-	M	(920,1290)

Cont.

Family Species (Synonyms)	Type(a)	Frequency(b)		Voucher (M.J.Pires, Col. nº)
VERBENACEAE				
Aegiphila amazonica Moldenke	P	-	L	(1169)
Lantana camara L.	W	-	L	(1172)
Stachytarpheta cayennensis (L.C. Rich) Vahl	W	-	H	(1094,1280)
PTERIDOPHYTA (FERNS)				
Lycopodium cernuum L. (Lycopodiella cernua (L.) Pichi.-Serm.)	W	-	L	(943)
Nephrolepis biserrata L.	W	-	L	(1015)
Pteridium aquilinum (L.) Kuhn	W	-	L	(936,1091)
Ptyrogramma calomelanos (L.) Link.	W	-	L	(925,1214)
Selaginella stellata Spring	P	-	L	(1009)

fact that the forestry plantations of Jari are relatively new when compared with other agricultural lands and pastures, and therefore have more resources in their soil seed bank. It would be interesting to compare the pioneer species listed in Table 1 with a list of the species found in areas of known stages of forest secondary sucession. This would inform whether or not the periodical cutting of the planted forest maintained the invasive community of pioneers at an early stage of secondary succession.

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SUMMARY

The work consists of a survey of the invasive plants which appeared during the first six months of seedling stage in forest plantations of second and third rotation, in the Jari area,

Brazil. The resulting list showed two types of invasives: (1) **true weeds** - those cosmopolitan species that are typical of disturbed habitats; and (2) **pioneer species** - those which were probably remnants from the original natural vegetation of the studied area.

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