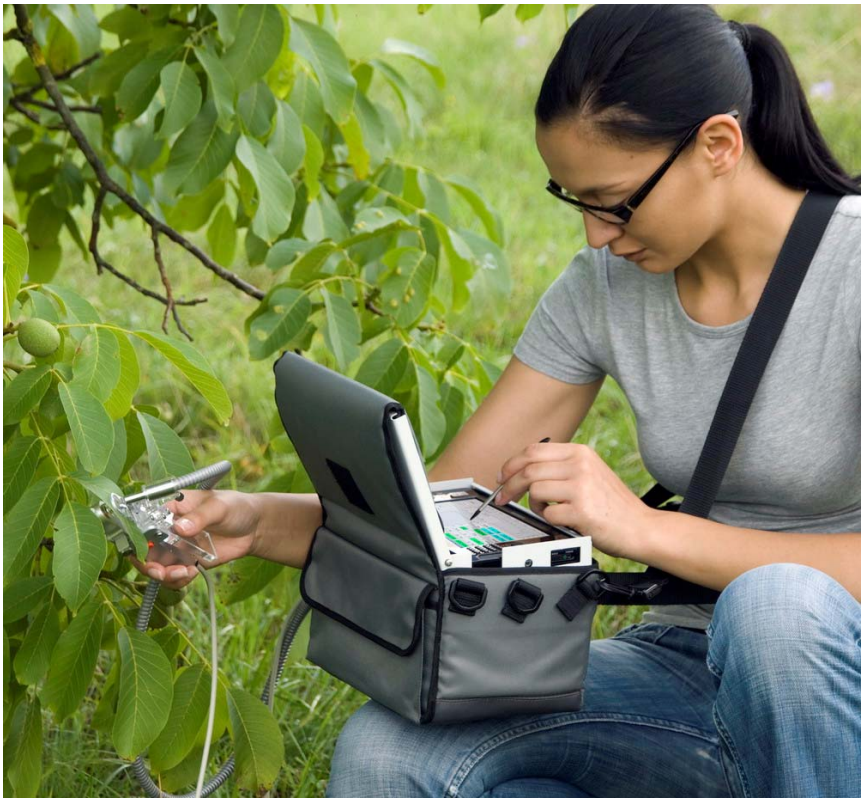
便携式调制叶绿素荧光仪

PAM-2500

操作手册



泽泉科技有限公司

Zealquest Scientific Technology Co., Ltd

泽泉生态开放实验室

Zealquest Laboratory for Ecological Research

上海总部： 中江路 879 号天地软件园 28 幢 402-403 座 (200333) 电话：021-51556112/3/4/5/6/7/8 传真：021-51556111

北京分公司： 西三环北路 72 号世纪经贸大厦 2600 室 (100037) 电话：010-88824075/76/77 传真： 转 605 分机

广州代表处： 天河区马赛国际公寓 C 栋 2213A (510632) 电话：020-62819702,62819932 传真： 转 806 分机

成都代表处： 人民南路一段 97 号现代之窗 1018 室 (610016) 电话：028-86722096，86719836 传真：028-86721922

新疆代表处： 乌鲁木齐人民路 33 号瑞达国际大厦 1501 室(830004) 电话：0991-2328056 传真：0991-2825296

http://www.zealquest.com **E-mail: sales@zealquest.com**

目录

1 安全指导

1、仪器安装使用前首先阅读安全指导和操作指南

2、注意所有的安全警告

3、保持仪器清洁，注意防尘，远离水和潮湿的地方。特别是主控单元PAM-2500和叶夹2030-B更应防潮和防尘。只要把敏感部位（如微型光量子探头）用塑料袋包住，即使在极端环境中（如潮湿或有风沙的地方）仪器也可正常操作运行。

4、仪器应放置在通风的环境中

5、仪器要远离热源

6、严格按照操作手册连接电源，**禁止在PAM-2500 开机的情况下连接外接电源！！！禁止在PAM-2500 开机的情况下通过数据线连接PC或UMPC！！！**

7、**禁止过度弯曲光导纤维！**

8、**禁止将光纤末端对着眼睛，防止灼伤！！！**

9、光源不用时应当关闭，这样可以延长光源的寿命。

10、测量间隙较长时应关闭主机，这样可以省电。**仪器长期放置不用时，应每隔2个月充电一次！**

11、每次测量开始前应通过调节“Gain”、测量光强或光纤与样品间的距离使只打开测量光时的荧光**Ft**（即**Fo**）在**300～900** 之间

12、只能按厂家推荐方法清洁仪器

13、不允许液体或其它东西进入仪器内部

14、仪器应由专业人员维修

2 简介

PAM-2500型便携式叶绿素荧光仪是著名的**PAM-2000/PAM-2100**叶绿素荧光仪的升级版。Walz 公司于1992 年研制出第一台便携式叶绿素荧光仪PAM-2000，它一面世就获得了良好的声誉，并在世界各地得到广泛应用。PAM-2500 保留了PAM-2000/PAM-2100的所有优点并且在技术上做了很大改进，它的硬件和光学系统都采用了最新的技术。结合最新的超便携个人电脑（UMPC）技术，仪器操作通过最新操作软件PamWin-3进行，完全基于Windows操作系统，界面友好。

PAM—2500的主要改进如下：

- 利用发光二极管（LED）提供光化光和饱和脉冲，不再使用散热量大的卤素灯
- 光化光为红蓝光源，由发光二极管（LED）提供
- PAM—2500的触摸屏使野外操作更为方便
- PAM—2500提供单周转饱和闪光和多周转饱和闪光
- 荧光测量的最大时间分辨率为15μs，可测荧光诱导曲线的快速上升动力学O-I-D-P相和O-J-I-P相
- 利用强大的UMPC电脑进行操作，完全基于Windows操作系统，界面友好
- 60 G硬盘，无限量存储

叶绿素荧光可以通过不同的方法测量，根据不同的应用目的，数据的分析方法也不同。便携式叶绿素荧光仪PAM-2500 在荧光测量和数据分析方面具有高度可塑性（flexibility）。但这并不意味着在开始测量前就必须掌握这台多功能仪器的所有特性。实际上，由于软件PamWin-3对仪器的控制是“智能化”的，因此操作失误几乎不对仪器本身产生有害影响。另外，也不必当心仪器参数的设置，因为这些都是标准测量设置，即使人为对其进行了改变，也可以随时恢复。因此，即使专业背景很弱的初级用户也很容易掌握测量方法，并且随着测量的进行对专业知识的掌握也会逐渐深入，直至能够进行高级应用。这本手册试图涵盖PAM- 2500的所有功能和应用，有些对用户来说可能暂时还用不到，但随着用户对测量结果分析的深入，这些功能可能会成为有用的辅助手段。如果时间允许的话，用户最好逐章阅读本手册，熟悉PAM-2500 的所有功能，并且重复列举的实验，以便更好的掌握本仪器。如果用户需要马上就使用本仪器的话，可以阅读第4章第2节“野外屏幕”。

3 PAM-2500 的组件及安装

3.1 基本系统组件

PAM-2500基本系统组件包括：

- PAM-2500主控单元
- 特制的光纤2010-F
- 60°距离叶夹2010-A
- 电池充电器MINI-PAM/L
- MINI-PAM/AK电缆
- 特制USB数据线PAM-2500/K1
- 荧光标准
- 保险丝
- 背包
- 运输箱2040-T
- 仪器操作及数据采集软件PamWin-3

3.2 基本系统的安装

PAM-2500的安装

- 将PAM-2500主控单元（图3.1 A）放置到一个平面上
- 将光纤的一段通过位于前面板的三孔光纤连接器（图3.1 A）连接到主控单元

注意：不要让任何物品进入光纤连接孔！！！

- 将电池充电器连接到仪器前面板的<EXT.DC>插孔，并接通电源（如果内置电池电量充足的话可以不用连充电器）。<Charge>指示灯（图3.1 A）黄灯亮表示正在充电，电池充满后绿灯亮。请注意，外置12 V电池不能给内置电池充电，但是可以通过MINI-PAM/AK电缆给仪器供电。
- 将特制USB数据线连接到计算机
- 按POWER ON键打开仪器。<Status LED>指示灯开始闪烁说明仪器以正常启动可以进行软件连接。

当电脑成功连接好仪器后<Status LED>指示灯会一直亮着。如果没有连接电脑而<Status LED>指示灯一直亮着说明PAM-2500发生错误，一般情况下将仪器关掉后等几秒钟后重新开机便可恢复正常。

注意：四个连接插孔（LEAF CLIP、AUX、EXT. DC和USB）不能连错。不能将插头接到错误的插孔里。插头和插孔上的红点指示了连接方向。不要通过拽电缆来拔出插头，应当通过捏住带波纹的金属部位来拔出插头。

图3.1 PAM-2500主控单元前面板

3.3 安装 PamWin-3 软件

- 登录http://www.walz.com/ 下载最新版PamWin-3（或者使用随机光盘中的PamWin-3），双击软件进行安装。（建议将软件安装到D盘或者E盘等非系统分区）安装完成后会在桌面上出现PamWin-3快捷方式。
- 双击桌面上PamWin-3的快捷方式启动软件。

3.3.1 USB 端口设置

安装 PamWin-3 时，程序会安装 USB 数据线的驱动。第一次启动 PamWin-3 时需要对 USB 端口进行设置，设置方法如下（Windows XP）：

- 首先确保 PAM-2500 已打开，USB 数据线以连接好并且已经成功安装了驱动
- 在桌面右键点击“我的电脑”，选择“属性”
- 点击“硬件”标签
- 点击“设备管理器”
- 选择“端口（Com 和 LPT）”，双击展开
- 选择“USB Serial Port COM#”，双击打开
- 点击“端口设置”
- 点击“Advanced”
- 将“Latency timer”设置为 1ms
- 点击“确定”完成设置

3.3.2 蓝牙无线连接

- 注意：相对 PamWin-3 的<Fast Kinetics>模式来说，蓝牙的数据传输速度太慢，所以当用蓝牙进行无线连接时，<Fast Kinetics>模式不可用。
- 确保 PAM-2500 已打开并且没有通过 USB 数据线进行连接。
- 在桌面或者开始菜单打开“我的蓝牙位置”
- 双击“搜索蓝牙设备”
- 现在设备<PAM 2500 SNR XXXX>会出现在蓝牙列表上(X 代表了 4 位阿拉伯数字)。如果列表中没有 PAM 2500，请调整 PAM2500 和电脑的位置（注意：蓝牙天线在 PAM 2500 的后端顶部）
- 双击<PAM 2500 SNR XXXX>，接着双击<SerialPort on PAM 2500 SNR XXXX >
- 输入“蓝牙安全码”（BlueTooth security code），所有的 PAM 2500 都是输入：**2500**
- 到此，蓝牙连接已连接好

3.4 野外背包

1）UMPC 超便携电脑

2）外置电池 000160101314

3）自动充电器 0001X

图 3.2 野外安装 PAM-2500

通过野外背包可以将 PAM-2500 转变成一个功能强大的便携式调制荧光仪，图 3.2 图示了野外背包的组装过程。

3.5 其它组件

3.5.1 特制光纤 2010-F

特制光纤 2010-F 在一个特制插头的帮助下可以连接到 PAM-2500 的前部（仪器右侧）。光纤有三个光学直径不同的末端，在插头的帮助下分别接入对应的插孔中与相应的光学装置相连。在特制的插头内，光纤的三个末端整合到一起与光纤主体相连，光纤主体的光学直径为 6 mm，长 100 cm。

注意：光纤应轻拿轻放。光纤（特别是与主控单元相连的末端部位）不能被过度弯曲，否则可能会导致光纤破损从而影响信号强度。光纤被钢制螺旋和塑料覆盖，在一定程度上避免了过度的弯曲。

3.5.2 60°距离叶夹 2010-A

“距离叶夹”上有两个隔离环（spacer ring）用来确定光纤前端与叶片间的距离。光纤与叶片呈 60°角。这样如果光纤前端朝向入射光方向的话，就不会在叶片上产生阴影。样品可以放在透光孔的下部，也可以放在透光孔的上部（图 3.3）。当叶片放在透光孔的上部时，可将叶片抵在叶夹的折叠

部位。当样品为厚叶片、地衣或苔藓时经常放在透光孔下部。

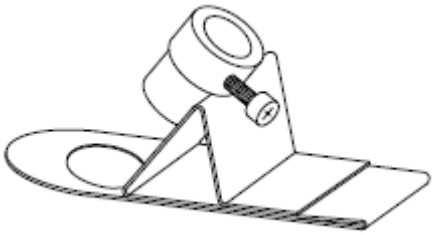


图 3.3 “距离叶夹”，可以调节光纤和叶片之间的距离

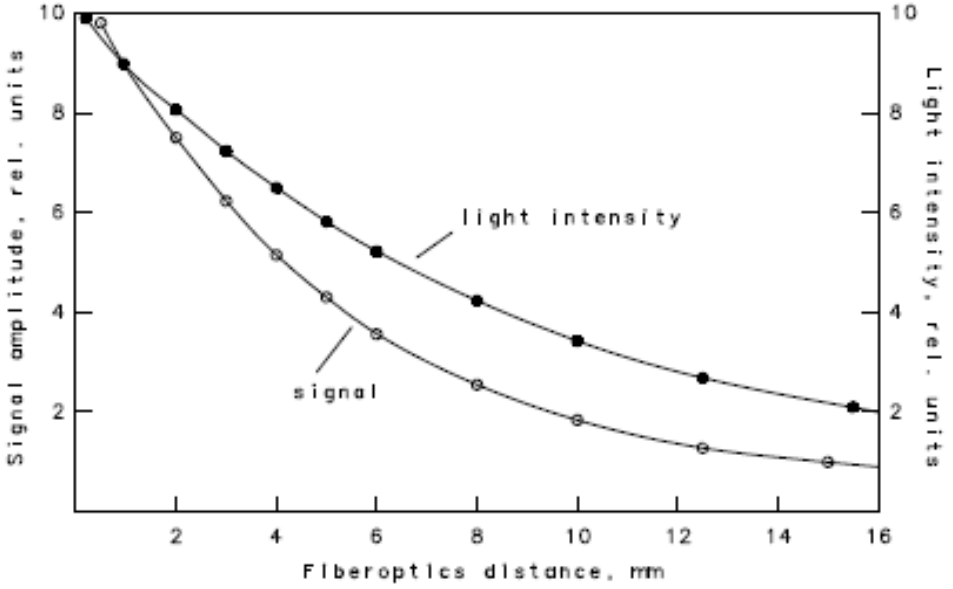


图 3.4 信号强度/光强和样品与光纤间距离的关系

光纤末端与样品间的距离对信号强度和有效光强有影响。由于光纤与叶片呈 60° 角，光纤与叶片间距离的改变不可避免的会产生一系列的有效光强梯度。但这种影响不应被过于夸大，因为在叶片内部由于叶绿体的遮荫作用，存在更大的垂直光强梯度。同时，测量的信号主要由吸收光强最多的叶片部位发出，这些部位被测量光激发的程度最高，光纤接收到的荧光主要由它们发出。图 3.4 描述了信号强度和光强对光纤与样品间距离的依赖性。

3.5.3 叶夹 2030-B

叶夹 2030-B 是 PAM-2100 最重要的附件，在环境光和温度不断变化的野外，它不可或缺。它可以代替标准的“距离叶夹”。其特点是配备了特制的微型光量子/温度探头，每个测量数据都被及时传到 PAM-2500。

叶片被 2030-B 的两个扁平有机玻璃环夹住，该环具有较宽的平面，可以通过垂直调整两个环的距离来适应不同厚度的叶片。光纤与叶片成 60° 角。另外还具有一个 90° 角光纤适配器（2030-B90）可

供选择。光纤与叶片之间的距离可以调整，标准距离由隔离环确定。叶片照光部分由一直径 10 mm 的不锈钢环决定。

图 3.5 插有光纤 2010-F 的 2030-B 叶夹

在叶夹 2030-B 的底部具有连接三角架的螺纹接口。将该支架固定在三角架（如便携式三角架 ST-2101）上有助于对同一植物的长期测量。

在叶夹 2030-B 的手柄部位有一个红色按钮，用于对 PAM-2500 进行遥控。按此按钮就相当于按键盘上的回车键。这样可以一手扶着叶片，一手拿着叶夹并遥控操作来测量荧光，特别适合于野外工作。

3.5.3.1 微型光量子探头

叶夹 2030-B 上配有一微型光量子探头，用于测量叶片吸收的光合有效辐射（Photosynthetic Active Radiation，PAR）。在总共 80 mm^2 的测量面积上，探头只占 4 mm^2，这基本不影响荧光信号的检测。微型光量子探头的必备光电元件为：

- 一个 1.5 mm 的漫射盘（diffusing disk）；
- 一个直径 0.5 mm 的光纤，用于介导光纤到检测器；
- 一个滤光片组合，用于选择性的测量波长在 380 nm～710 nm 光合有效辐射；
- 一个蓝光增强的硅光电二极管。

除了尺寸小外，探头还保证即使以很小的入射角入射的光线（如日出日落时）也会被检测到。由于探头紧挨着叶片，因此能保证探头测得的 PAR 几乎就是叶片吸收的 PAR。光强单位为 $\mu mol \cdot m^{-2} \cdot s^{-1}$。这样 PAR 就等价于 PPFD（photosynthetic photon flux density，光合有效光量子通量密度）。连接叶夹

2030-B 后，在显示屏的 PAR 参数区会显示测得的 PAR 值。

该探头经过了 LI-COR 光量子探头的校准。校正的稳定性依赖于探头表面是否清洁。建议用标准光量子探头定期校准。任何偏差均可在 PamWin-3 程序中输入校正因子来校正（见 4.3.1.1）。当校正因子（由初始值 1.000）明显升高时，表明探头表面不清洁，需用酒精棉球轻轻擦拭。

需要指出的是，在许多应用中，荧光参数的合理解释需要获得荧光测量点的 PAR 值。因此带光量子探头的叶夹 2030-B 可以被认为是 PAM-2500 最重要的附件。测得的 PAR 值会自动存入报告文件中。

3.5.3.2 热电偶

叶夹 2030-B 带有一个 NiCr-Ni 热电偶，用于测量叶片温度。其末端为一圆环，可以轻轻接触叶片反面。这样既能有效测量温度，又防止了阳光直射。参照电偶位于电路板上，靠近热电压计放大器，密封于叶夹底部。热电压与温度几乎完全呈线性关系。当温度降低时，ΔV/℃也稍有降低。校准是在 25℃进行的。在 0℃和－15℃，偏差分别为 0.5 和 0.8℃。在 PamWin-3 程序中可以输入零偏移值（见 4.3.1.1），其精度为 0.3℃。当连接叶夹 2030-B 时，测得的温度显示在显示屏的 Tmp 参数区。温度精度为 0.3℃。测得的温度也会自动存入报告文件中。

3.5.4 微型光量子/温度探头 2060-M

微型光量子/温度探头 2060-M 可以测量 PAR 和温度，这种功能与叶夹 2030-B 相同，只不过 2060-M 不是固定在叶夹上的。此装置主要是为非叶形样品如地衣、苔藓等设计的。这两个微型探头可以放在荧光测量部位，但不影响荧光测量。它们也可以装在”距离叶夹”（“Distance Clip”）上。

3.5.5 暗适应叶夹 DLC-8

图 3.6 暗适应叶夹

暗适应叶夹 DLC-8 重 4 g，因此可以直接夹到多数叶子上，而不会伤害到叶片。在叶夹上装有一个滑片，可以在暗适应时阻止光线照射。实际测量时，打开滑片，使叶片只受到来自光纤的光，而不受环境光干扰。只有经过合理的暗适应，才能得到较好的最大量子产量 Fv/Fm 和暗-光诱导动力学曲线。

在使用暗适应叶夹 DLC-8 时，光纤与叶片间呈直角，叶片与光纤末端间的距离约为 7mm。这样就导致荧光信号比使用叶夹 2030-B 时（光线入射角 60º ）高的多。为了避免检测器饱和，需降低测量光强度或 Gain（增益）。

当滑片仍关闭时打开测量光，也会有部分 Ft 信号。这些信号是由于部分测量光被滑片反射而干扰检测器的结果。当打开滑片时这种干扰就几乎没有了，所以不影响正常测量。

4 使用 PAM-2500

4.1 PamWin-3 帮助文档

PamWin-3 的每步操作都提供一个在线帮助文档。通过下列途径打开帮助文档：

- 将鼠标移动到想要得到帮助的地方，稍等片刻即可出现帮助文本提示
- 将鼠标移动到想要得到帮助的地方，按 F1 弹出帮助文档

4.2 野外屏幕（Field Screen）

PamWin-3 的野外屏幕（Field Screen）适用于 PAM-2500 的野外操作。在野外通过 UMPC 的触摸屏对<Field Screen>进行操作。<Field Screen>分为三个区，分别为：字母数字区（alphanumeric fields）、程序和脚本控制区（program and script control）和监测图形显示区（monitoring graphs）（图 4.1）。

字母数字区（alphanumeric fields）显示了饱和脉冲分析的重要信息，同时也包含一个 Zoom In 按钮，这个按钮可以切换字母数字区（alphanumeric fields）为全屏显示。

<Field Screen>显示了两个不同类型的图形（图 4.1）左边监测图形显示了慢速荧光变化曲线，同时也显示了 Fm 和 Fm’。通常来讲进行饱和脉冲分析时只有 Fm 或 Fm’在该区显示时，饱和脉冲的数据才会记录到报告文件中。如果监测图形（monitoring graphs）被停止后，通过 SAT 键执行的饱和脉冲记录的数据不会记录到报告文件中，可以通过点击 Report 按钮查看报告文件。

PamWin-3 启动后，慢速动力学监测图形会自动启动。点击 Fv/Fm 按钮（见下文）后将重启慢速动力学监测图形，也可以通过点击 Stop/Start 来重启慢速动力学监测图形。测定 Fv/Fm 时程序会自动调整 Y 轴坐标从而使图形完全显示出来。荧光信号值可以从 Y 轴读取。在每个图形中，程序都会用黄色和红色的虚线将 Fo 和 Fm 的值分别标示出来。

右侧监测图形显示了当前饱和脉冲的荧光曲线（1.6S 钟长），除了 Fo 和 Fm 外，程序用黑色虚线将 Fm’的值标示出来。

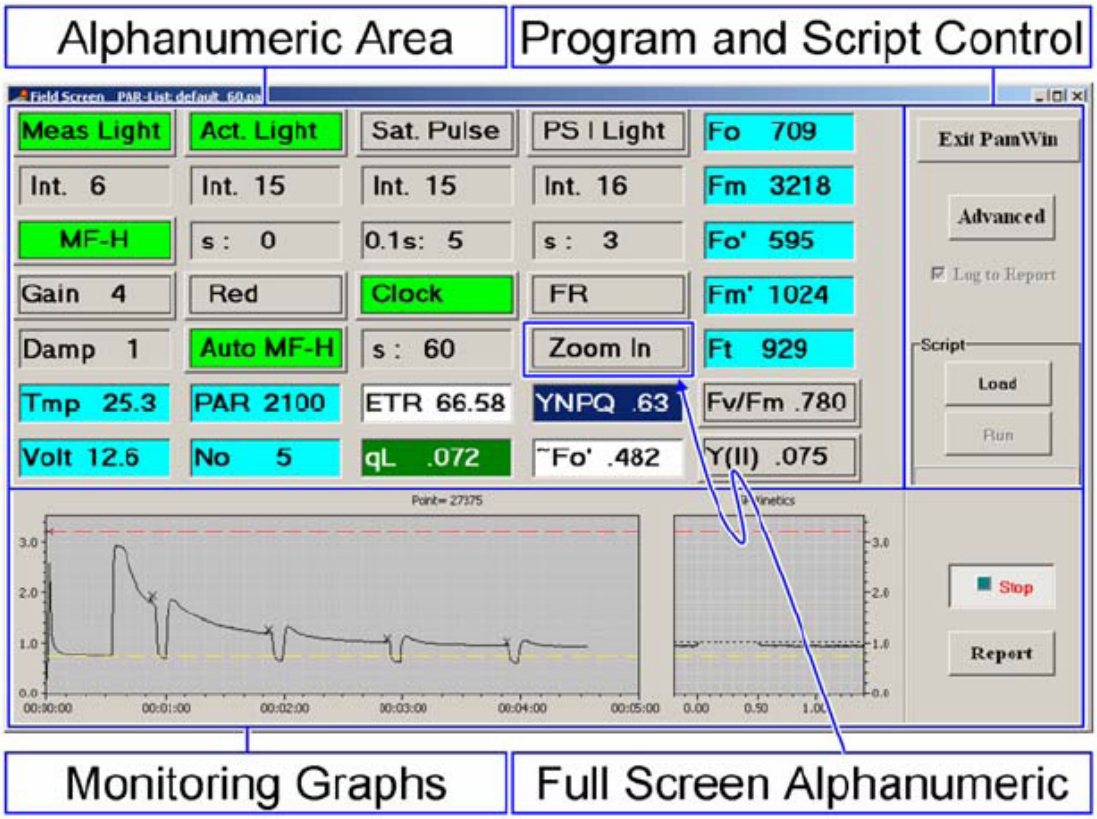


图 4.1 野外屏幕总览

程序和脚本控制区包括退出程序的按钮 Exit PamWin、高级设置按钮 Advanced 和载入自定义脚本的按钮 Load 和 Run。

4.2.1 字母数字区（alphanumeric fields）

字母数字区可以分为 4 组：a）光源控制；b）主要荧光数据；c）荧光比值参数；d）其它数据，光强和温度等（图 4.2）。

组一：包括状态按钮和调节按钮。按钮状态的变化可以开/关某个功能或者调节某个值。可以通过鼠标左键的点击来改变按钮的状态，当某个按钮的背景是绿色的时候表明当前按钮执行的功能处于激活状态。控制光源颜色的按钮以文字形式将当前光源的颜色显示出来。

调节按钮的值可以通过三种方式调整：1）在按钮上点击鼠标左键后用滚轮进行调整；2）在按钮上双击鼠标左键后输入数值；3）用 UMPC 操作时，轻点按钮然后用上下箭头进行调整，方向键的下箭头为减，按住 shift，再按方向键的上箭头为加，或者直接按加号也可增加数值。

组二，组三和组四显示了当前测量的相关信息。当用鼠标点击 Fv/Fm 或者 Y(II)按钮时都会执行一

个饱和脉冲（见 4.2.1.3）。

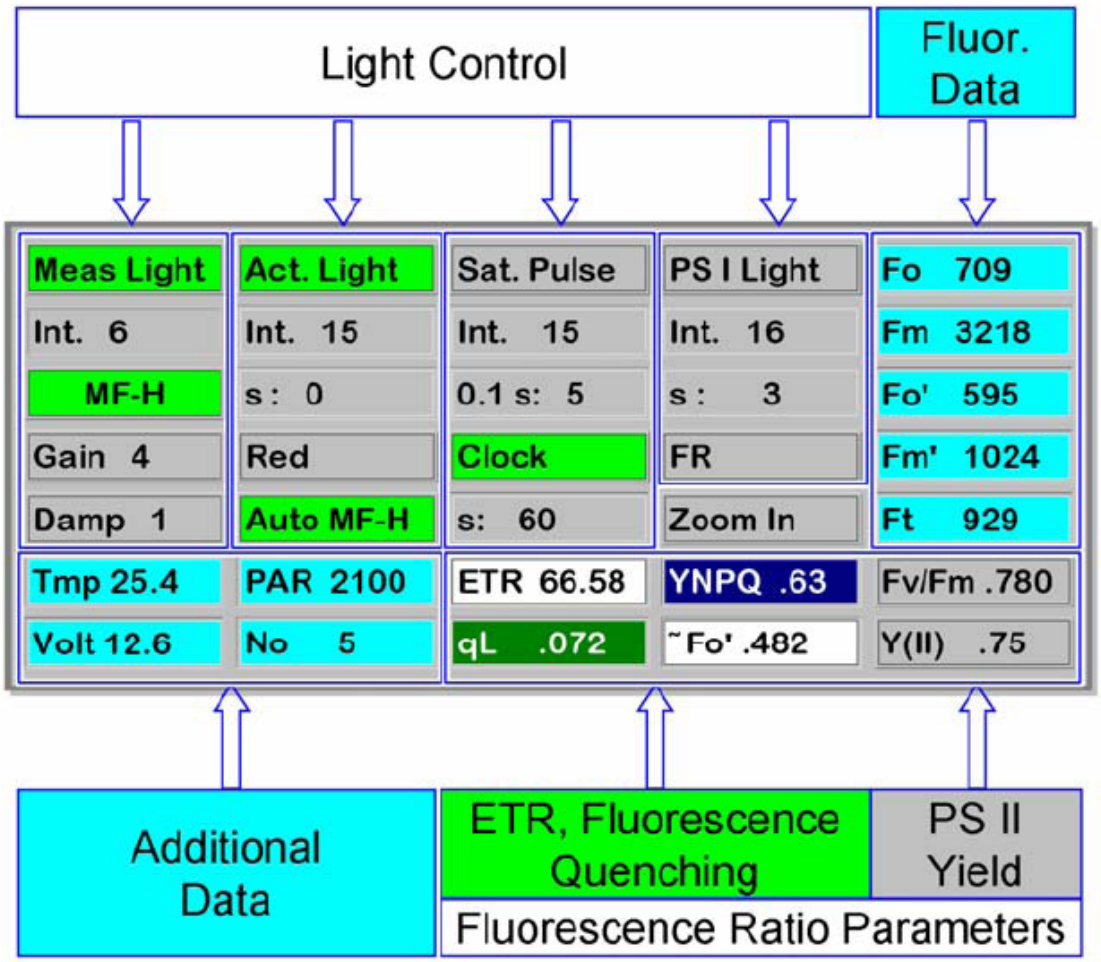


图 4.2 野外屏幕的字母数字区

4.2.1.1 光源控制

Meas Light 该按钮用于开/关测量光

Int. 调节测量光强度，共有 20 档可选。在 PamWin-3 的高级设置中提供了每档测量光的光强。可以通过调整测量光的强度调整荧光信号的高低。

MF-H 切换调节测量光的频率。该按钮为灰色背景时说明测量光处于低频（比如测 Fo 时），当按钮为绿色背景时说明测量光处于高频。

Gain 调整电子信号的增益，共有 10 档。当增益为 10 时，信号放大倍数是增益为 1 时的 7 倍。可以通过调整增益的大小调整荧光信号的高低，升高增益，不仅放大荧光信号，**噪音也被放大**。

Damp 阻尼设置，共有 9 个梯度分别为：关闭阻尼，梯度 1（t(1/2)=10 μS）到梯度 8（t(1/2)=4 mS）。阻尼限制了信号变化的最大速率，任何比设置的时间常数快的信号波动（噪音）都会被抑制。注意：在低频测量光时，响应时间由当前采样速度决定，因此比上面列出的值都要低。

Act. Light 打开/关闭光化光。

Int. 调节光化光的强度。

S： 设置光化光持续时间，单位为 S，当设为 0 时需要手动开/关光化光。

Red (Blue) 切换光化光为红光或蓝光。

Auto MF-H 当<Auto MF-H>被激活后，打开光化光时测量光频率自动升高，这样可以降低信噪比。强烈建议一直将此按钮处于激活状态。不论<Auto MF-H>是否激活，当执行饱和脉冲时测量光的频率都会自动上升到 100 KHZ。

Sat. Pulse 点击该按钮将执行一个饱和脉冲。得到的数据显示在字母数字区（alphanumeric fields）（图 4.2）但不可能会被记录到报告文件。

Int. 调节饱和脉冲光的强度。共 20 个梯度可调，梯度 1 和梯度 20 对应的光强分别是 910 和 16500 $\mu mol \cdot m^{-2} \cdot s^{-1}$。光强梯度和强度之间是半线性相关的。

0.1S： 调节饱和脉冲的持续时间。

Clock 激活后程序将每隔一定时间连续执行饱和脉冲。

S： 连续执行饱和脉冲时，设置两个饱和脉冲之间的间隔时间。

PS I Light 点击后打开第二个光源。如果当前光化光是红光，< PS I Light >可能是远红光（740 nm）或者是蓝光（460 nm）。远红光主要激发植物和大多数真核藻类的 PS I ，而蓝光主要用来激发蓝藻的 PS I 。当然，光化光设置为红光时，< PS I Light >设成蓝光可以作为植物和真核藻类的第二种光化光光源。

Int. <PS I Light >的强度。由于只有一小部分的远红光被 PS I 吸收，并且不同植物对远红光的吸收率存在很多差别，所有报告文件里没有记录远红光的光强。

S： <PS I Light >的持续时间，设为 0 时需要手动开/关<PS I Light >。

FR (Blue) 当光化光设为红光时，这个按钮用来切换第二种光源<PS I Light >的类型（远红光或者红光）。

4.2.1.2 荧光数据

样品暗适应后执行饱和脉冲记录了两个荧光数据（图 4.2 Fluor.Data）：

Fo 最小荧光产量

Fm 最大荧光产量

照光后样品执行饱和脉冲记录了三个荧光数据：

Fo’ 光下最小荧光产量。关闭光化光后打开远红光可以测量 Fo’。可以在<Advanced Level>和<General Settings>中激活 Fo’模式。Fo’模式未激活时，Fo’显示的值为 0。

Fm’ 光下最大荧光产量。

Ft 在执行饱和脉冲前测量的实时荧光值 F。很多参数的计算需要用到此数值（见第 5 章）。

4.2.1.3 荧光比值参数

两个反映 PS II 光能利用效率的参数计算如下（见 4.2 PS II Yield）：

Fv/Fm = (Fm-Fo)/Fm；PS II 的最大光合量子产量，反映了样品的光合潜能。

Y(II) = (Fm’-F)/Fm’； PS II 的实际光合量子产量。

其它的荧光比例参数以反背景色显示出来（图 4.2：ETR，Fluorescence Quenching）。所有参数的计算都参照第五章：缩写和公式。

一共有 8 个参数可用，但是每次只能显示 4 个。点击 4 个数据显示面板可以选择要显示的参数。注意这些参数的计算公式（见第 5 章），如果要用到 Fo’而没有测 Fo’时就需要通过 Fo, Fm 和 Fm’来推导 Fo’（Oxborough and Baker 1997, 见第 5 章）。

这 8 个参数分别是：

ETR 通过 PS II 的电子传递速率

~FO’ 光下最小荧光

qL 光化学淬灭系数（基于“湖泊模型”）

Y(NO) 非调节性能量耗散的量子产量

Y(NPQ) 调节性能量耗散的量子产量

NPQ 非光化学淬灭系数

qN 非光化学淬灭吸收。qN 和 NPQ 都是反映了非光化学淬灭，只是计算公式不同。

qP 光化学淬灭系数（基于“沼泽模型”）

4.2.1.4 其它数据

Tmp 当连接 2030-B 时显示了叶片下表面的温度，单位：℃。

PAR 当连接 2030-B 时显示的是叶夹测量的光合有效辐射，单位：$\mu mol \cdot m^{-2} \cdot s^{-1}$。当未连接 2030-B 时显示的是从内置光强列表读取的光化光的光强和 PS I 的光强。在 PamWin-3 的高级设置的<General Settings>窗口可以关闭从内置光强列表读取光强的功能。

Volt 电池电压，电池完全充满电时电池电压可以达到 13.7 V。当电池电压低于 10.5 V 时，PAM-2500 仍可以工作，但是此时得到的信息不可靠，特别是进行饱和脉冲时（所需电流太高）。

注意：当电池电压低于 9.4 V 时 PAM-2500 必须关机！！！

注意：当电池电压低于 11.8 V 时 PAM-2500 无法开机！！！

NO 显示了当前实验饱和脉冲的总数，点击<Stop/Start>按钮或点击 Fv/Fm 后程序将重新计数。

4.2.2 用“野外屏幕”进行第一次测量

本小结介绍了如何利用“野外屏幕”进行叶绿素荧光的基础测量。

首先，确保测量光已打开，此时在光纤末端能看到微弱的红光。不夹叶片或者其它能发荧光的物品时 Ft 的值应该接近 0。当夹上叶片后，仪器便会检测到荧光信号，荧光信号的强弱和光纤距样品间的距离直接相关，因此为了保证每次测量的可比性，样品到光纤的距离应该保持一致。距离叶夹 2010-A 和叶夹 2030-B 都可以保证光纤到样品距离的一致性。

比较不同光强下的荧光产量可以得到一些相关信息，因此 PAM-2500 提供了不同的光源。点击 Act.

Light 打开光化光，叶片介绍相对较强的光照射，同时，Ft 迅速上升然后慢慢下降，这就是“Kautsky-effect”。再次点击 Act. Light 关闭光化光，Ft 下降。

当 PS I Light 选为远红光（FR）时，关闭光化光后点击 PS I Light 打开远红光一段时间（一般为 3S），在远红光的照射下 Ft 迅速下降，逐渐接近打开光化光之前的水平。远红光优先激发 PS I ，在没有光化光的情况下，PS I 接收远红光后迅速从供体侧获得电子，从而使 PS II 的反应中心迅速打开。

样品暗适应后所有的 PS II 反应中心都处于开放状态时荧光产量最低记作 Fo，此时打开饱和脉冲所有的 PS II 反应中心都关闭，荧光产量达到最大记作 Fm，这一过程可以通过点击 Fv/Fm 执行。Fv/Fm 通过 Fo 和 Fm 计算，Fv/Fm = (Fm-Fo)/Fm。Fv/Fm 反映了植物的最大光合潜能，对大多数高等植物来说，一片健康的叶片经过充分的暗适应后，Fv/Fm 值大约在 0.8 左右。

点击 Y(II)同样执行饱和脉冲，测定的值显示在 Y(II)区。当样品经过暗适应后，测得的 Y(II)等同于 Fv/Fm。打开光化光后测得的 Y(II)是当前照光状态下 PS II 的实际光合量子产量。

点击 Clock 后会间隔一定时间连续执行饱和脉冲，相邻两个饱和脉冲的时间通过 Clock 按钮下的 S: 按钮来设定。

执行饱和脉冲时测定的数据会自动存储到报告文件中，可以通过点击 Advanced 按钮并选中<report>标签查看。

4.3 PamWin-3 高级设置

4.3.1 常规设置（General Settings）

图 4.3 显示的是<General Settings>窗口，和<Field Screen>窗口功能相同的按钮或者显示信息相同的区域以灰色标示出来，在下文中不再介绍（注意：8 选 4 的参数区（见 4.2.1.3）显示在侧栏）。

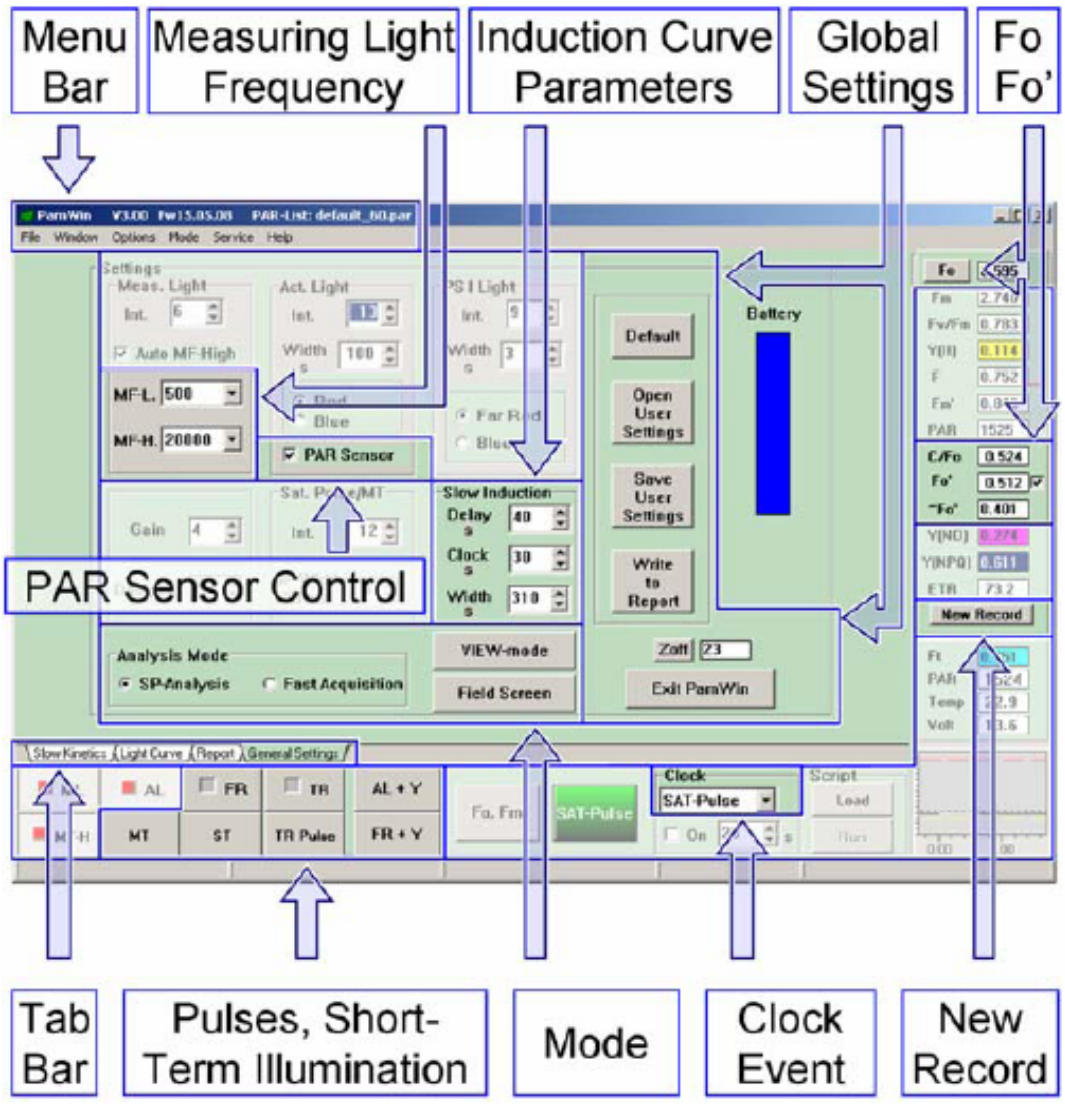


图 4.3 常规设置窗

4.3.1.1 菜单栏（Menu Bar）

<General Settings>窗口的菜单栏包括 6 个菜单（图 4.3）。

File

从 File 菜单可以导入，执行 PamWin-3 的脚本程序，也可以进行打印设置，退出程序等操作。

Window

<Window>菜单等效于<Tab Bar>（图 4.3）。<Window>菜单链接到<SP Analysis>模式中的 4 个窗口。在<Fast Acquisition>模式中，<Window>菜单链接<Fast Acquisition>模式中的 3 个窗口。

Options

L Curve Fit Parameters

点击<Light Curve Fit Parameters>打开光响应曲线拟合参数窗口，并列出了 4 个从拟合公式中得到参数（见 4.4.2 光响应曲线和 5.5 理论知识），分别是：

Fv/Fm x ETR factor/2

暗适应后样品，由 1 个饱和脉冲闪光引起的最大电子传递的产量 electrons/photons

alpha

光响应曲线的初始斜率，相当于最大光合效率 electrons/photons

ETRmax

最大电子传递速率 μmol electrons/(m^2•s)

Ik

最小饱和光强（半饱和光强） μmol electrons/(m^2•s)

Light Calibration

输入校正系数对连接到 PAM-2500 的光量子传感器进行校正（校正系数的范围为：0.2~0.5）。连接 2030-B 时默认的校正系数是 1.000。

Light Offset

对光量子传感器进行调零，将光量子传感器放到完全黑暗的环境中点击 Auto Zero 进行自动调零，当然也可以通过手动输入数字进行调零。

Temperature Offset

对外置温度传感器进行调零。

ETR Factor

叶片的吸光系数，该系数用于计算电子传递速率 ETR。吸光系数的默认值是 0.84，这适用于绝大多数高等植物。

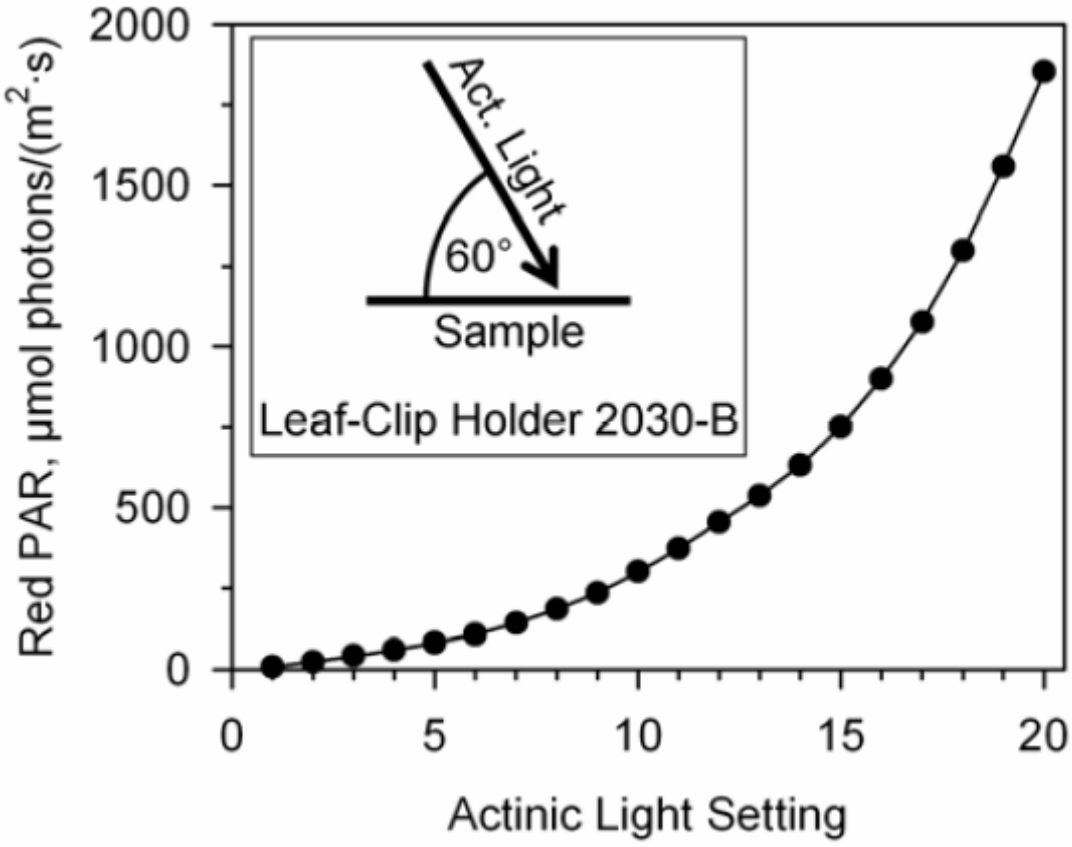


图 4.4 用 2030-B 时样品处红色光化光光强和光强梯度设置间的关系

AL Current/PAR Lists

PamWin-3 在安装时自动把<default_60.par>和表 4.1 中的其它几个光强列表文件复制到<\PamWin-3\Data_2500>目录下。光强列表文件里包含了不同光几何学下内置红/蓝光源的输出信息。

第一次运行 PamWin-3 时程序自动加载<default_60.par>。<default_60.par>文件中对应的是用 2030-B，把光纤以 60°角插到底时样品处接收到的光强。以后每次启动时程序会自动最近一次用过的光强列表文件。

如果<\PamWin-3\Data_2500>目录下没有<default_60.par>文件时，仪器将使用出厂时的设定值（factory values are used）。注意，在所有光强列表中当光化光光强设为 0 时表示关闭光化光，此时光化光的强度是测量光的强度（频率设为 10 Hz 或 100 KHz）。

未接外置光量子传感器时（或者在”General Settings”中通过取消<PAR sensor>来关闭光量子传感器），PamWin-3 计算的光强为从光强列表中读取的数值加上测量的光强。

表4.1 默认红蓝光源光强列表文件

File Name	Sample Holder	Optical Geometry*
default_60.par	Leaf-Clip Holder 2030-B	60°
	Distance Clip 2010-A	60°, 2 mm distance ring
	Arabidopsis Leaf Clip 2060-B	60°, 6 mm distance ring
default_90.par	Leaf-Clip Holder 2030-B	90°, 4 mm distance ring
default_90_2060.par	Arabidopsis Leaf Clip 2060-B	90°, 2 mm distance ring
default_DLC.par	Dark-Leaf-Clip DLC-8	90°
default_KS.par	KS-2500 Suspension	Cuvette 90° and 4 mm

图 4.4 显示了光强列表文件中光强和设置梯度间的关系图。每个光强列表文件里都包含了光学几何学信息，可以通过点击  图标查看。

每个光强列表都包含 3 列：<AL>光强设置梯度；<Current>表示当前 LED 的相对电流大小（最大值为 255）；<PAR>列出了光强值（$\mu mol \cdot m^{-2} \cdot s^{-1}$）。红光光源的光强值和电流值线性相关，而蓝光光源的光强值和电流值半线性相关（quasi-linearly）。如果要更改电流值或者光强值，在相应区域点击并输入新的值即可。新的光强列表可以通过  图标注释，  图标保存，  图标打开。

Mode

<VIEW>命令将程序转换到离线模式，通过点击<MEASURE>回到测量模式。<VIEW>命令和<MEASURE>命令等效于<General Settings>窗口的 VIEW-mode 和离线时的 MEASURE-mode 按钮。

Service

<Service>用来进行仪器的固件升级（安装到仪器内部处理器上的软件被称为固件）。新版固件升级程序由 Walz 公司提供。可以通过点击<Read Firmware Version>查看当前固件版本。

注意：为防止固件升级时发生错误，在升级固件时请将电池充满电，如果出现错误请与 Walz 公司联系。

点击<Controller Service>进行固件升级的操作。PAM-2500 包括两个可编程的处理器 RISC 和 TINY。

a) RISC

点击 **Program RISC** →**Read HexFile** →**Download HexFile**。接下来点击 **Program RISC**（这一步需要等一段时间）。最后通过点击 **OK** 完成操作。

注意：在执行下一步前关掉并重启 PamWin-3 程序！！！（Before proceeding, close and restart he PamWin-3 Program!）

b) TINY

点击 **Program RISC**，再点击 **Read HexFile** →**Download HexFile** →**Program RISC**。最后通过点击 **OK** 完成操作。关掉并重启 PamWin-3 程序。

<Trigger out with SP>该项功能在每个饱和脉冲时输出一个 5 V 的触发脉冲波。见 4.3.1.8 对 AUX 连接器触发针和触发脉冲的设置的描述。

Help

打开帮助文档。

4.3.1.2 测量光频率（Measuring Light Frequency）

在<General Settings>窗口设置测量光频率，各个图标对应的设置如表 4.2。

表 4.2 测量光频率

Icon		Range
MF-L.	低频测量光	5 - 5000 Hz
MF-H.	高频测量光	1000 – 100 000 Hz*

* 仪器的最大分辨率 200 000 Hz 在<Fast Acquisition Analysis Mode>

4.3.1.3 诱导曲线参数（Induction Curve Parameters）

PamWin-3 定义了三个和诱导曲线相关的时间参数（图 4.3）

Delay, seconds: 设定测量 Fv/Fm 后到打开光化光的间隔时间，默认为 40 S。

Clock, seconds: 设定在执行光化光期间相邻两个饱和脉冲之间间隔时间。

Width, seconds: 设定光化光持续时间。

4.3.1.4 全局设置（Global Settings）

Settings

Default 恢复默认设置（<Walz2500.DEF>）

Open User Settings 打开以前存储的设置文件

Save User Settings 将当前设置保存到设置文件（*.DEF）

Write To Report 将当前设置写入报告文件（见 4.4.3.1 中各命令的缩写）

Other Commands

Zoff 对荧光信号进行调零

Exit PamWin 关闭 PamWin-3 软件

4.3.1.5 光量子传感器控制（PAR Sensor Control）

选中<PAR Sensor Control>后打开外置光量子传感器，取消选择<PAR Sensor Control>后关闭外置光量子传感器，此时光强值从内置光强列表文件中读取。

4.3.1.6 Fo, Fo’

样品暗适应后点击 Fo 即把当前荧光值 Ft 记作 Fo。

C/Fo 代表的是恒定荧光产量（来自 PS I）对测量的 Fo 值的贡献量。只有激活了 Fo’模式并且非光化学淬灭引起 Fo’降到 Fo 值以下时才能评估 C/Fo 的值。

Fo’ 代表的是**仪器测量**的光下最小荧光（而不是计算的）。选中 Fo’复选框便激活了 Fo’模式，即在每个饱和脉冲后关闭光化光打开<PS I Light>光优先激发 PS I ，使 PS II 反应中心迅速开放，光化学淬灭达到最大荧光产量达到最小。<PS I Light>光强可以在<General Settings>窗口进行设定（见<Field Screen>）。

~Fo’ 代表的是程序**计算推导**的光下最小荧光（而不是实际测量的）。~Fo’是根据 Oxborough and Baker (1997)的公式从 Fo，Fm 和 Fm’推导而来（见 5.1.2）。

4.3.1.7 标签栏（Tab Bar）

PamWin-3 软件中每个激活的窗口都会在<Tab Bar>区显示一个对应的标签，点击标签可以前端显示相应的窗口。

4.3.1.8 脉冲，短期光照（Pulses, Short Term Illuminaion）

PamWin 高级应用可以给样品提供其它额外的光照，也可以通过定义一个触发信号来控制外部设备。

这些短时间事件的持续时间从几个微秒到 1 秒，他们分别是：

ST 单周转闪光，持续事件为 5~50μS 可调，光强为 10000 $\mu mol \cdot m^{-2} \cdot s^{-1}$。

MT 多周转闪光，持续事件为 1~300mS 可调，光强为 10000 $\mu mol \cdot m^{-2} \cdot s^{-1}$。

TR Pulse 向 AUX 插口传送一个 5 V 的触发脉冲，脉冲持续时间 10μS 到 1000mS 可调。

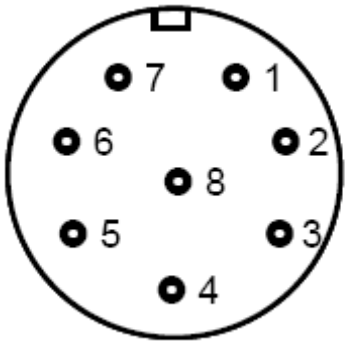
通过右键点击 ST ， MT ，或 TR Pulse 打开<Pulse Widths>设置每个短时间事件的持续时间。

在< Pulse Widths >窗口选中 S+H off 将取样保持电路放大器（sample-and-hold amplifier）暂时短期关闭，短期关闭取样保持电路放大器（sample-and-hold amplifier）可以防止由于执行单周转闪光而人为引起的信号的增大。关闭的时间长度从 Extended S+H off time 下拉列表中选择。

TR 手动控制向外接设备发送一个触发。

AL+Y 照射一段时间光化光（光强和持续时间在 General Settings 中设置）然后进行饱和脉冲分析。

FR+Y 执行的程序和 AL+Y 相同，只是把光化光换成了<PS I light>。



1. DGND (digital ground)
2. UBatt (battery voltage)
3. GND (ground)
4. DA out (analog output)
5. DGND (digital ground)
6. Trigger Out
7. +5 V
8. -5 V

图 4.5 AUX 接口

4.3.1.9 模式（Mode）

切换 PAM-2500 工作模式为 SP-Analysis 和 Fast Acquisition 或者离线模式（View mode）。

4.3.1.10 定时事件（Clock Event）

有 6 个测量程序可以设置成每隔一段时间重复执行。程序间隔时间为 3-900S 可调，但是要确保程序间隔时间比单个程序执行所花的时间长一些。这 6 个测量程序分别是：

SAT-Pulse：饱和脉冲分析

AL：照射光化光

AL+Y：照射一段时间光化光并进行饱和脉冲分析

FR+Y：照射一段时间<PS I Light>并进行饱和脉冲分析

Light Curve：光响应曲线

Slow Induc.：诱导曲线

4.3.1.11 新记录（New Record）

新建一个报告文件。

4.4 饱和脉冲模式（SP-Analysis Mode）

4.4.1 慢速动力学窗口（Slow Kinetics Window）

<Slow Kinetics>窗口的主要功能是实时显示荧光值 Ft 和从饱和脉冲分析得到的参数（曲线的形式显示）（图 4.6）。

可以通过 File 菜单里的<Save as pws-file>命令将荧光曲线数据保存为*.pws 格式文件，在 View 模式下可以打开 pws 格式文件。

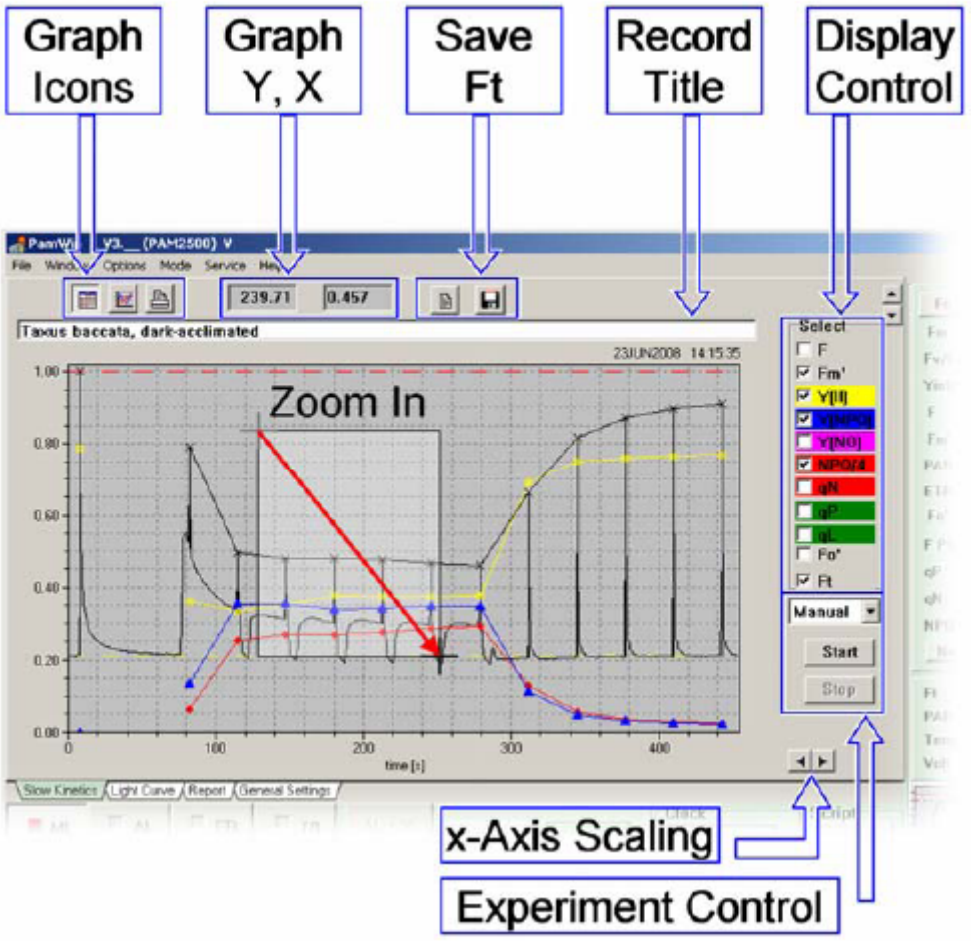


图 4.6 慢速动力学窗口

4.4.1.1 图标（Graph Icons）

图 4.6 中从左到右三个图标的功能分别是：控制显示网格、自动调整两个坐标轴和打印图形。

4.4.1.2 图形 Y，X（Graph Y, X）

显示的是当前鼠标所处位置的在程序中的时间（S，左边），和相对数值（右边）。

4.4.1.3 保存 Ft（Save Ft）

点击按钮保存当前 Ft 图像（功能等同于<File>菜单的<Save as pws-file>）。点击按钮打开已经保存的文件。

4.4.1.4 显示控制（Display Control）

实时显示荧光值 Ft 和从饱和脉冲分析得到的参数（曲线的形式显示）（图 4.6）。

4.4.1.5 X 坐标轴调整（X-Axis Scaling）

通过点击  调整横坐标的大小。

在图形区按住鼠标左键拖动鼠标可以放大选中的区域，在图形区的任何地方单击鼠标右键都可以自动调整坐标轴将所有图形都显示出来。

4.4.1.6 实验控制（Experiment Control）

从下拉菜单选择要执行的程序，点 Start/ Stop 开始或结束这个程序。数据被存储到报告文件。

4.4.2 光响应曲线（Light Curve）

光响应曲线的详细信息见 5.5。

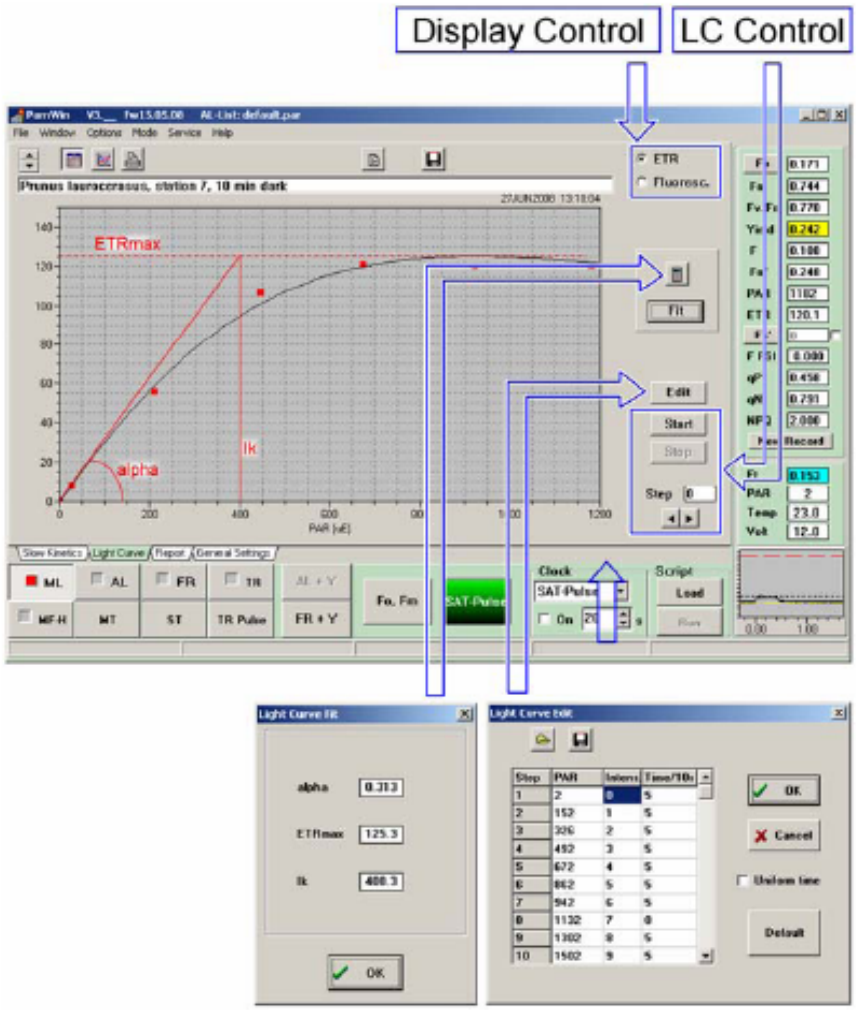


图 4.7 光响应曲线窗口

4.4.2.1 显示控制（Display Control）

选中 **Fluoresc.**后在图形区显示荧光比值参数，选中 **ETR** 后将显示 **ETR** 对 PAR 的曲线图。和传统的光响应曲线不同，ETR 对 PAR 曲线测定速度很快，在每个光强下 ETR 并没有达到稳态，因此这个光曲线也叫快速光曲线。

4.4.2.2 光响应曲线控制（Light Curve Control）

点击 Start/ Stop 开始或结束一个光响应曲线程序。

4.4.2.3 光响应曲线编辑（Light Curve Edit）

编辑光响应曲线的程序，可以将编辑好的程序保存为*.lcp 格式的文件，也可以导入以前编辑好的光响应曲线的程序。

可以设置光强、每个光强光化光的持续时间，当持续时间设为“0”时，程序执行到这一步便会停止，例如，将第 9 步的持续时间设为“0”，那么程序执行时只会执行 1-8 步设置的光强，然后停止。

注意：此时显示的实际光强值是从内置光强列表文件中读取的。如果实验室使用了 2030-B，且激活了外置光量子传感器时，仪器记录的是实际测量值。

4.4.2.4 光响应曲线拟合（Light Curve Fit）

采用 Eilers and Peeters (Ecological Modelling 42(1988) 199-215)的公式进行光响应曲线的拟合，3 个拟合参数如下：

α， 单位：electrons/photons，快速光曲线的初始斜率，反映了光能利用效率。

ETRm， 单位：μmol· m^{-2} · s^{-1}，最大电子传递速率。

Ek， 单位：μmol· m^{-2} · s^{-1}，最小饱和光强（半饱和光强），反映了样品对强光的耐受能力。

4.4.3 报告文件（Report）

4.4.3.1 报告文件数据排列（Report Data Arrangement）

<General Settings>窗口的<Write to Report>命令执行时在报告文件中写入一行包含 16 个参数的数据（表 4.3）。

4.4.3.2 报告文件头和最后一行（Record Header and Last Line）

第一行：报告标题

第一行为报告文件的标题。可以在<Slow Kinetics>或<Light Curve>窗口上部输入实验注释，输入的实验注释也被记录到报告文件的第一行。

第二行和第三行：Fo, Fm

第二行和第三行显示的是 Fo, Fm 和 Fv/Fm，如果用<Induction Curve>或<Induction Curve Recovery>程序进行测量时，在第二行会加入<IC>或<IC+>缩写。

注意：如果实验时第一个饱和脉冲不是测定 Fo 和 Fm，第二行和第三行就不显示 Fo, Fm 和 Fv/Fm，如果在实验的过程中测定了 Fo 和 Fm，那么后来测定的 Fo 和 Fm 也不会再记录到第二行和第三行，但是仍然使用后面测定的 Fo 和 Fm 来计算其他参数。

最后一行：荧光曲线的状态

这一行描述了当前实验过程中有没有测量原始荧光曲线。

4.4.3.3 纪录列（Record Columns）

在测量模式下记录图表（Record chart）包含 12 列（在<View>模式下可以看到更多的数据）。下面对图 4.8 中标注的数据列分别进行注释（测量模式下）。

1、日期和时间

2、饱和脉冲光的编号，如果第一饱和脉冲测量的是<Fo, Fm>，将不显示编号 1

3、测量光的强度

4、温度℃

5、光化光强度

6、Fo（第一行）和 F（接下来的数据）（电压值）

7、光合电子传递速率

8、PS II 的最大量子产量（Fv/Fm）、实际量子产量（Y(II)）

9、光化学淬灭系数，这个值为 1 时说明没有正确测量 Fo，Fm

10、非光化学淬灭系数，这个值为 0 时说明没有正确测量 Fo，Fm

11、Fm（第一行）和 Fm’（接下来的数据）（电压值）

12、Fo’，如果没有激活 Fo’-mode，这一列为空

13、电池电压

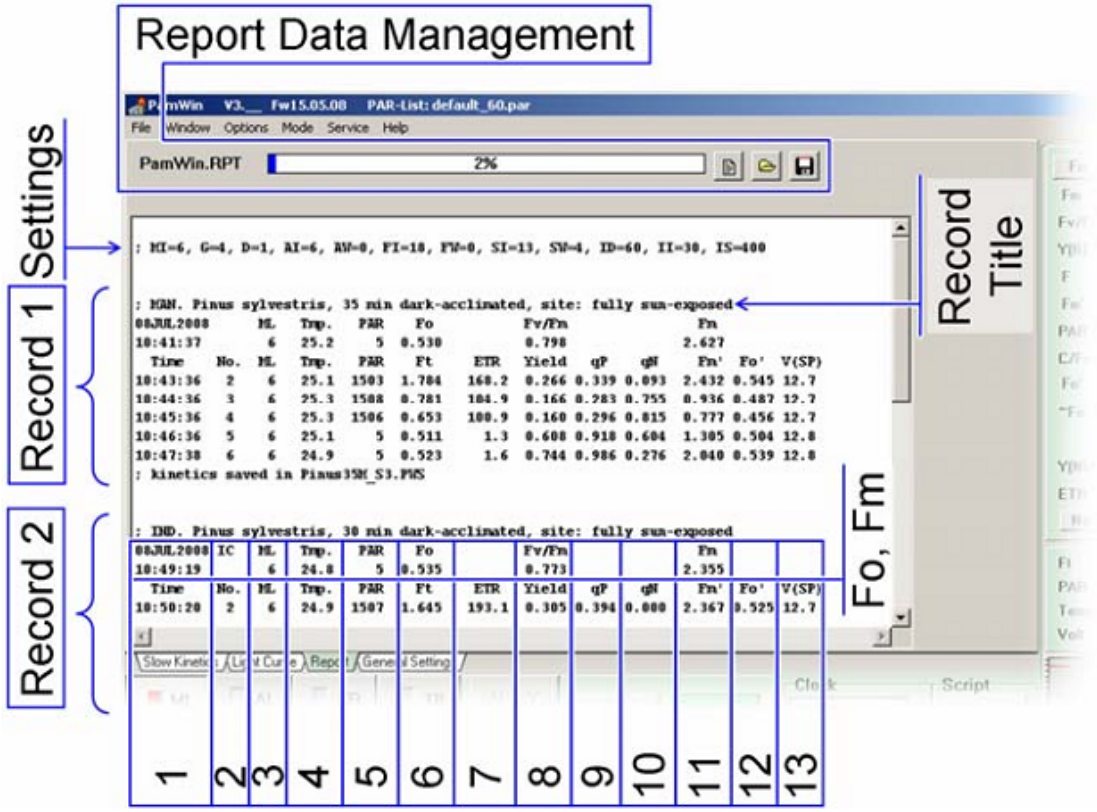

Report Data Management
Settings
Record 1
Record 2
Record Title
Fo, Fm
PamWin.RPT
2%
: MI=6, G=4, D=1, AI=6, AW=0, FI=18, FW=0, SI=13, SW=4, ID=60, II=30, IS=400
: MAN. Pinus sylvestris, 35 min dark-acclimated, site: fully sun-exposed
08JUL2008 ML Tmp. PAR Fo Fv/Fm Fn
10:41:37 6 25.2 5 0.530 0.798 2.627
Time No. ML Tmp. PAR Ft ETR Yield qP qN Fn' Fo' V(SP)
10:43:36 2 6 25.1 1503 1.784 168.2 0.266 0.339 0.893 2.432 0.545 12.7
10:44:36 3 6 25.3 1508 0.781 184.9 0.166 0.283 0.755 0.936 0.487 12.7
10:45:36 4 6 25.3 1506 0.653 180.9 0.160 0.296 0.815 0.777 0.456 12.7
10:46:36 5 6 25.1 5 0.511 1.3 0.608 0.918 0.604 1.305 0.504 12.8
10:47:38 6 6 24.9 5 0.523 1.6 0.744 0.986 0.276 2.040 0.539 12.8
: kinetics saved in Pinus35M_S3.PMS
: IND. Pinus sylvestris, 30 min dark-acclimated, site: fully sun-exposed
08JUL2008 IC ML Tmp. PAR Fo Fv/Fm Fn
10:49:19 6 24.8 5 0.535 0.773 2.355
Time No. ML Tmp. PAR Ft ETR Yield qP qN Fn' Fo' V(SP)
10:50:20 2 6 24.9 1507 1.645 193.1 0.305 0.394 0.080 2.367 0.525 12.7
Slow Kinetic
Script
1 2 3 4 5 6 7 8 9 10 11 12 13

图 4.8 报告文件窗口

表 4.3 仪器设置报告

Abbreviation	Parameter
AI	Actinic Light Intensity
AW	Actinic Light Width
BI	Blue Light Intensity
BW	Blue Light Width
D	Damping
FI	Far Red Light Intensity
FW	Far Red Light Width
G	Gain
H	High Measuring Frequency
ID	Slow Induction Delay
II	Slow Induction Clock
IS	Slow Induction Actinic Light Width
L	Low Measuring Frequency
MI	Measuring Light Intensity
SI	Saturating Pulse Intensity
SW	Saturating Pulse Width

4.4.3.4 报告文件数据管理

在报告文件窗口，<File>菜单包括 4 个子菜单，分别是：

Open Report

打开以前存储的报告文件。

Save Report

将当前数据保存为*.rpt 格式的文件。

Clear Report

删除当前报告文件中的所有数据，并开始新的记录。

Print Report

打印当前报告文件。

4.5 快速获取模式（Fast Acquisition Mode）

PamWin-3 的快速获取模式最大时间分辨率为 10μS，用来记录快速荧光上升动力学。

4.5.1 快速设置（Fast Setting）

4.5.1.1 基础设置（Basic Setting）

MF-max

设置测量光的最大频率（图 4.9），测量光越高仪器的信噪比越低，但是测量光强也随着频率的升高而升高，从而会影响到光合作用。

Rate/Points

<Fast Kinetics>的总时间由采样速率和采样点的数目共同决定。在<Fast Kinetics>模式下执行一次测量最多可以采集 128000 个时间点的数据。

Target Averages

设置是否对<Fast Kinetics>模式中采集的数据点取平均值（相邻的数据点），并设置每几个点取一次平均值。

4.5.1.2 菜单栏（Menu Bar）

<Fast Kinetics>模式下的菜单和<SP-Analysis>模式下（见 4.3.1.1）的菜单基本相同。

4.5.1.3 触发设置 I 和 II（Trigger Settings (I) and (II)）

一共有 6 个工具标签来对触发信号进行设置（图 4.9，图 4.10）。

一共有 8 个不同的事件可以被触发（见 Trigger Settings(II)和表 4.4）。在这些事件中，单周转闪光（ST）的时间应该非常短（只让 PS II 反应中心完全周转一次），因此在设置 ST 时只有<High Pulse>和<All Low>按钮可用。

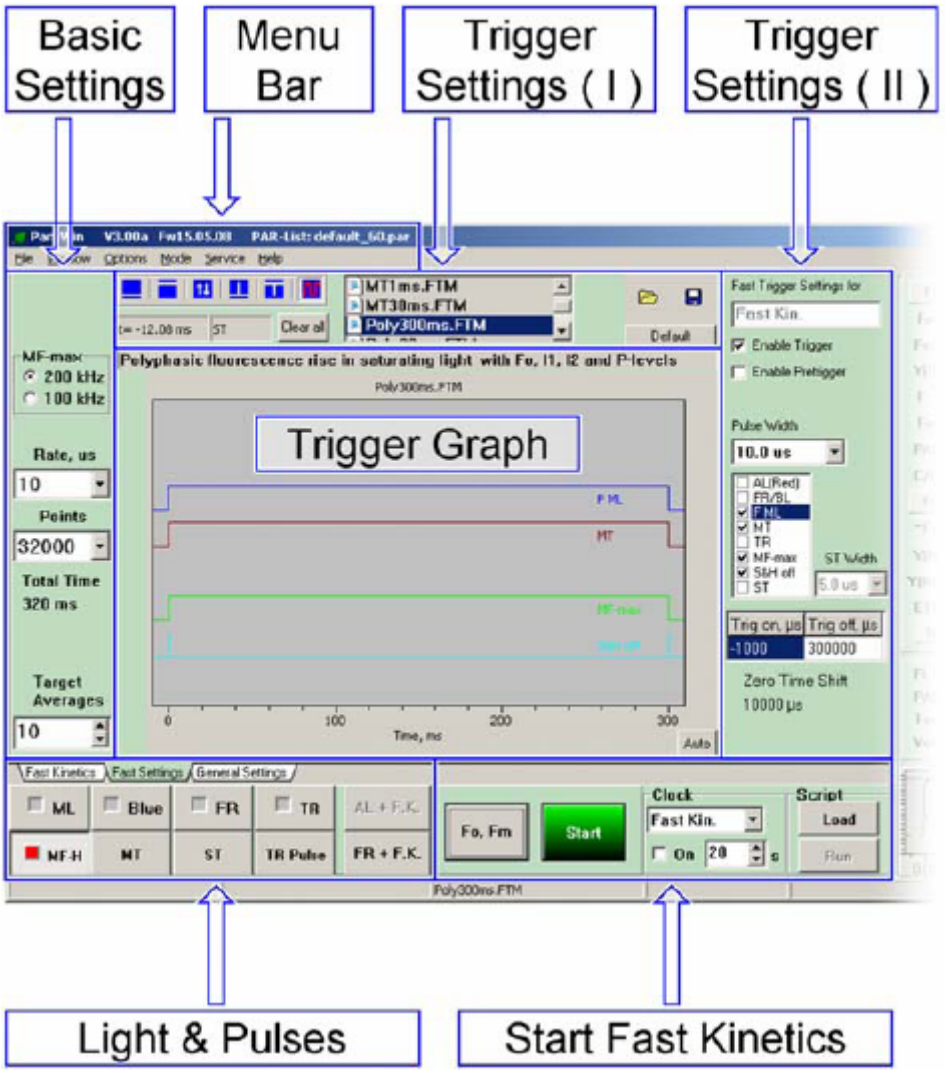

Basic Settings
Menu Bar
Trigger Settings (I)
Trigger Settings (II)
Trigger Graph
Light & Pulses
Start Fast Kinetics

图 4.9 快速设置窗口

表 4.4 触发图：复选框面板

Checkbox Label	Action	Comments
AL(Red)	Red actinic light	Intensity - as defined for <Act. Light> in <General Settings>
FR/BL	Far red light/Blue light	FR/Blue selection: <General Settings>. Intensity as defined for <PS I Light> in <General Settings>
F ML	Measuring light	Frequencies (MF-L. and MF-H.) and intensity: <General Settings>. Measuring light settings at kinetics start are controlled by ML and MF-H buttons.
MT	Multiple turn-over flash	Intensity - as defined for <Sat. Pulse/MT> in <General Settings>
TR	Trigger out	See Section 4.3.1.7
MF-max	Maximum frequency of measuring light	Frequency as defined in <Fast Settings> window (MF-max)
S&H off	Sample and hold circuit off	Surpresses artifacts caused by extreme intensity variations of non-measuring light
ST	Single turn-over flash	Always at maximum intensity (about 125 000 µE/(m^2·s)

其他所有事件都可以被脉冲和信号转移（signal shifts）触发。要设置一个脉冲：

a) 通过点击标签上的复选框选择一个事件（图 4.9 Trigger Settings(II)）

b) 点击相应的框（box）激活事件

c) 点击<High pulse>标签

d) 从下拉菜单选择时间间隔

e) 点击<Trig on, us>下面的区域，输入脉冲开始采集数据点的时间

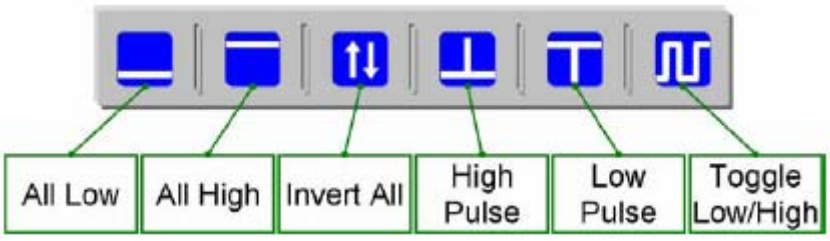


图 4.10 触发工具标签

4.5.1.4 光源和脉冲（Light & Pulses）

AL + F.K. 打开光化光随后执行当前脉冲

FR + F.K. 打开<PS I Light>光随后执行当前脉冲

4.5.1.5 开始快速动力学（Start Fast Kinetics）

Fo, Fm 测量 Fo，Fm

Start 开始当前触发

4.5.2 快速动力学（Start Fast Kinetics）

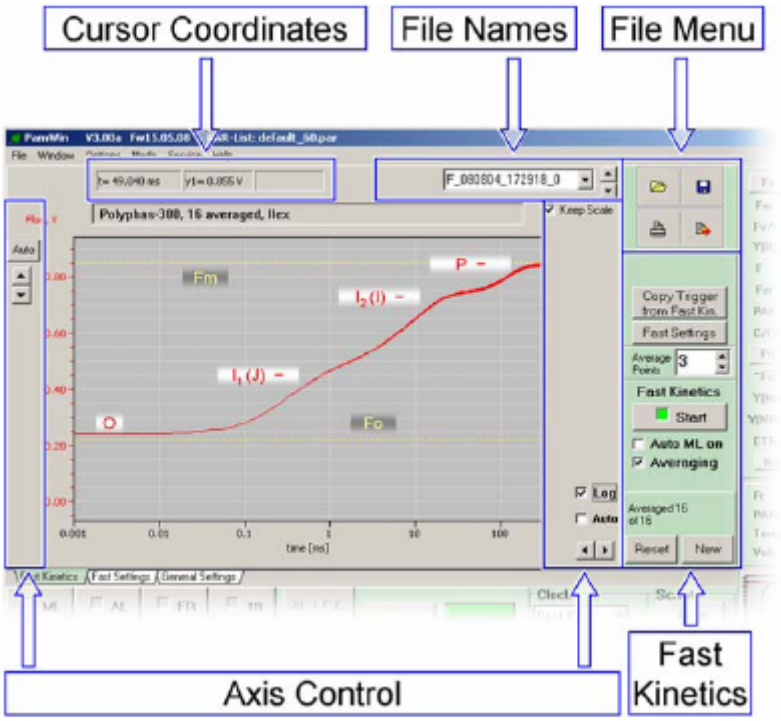


图 4.10 快速动力学窗口

4.5.2.1 光标坐标（Cursor Coordinates）

显示鼠标光标的位置。

4.5.2.2 文件名（File Names）

当前快速动力学曲线的文件名，格式为 F_日期_时间_0。

4.5.2.3 文件菜单（File Menu）

将实验数据保存成*.pfk 格式或者导出成 ASCII 格式的文件。

4.5.2.4 快速动力学（Fast Kinetics）

Copy Trigger from Fast Kin. 用于重复当前显示的动力学曲线

Fast Settings 打开快速设置窗口

Average Point 对<Fast Kinetics>模式中采集的数据点取平均值（相邻的数据点）时设置每几个点取一次平均值

Start 开始当前触发测量

AUTO ML ON 选中后在开始<Fast Kinetics>时自动打开测量光

4.6 查看模式（View Mode）

查看模式可以在未连接 PAM-2500 荧光仪时使用，当然连接荧光仪时照样可以使用。主要用于数据的查看和分析。

4.6.1 图标栏（Icon Bar）

图标的功能包括注释数据文件、打开数据文件、保存数据、将数据导出成 ASCII 码格式文件、将数据导出到系统粘贴板等。

4.6.2 侧栏（Sidebar）

详细功能见图 4.11 中的列表。

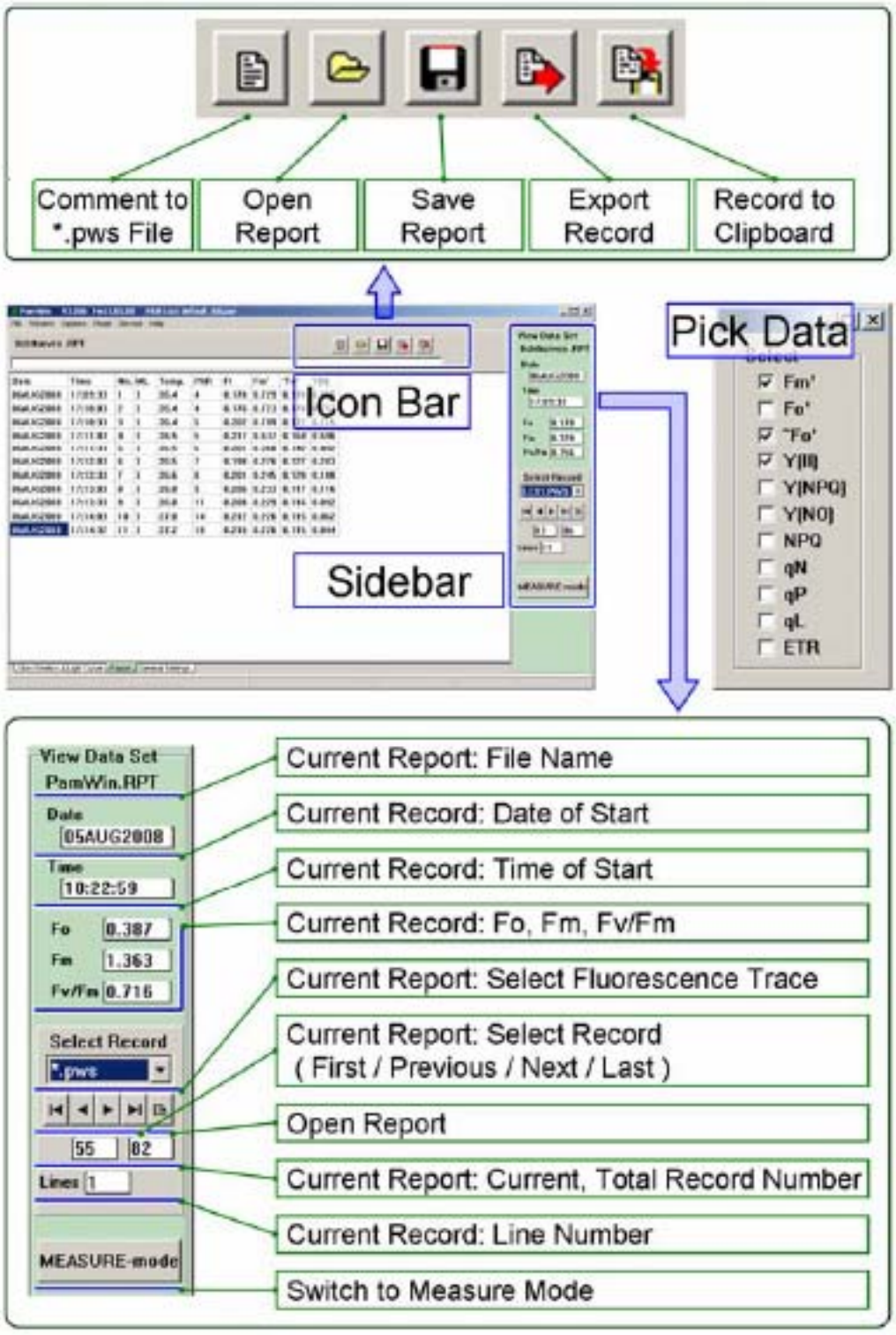


图 4.11 查看模式窗口

4.6.3 挑选数据（Pick Data）

选中在报告文件窗口显示的数据。

4.7 脚本文件（Script Files）

脚本文件用来编制一些测量程序来完成一些复杂的测量或者是自动测量。使用脚本程序大大扩展了 PAM-2500 的功能，你可以编写自己需要的测量程序。

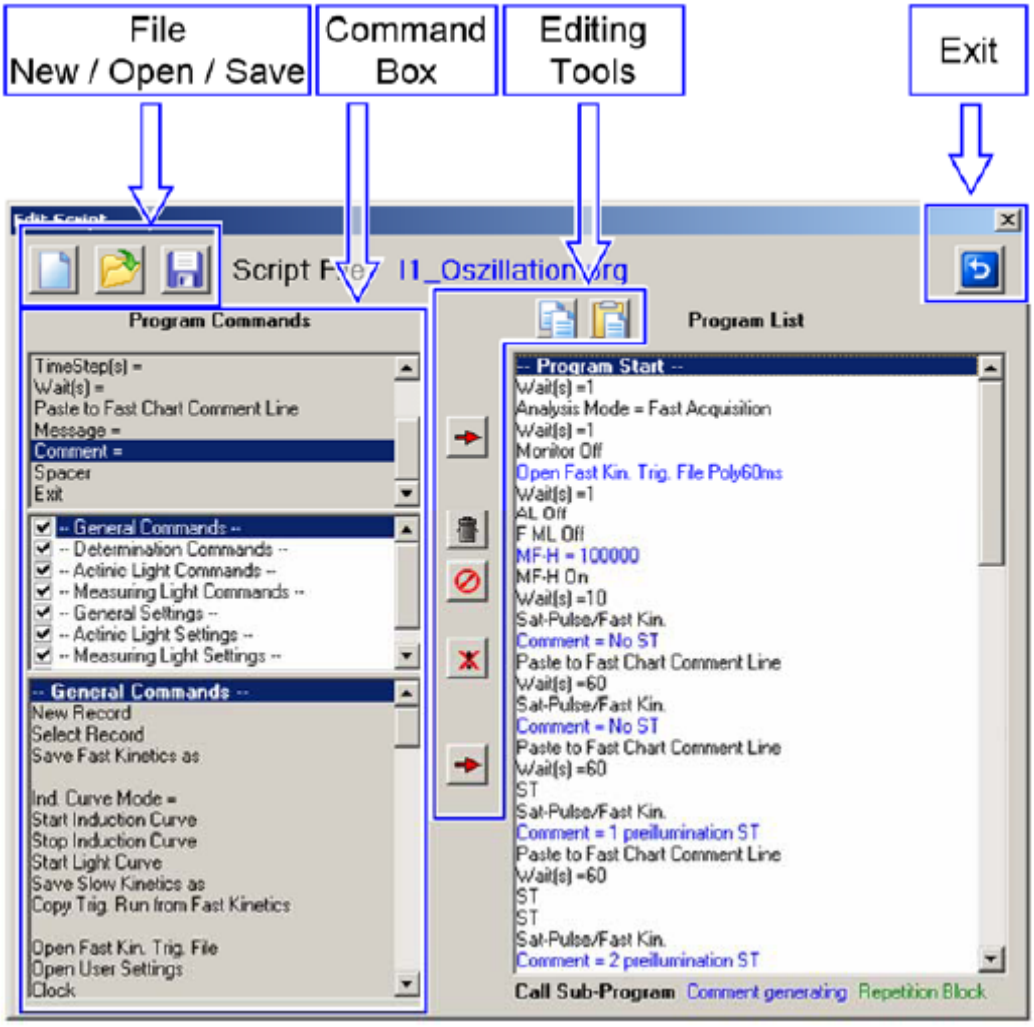


图 4.12 脚本程序窗口

按照下面的步骤创建一个新的脚本程序：

- 点击 Load 图标打开一个读取脚本文件的对话框
- 点击 OPEN 但不要选择任何文件，而是点击 Cancel，然后输入要创建的脚本程序名。
- 也可以打开一个现有的脚本文件，然后点击<New Script File>新建一个脚本文件。

4.8 编写脚本程序

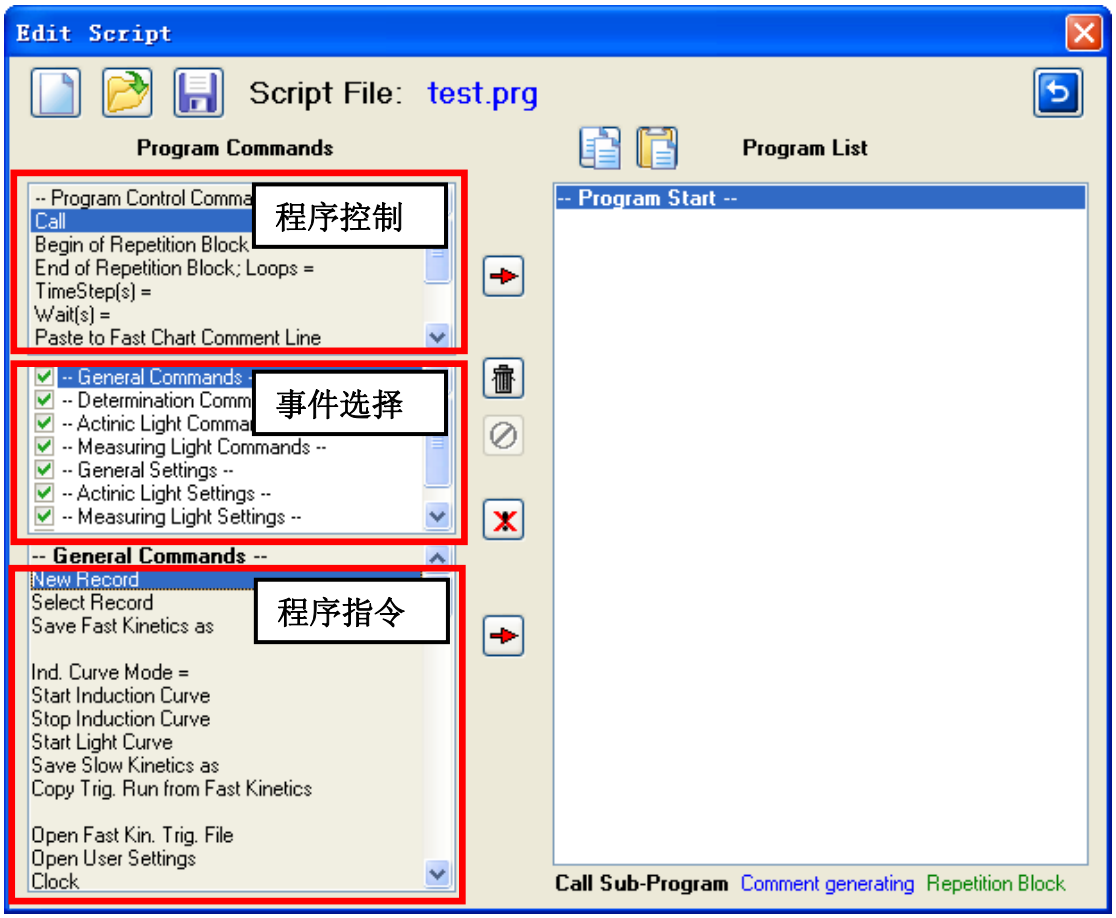


图 4.13 脚本程序窗口

为了描述方便同时根据各自功能现将编程窗口的左半部分分为 3 个区，分别是：程序控制区、事件选择区和程序指令区，下面对各个区的功能进行简要介绍（图 4.13）。

程序控制区

该区域的命令主要是控制整个程序的运行情况，现将其中包含的主要命令进行简要介绍。

Call 从本机硬盘上调取一个已经编辑好的脚本程序文件

Begin of Repetition Block 和“End of Repetition Block; Loops=”连用，开始一个循环程序，循环执行设定 Begin of Repetition Block 和 End of Repetition Block; Loops= 之间的命令，Loops=是指该循环的次数。

TimeStep(S)= 设置当前步骤的时间

Wait(S)= 设置等待时间，即在等待一段时间后再执行下一个命令

Comment= 对脚本文件的注释

Spacer 空格

Exit 终止当前程序

事件选择区

点击响应事件后会在“程序指令区”显示和该事件对应的指令。

程序指令区

显示和“事件选择区”对应的程序指令，通过这些指令可以控制 PAM-2500 执行各项操作。

PAM-2500 的快速光曲线（RLC）程序模板

程序	解释
-- Program Star --	脚本程序开始
F ML ON	打开测量光
AL ON	打开光化光
AL-Int. =1	设置光化光强度为 1
Wait(s) =10	等待 10 S
Sat-Pulse/Fast Kin.	执行饱和脉冲
AL-Int. =2	将光化光强度升高到 2
Wait(s) =10	等待 10 S
Sat-Pulse/Fast Kin.	执行饱和脉冲
……	逐渐升高光化光强度
AL-Int. =9	将光化光强度升高到 9
Wait(s) =10	等待 10 S
Sat-Pulse/Fast Kin.	执行饱和脉冲
AL Off	关闭光化光
F ML Off	关闭测量光
Exit	退出程序

我们提供了一个动画以快速光曲线的程序为例简单演示了脚本程序的具体编制方法，这里只是提供一个简单的例子，具体操作根据程序的不同而不同。动画下载地址：http://www.zealquest.com/down.as

5 参数符号及计算公式

5.1 相对荧光产量

5.1.1 样品暗适应后进行测定

Fo 当 PSII 反应中心都处于开放状态时的最小荧光。

Fm 暗适应后执行饱和脉冲当 PSII 反应中心都处于关闭状态时的最大荧光产量。

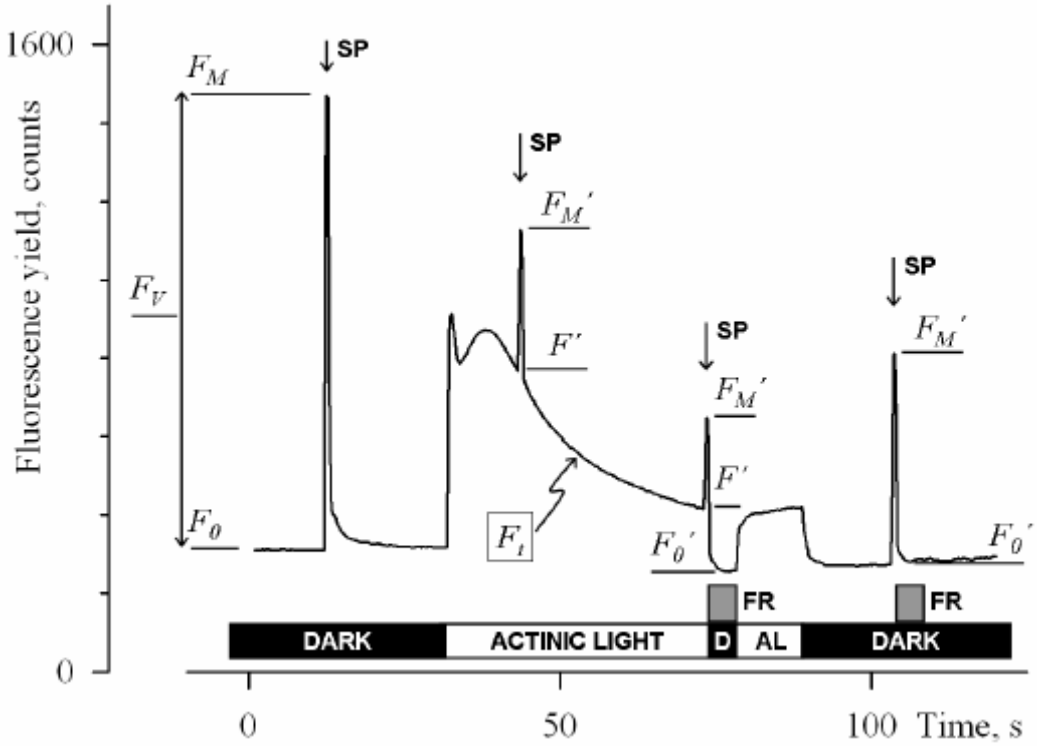


图 5.1 饱和脉冲分析。AL，光化光；D，黑暗；SP，饱和闪光；FR，远红光。

5.1.2 对光下样品进行测量

Fo' 光下最小荧光。当<Fo'-Mode>激活时，在饱和脉冲后仪器关闭光化光打开远红光优先激发 PSI，PSI 迅速从两个光系统间的电子递体得到电子，使 PSII 反应中心打开，此时荧光产量降到最低记为 Fo'（图 6.1 75S 时）。当<Fo'-Mode>未激活时，参考 Oxborough 和 Baker（1997）的方法计算 Fo'。计算公式如下：

Fo’ = 1/(1/Fo-1/Fm+1/Fm’)

Fm’ 光下执行饱和脉冲当 PSII 反应中心都处于关闭状态时的最大荧光产量。

F’ 执行饱和脉冲前的实时荧光产量。

5.2 荧光淬灭参数

叶片吸收的光能用于光化学反应和非光化学反应的两部分可以通过荧光产量的比值参数来进行区分。表 6.1 列出了 WinControl-3 中用到的所有用比值表示的荧光参数及计算公式。下面就各个参数进行简单的介绍。

表 6.1 用比值表示的荧光参数

定义及文献来源	计算公式
Maximum photochemical quantum yield of PS II (Kitajima and Butler, 1975)	Fv/Fm=(Fm-Fo)/Fm
Effective photochemical quantum yield of PS II (Genty et al., 1989)	Y(II)=(Fm’-F’)/Fm’
Coefficient of photochemical fluorescence quenching (Schreiber et al. 1986 as formulated by van Kooten and Snel, 1990)	qP=(Fm’-F’)/(Fm’-Fo’)
Coefficient of photochemical fluores-cence quenching assuming intercon-nected PS II antennae (Kramer et al. 2004)	qL=qP*Fo’/F’
Coefficient of photochemical fluorescence quenching (Schreiber et al. 1986 as formulated by van Kooten and Snel,1990)	qN=1-(Fm’-fo’)/(Fm-Fo)
Stern-Volmer type non-photochem-ical fluorescence quenching (Bilger and Björkman, 1990)	NPQ=Fm/Fm’-1
Quantum yield of non-light induced non-photochemical fluorescence quenching (Kramer et al. 2004)	Y(NO)=1/(NPQ+1+qL*(Fm/Fo-1))
Quantum yield of light-induced (∆ pH and zeaxanthin-dependent) non-photochemical fluorescence quench-ing (Kramer et al. 2004)	Y(NPQ)=1-Y(II)-Y(NO)

Fv/Fm and Y(II) PSII 的最大量子产量（Fv/Fm）和实际量子产量（Y(II)）

这两个参数表示的都是 PSII 将吸收的光能转化成化学能的效率。测 Fv/Fm 前，样品必需经过充分的暗适应以确保 PSII 所有的反应中心都处于开放状态并且非光化学淬灭达到最小。不同植物的暗适应时间不同，阴生叶片和阳生叶片的暗适应时间也不相同。

Y(II)反映的是光下叶片的实际光能转化效率。只有当照光强度（光化光）达到一定水平时 Y(II)的信息才能真实的反映光合的状态，因为在光强很弱时卡尔文碳同化过程可能无法正常运转而 Y(II)可能会比较高。

qP and qL 光化学淬灭系数

这两个参数表示的是 PSII 中处于开放状态的反应中心所占的比例。其中 qP 是基于沼泽模型的（puddle model，Schreiber et al. 1986 as formulated by van Kooten and Snel, 1990）。qL 是基于湖泊模型的（lake model, Kramer et al. 2004）。

qN and NPQ 非光化学淬灭参数。

这两个参数都和基于跨膜质子梯度和玉米黄质的非光化学淬灭相关。

Y(NO) and Y(NPQ) 非光化学淬灭的量子产量

这两个是 Kramer 等在 2004 年提出的新参数。Y(NPQ)是指 PS II 处调节性能量耗散的量子产量。若 Y(NPQ)较高，一方面表明植物接受的光强过剩，另一方面则说明植物仍可以通过调节（如将过剩光能耗散为热）来保护自身。Y（NPQ）是光保护的重要指标。Y(NO)是指 PS II 处非调节性能量耗散的量子产量。若 Y(NO)较高，则表明光化学能量转换和保护性的调节机制（如热耗散）不足以将植物吸收的光能完全消耗掉。也就是说，入射光强超过了植物能接受的程度。这时，植物可能已经受到损伤，或者（尽管还未受到损伤）继续照光的话植物将要受到损伤。Y（NO）是光损伤的重要指标。

Y(II)+Y(NO)+Y(NPQ)=1

5.4 相对电子传递速率

相对电子传递速率的计算公式如下：

$$\mathbf{ETR = PAR \cdot ETR\text{-}Factor \cdot P_{PS2}/P_{PPS} \cdot Y(II)}$$

ETR 计算的基本思想是乘积， PSII 的实际量子产量，Y(II) 乘以 PSII 吸收的光能。下面对公式中的各个参数进行简单介绍。

PAR 光合有效辐射

ETR-Factor 吸光系数

ETR-Factor 是指光合色素吸收光量子的比例。在可见光范围内（400-700 nm）高等植物吸光系数的经验值约为 0.84。不同样品的吸光系数可能不同，当不同样品间相互比较时要考虑到这些差别。

P_{PS2}/P_{PPS} PSII 光合色素吸收的光量子占总光合色素吸收的光量子的比例

假设 PSII 和 PSI 接收的光量子数量是相同的，即 $P_{PS2}/P_{PPS} = 0.5$。WinControl-3 用 0.5 做 P_{PS2}/P_{PPS} 的默认值。

5.5 光响应曲线

测量光响应曲线时<Light Curve>程序连续照射几个强度逐渐升高的光化光，一般情况下每个梯度的光化光持续时间太短而不足以使光合作用达到稳态。因此，此时的光响应曲线被称为快速光曲线（RLC）。和传统的光响应曲线不同，快速光曲线反映了当前状态下光合作用的信息。通过对快速光曲线进行拟合，可以得到以下几个主要参数：

- α，单位：electrons/photons，快速光曲线的初始斜率，反映了光能利用效率。
- ETRm，单位：$\mu mol \cdot m^{-2} \cdot s^{-1}$，最大电子传递速率。
- Ek，单位：$\mu mol \cdot m^{-2} \cdot s^{-1}$，最小饱和光强（半饱和光强），反映了样品对强光的耐受能力。

PamWin-3 采用 Eilers and Peeters（1988）的公式对快速光曲线进行拟合，拟合公式如下：

$$ETR = \frac{PAR}{a \cdot PAR^2 + b \cdot PAR + c}$$

各个参数的计算公式分别是：

$$\alpha = \frac{1}{c}$$

$$ETR_{max} = \frac{1}{b + 2 \cdot \sqrt{a \cdot c}}$$

$$I_K = \frac{c}{b + 2 \cdot \sqrt{a \cdot c}}$$

图 5.2 给出了几条快速光曲线的例子及拟合后的参数。

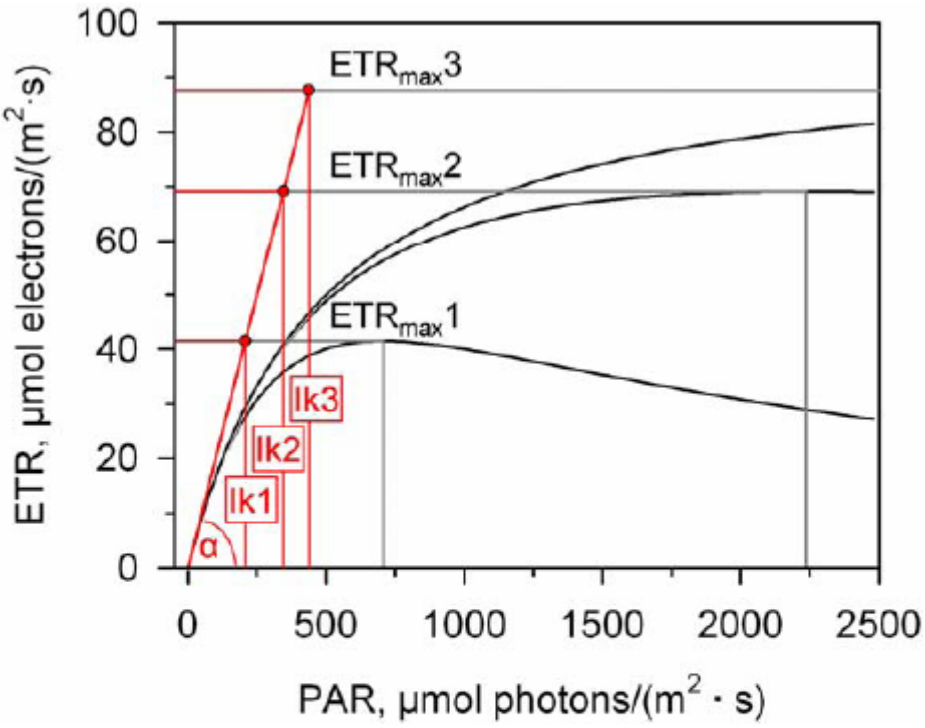


Figure 5.2: Three Exemplary Rapid Light Curves.

Curve	Parameter					
	a	b	c	α	ETR_{max}	Ik
1	$1 \cdot 10^{-5}$	$1 \cdot 10^{-2}$	5	0.2	41	207
2	$1 \cdot 10^{-6}$	$1 \cdot 10^{-2}$	5	0.2	69	345
3	$1 \cdot 10^{-7}$	$1 \cdot 10^{-2}$	5	0.2	88	438

5.5.1 关于快速光曲线的文献

Fouqueray M, Mouget J-L, Morant-Manceau A, Tremblin AG (2007) Dynamics of short-term acclimation to UV radiation in

marine diatoms. J Photochem Photobiol B: Biology 89: 1–8

Jassby AD, Platt T (1976) Mathematical formulation of the relationship between photosynthesis and light for phytoplankton. Limnol Oceanogr 21: 540-547

Perkins RG, Mouget J-L, Lefebvre S, Lavaud J (2006) Light response curve methodology and possible implications in the application of chlorophyll fluorescence to benthic diatoms. Marine Biol 149: 703-712

Platt T, Gallegos CL, Harrison WG (1980) Photoinhibition of photosynthesis in natural assemblages of marine phytoplankton. J Mar Res 38: 687-701

Ralph PJ, Gademann R (2005) Rapid light curves: A powerful tool to assess photosynthetic activity. Aquat Bot 82: 222-237

Rascher U, Liebig M, Lüttge U (2000) Evaluation of instant lightresponse curves of chlorophyll fluorescence parameters obtained with a portable chlorophyll fluorometer on site in the field. Plant Cell Environ 23: 1397-1405

Schreiber U, Gademann R, Ralph PJ, Larkum AWD (1997) Assessment of photosynthetic performance of *Prochloron* in *Lissoclinum patella* in hospite by chlorophyll fluorescence measurements. Plant Cell Physiol 38: 945-951

Serôdio J, Vieira S, Cruz S, Coelho H (2006) Rapid light-response curves of chlorophyll fluorescence in microalgae: relationship to steady-state light curves and non-photochemical quenching in benthic diatom-dominated assemblages. Photosynth Res 90: 29-43

Serôdio J, Vieira1 S, Cruz S, Barroso F (2005) Short-term variability in the photosynthetic activity of microphytobenthos as detected by measuring rapid light curves using variable fluorescence. Marine Biol 146: 903-914

White AJ, Critchley C (2005) Rapid light curves: A new fluorescence method to assess the state of the photosynthetic. Photosynth Res 59: 63-72

5.6 本章参考文献

Agati G, Cerovic ZG, Moya I (2000) The effect of decreasing temperature up to chilling values on the in vivo F685/F735 chlorophyll fluorescence ratio in Phaseolus vulgaris and Pisum sativum: the role of the Photosystem I contribution to the 735 nm fluorescence band, Photochem Photobiol 72: 75–84

Bilger W, Björkman O (1990) Role of the xanthophyll cycle in photoprotection

elucidated by measurements of light-induced absorbance changes, fluorescence and photosynthesis in leaves of *Hedera canariensis*. Photosynth Res 25:173-185

Eilers PHC, Peeters JCH (1988) A model for the relationship between light intensity and the rate of photosynthesis in phytoplankton. Ecol Model 42: 199-215

Franck F, Juneau P, Popovic R (2002) Resolution of the Photosystem I and Photosystem II contributions to chlorophyll

fluorescence of intact leaves at room temperature. Biochim Biophys Acta 1556: 239–246

Genty B, Briantais J-M, Baker NR (1989) The relationship between the quantum yield of photosynthetic electron transport and quenching of chlorophyll fluorescence. Biochim Biophys Acta 990: 87–92

Genty B, Harbinson J, Cailly AL and Rizza F (1996) Fate of excitation at PS II in leaves: the non-photochemical side. Presented at The Third BBSRC Robert Hill Symposium on Photosynthesis, March 31 to April 3, 1996, University of Sheffield, Department of Molecular Biology and Biotechnology, Western Bank, Sheffield, UK, Abstract P28

Genty B, Wonders J and Baker NR (1990) Non-photochemical quenching of F0 in leaves is emission wavelength dependent: Consequences for quenching analysis and its interpretation. Photosynth Res 26: 133–139

Gilmore AM, Yamamoto HY (1991) Zeaxanthin formation and energy-dependent fluorescence quenching in pea chloroplasts under artificially mediated linear and cyclic electron transport. Plant Physiol 96: 635–643

Kitajima M, Butler WL (1975) Quenching of chlorophyll fluorescence and primary photochemistry in chloroplasts by dibromothymoquinone. Biochim Biophys Acta 376:105-115

Klughammer C and Schreiber U (2008) Complementary PS II quantum yields calculated from simple fluorescence parameters measured by PAM fluorometry and the Saturation Pulse method. PAM Application Notes 1: 27-35 (http://www.walz.com/e_journal/pdfs/PAN078007.pdf)

Kramer DM, Johnson G., Kiirats O, Edwards GE (2004) New fluxparameters for the determination of QA redox state and excitation fluxes. Photosynthesis Res 79: 209-218

Oxborough K, Baker NR (1997) Resolving chlorophyll a fluorescence images of photosynthetic efficiency into photochemical and non-photochemical components - calculation of qP and Fv'/Fm' without measuring Fo'. Photosynth Res Volume 54 135-142

Peterson RB, Oja V, Laisk A (2001) Chlorophyll fluorescence at 680 and 730 nm and leaf photosynthesis. Photosynth Res 70: 185–196

Pfündel E (1998) Estimating the contribution of Photosystem I to total leaf chlorophyll fluorescence. Photosynth Res 56: 185–195

Pfündel EE, Naïma Ben Ghozlen N, Sylvie Meyer S, Zoran G. Cerovic ZG (2007) Investigating UV screening in leaves by two different types of portable UV fluorimeters reveals in vivo screening by anthocyanins and carotenoids. Photosynth Res 93. 205-221

Schreiber U, Schliwa U, Bilger W (1986) Continuous recording of photochemical and non-photochemical chlorophyll fluorescence quenching with a new type of modulation fluorometer. Photosynth Res 10: 51–62

van Kooten O, Snel J (1990) The use of chlorophyll fluorescence nomenclature in plant stress physiology. Photosynth Res 25: 147–150

8 部分 PAM-2000/PAM-2100/PAM-2500 文献

1. Ahmed H, Häder D-P: Rapid ecotoxicological bioassay of nickel and cadmium using motility and photosynthetic parameters of Euglena gracilis ***Environmental and Experimental Botany*** 2010, **69**(1):68-75.**[PAM-2000]**
2. Chen J, Wang P, Mi H-l, Chen G-Y, Xu D-Q: Reversible association of ribulose-1, 5-bisphosphate carboxylase/oxygenase activase with the thylakoid membrane depends upon the ATP level and pH in rice without heat stress. ***Journal of Experimental Botany*** 2010:in press.**[DUAL-PAM-100, PAM-2000]**
3. de la Peña TC, Redondo FJ, Manrique E, Lucas MM, Pueyo JJ: Nitrogen fixation persists under conditions of salt stress in transgenic Medicago truncatula plants expressing a cyanobacterial flavodoxin. ***Plant Biotechnology Journal*** 2010:in press.**[PAM-2000]**
4. de Oliveira VC, Joly CA: Flooding tolerance of *Calophyllum brasiliense* Camb. (Clusiaceae): morphological, physiological and growth responses ***Trees - Structure and Function*** 2010, **24**(1):185-193.**[PAM-2100]**
5. Gladis F, Karsten EU, Schumann R: Prevention of biofilm growth on man-made surfaces: evaluation of antialgal activity of two biocides and photocatalytic nanoparticles ***Biofouling*** 2010, **26**(1):89-101.**[PAM-2000]**
6. Gould KS, Dudle DA, Neufeld HS: Why some stems are red: cauline anthocyanins shield photosystem II against high light stress. ***Journal of Experimental Botany*** 2010:in press.**[IMAGING-PAM, PAM-2500, PAM-2000]**
7. Guadagno CR, De Santo AV, D'Ambrosio N: A revised energy partitioning approach to assess the yields of non-photochemical quenching components ***Biochimica et Biophysica Acta*** 2010, **1797**(5):525-530.**[PAM-2000]**
8. Iglesias-Baena I, Barranco-Medina S, Lázaro-Payo A, López-Jaramillo FJ, Sevilla F, Lázaro J-J: Characterization of plant sulfiredoxin and role of sulphinic form of 2-Cys peroxiredoxin. ***Journal of Experimental Botany*** 2010:in press.**[PAM-2000]**
9. Ilík P, Kotabová E, Špundová M, Novák O, Kaňa R, Strzałka K: Low-light-induced Violaxanthin De-epoxidation in Shortly Preheated Leaves: Uncoupling from ΔpH-dependent Nonphotochemical Quenching. ***Photochemistry and Photobiology*** 2010:in press.**[PAM-2000]**
10. Kurzbaum E, Beer S, Eckert W: Alterations in delayed and direct phytoplankton fluorescence in response to the diurnal light cycle. ***Hydrobiologia*** 2010, **639**(1):197-203.**[PAM-2000]**
11. Laviale M, Prygiel J, Créach A: Light modulated toxicity of isoproturon toward natural stream periphyton photosynthesis: A comparison between constant and dynamic light conditions ***Aquatic Toxicology*** 2010:in press.**[PAM-2100]**
12. Li G, Wan S, Zhou J, Yang Z, Qin P: Leaf chlorophyll fluorescence, hyperspectral reflectance, pigments content,

malondialdehyde and proline accumulation responses of castor bean (*Ricinus communis* L.) seedlings to salt stress levels ***Industrial Crops and Products*** 2010, **31**(1):13-19.**[PAM-2000]**

13. Lovelock CE, Grinham A, Adame MF, Penrose HM: Elemental composition and productivity of cyanobacterial mats in an arid zone estuary in north Western Australia ***Wetlands Ecology and Management*** 2010, **18**(1):37-47.**[PAM-2100]**
14. Naidoo G, Naidoo Y, Achar P: Responses of the mangroves *Avicennia marina* and *Bruguiera gymnorrhiza* to oil contamination ***Flora - Morphology, Distribution, Functional Ecology of Plants*** 2010:in press.**[PAM-2100]**
15. Parolin P, Waldhoff D, Zerm M: Photochemical capacity after submersion in darkness: How Amazonian floodplain trees cope with extreme flooding ***Aquatic Botany*** 2010:in press **[PAM-2000]**
16. Ren W, Tan H, Wu J, Deng Y, Wu Y, Tang Y, Cui X: UV light spectral response of photosynthetic photochemical efficiency in alpine mosses. ***Journal of Plant Ecology*** 2010:in press.**[PAM-2000]**
17. Richter A, Peter E, Pörs Y, Lorenzen S, Grimm B, Czarnecki O: Rapid Dark Repression Of 5-Aminolevulinic Acid Synthesis In Green Barley Leaves. ***Plant and Cell Physiology*** 2010:in press.**[PAM-2000]**
18. Rodriguez-Brljevich C, Kanobe C, Shanahan JF, Robertson AE: Seed treatments enhance photosynthesis in maize seedlings by reducing infection with *Fusarium* spp. and consequent disease development in maize ***European Journal of Plant Pathology*** 2010, **126**(3):343-347.**[PAM-2000]**
19. Solhaug K, Larsson P, Gauslaa Y: Light screening in lichen cortices can be quantified by chlorophyll fluorescence techniques for both reflecting and absorbing pigments ***Planta*** 2010, **231**(5):1003-1011.**[PAM-2000]**
20. Solovchenko AE, Merzlyak MN, Pogosyan SI: Light-induced decrease of reflectance provides an insight in the photoprotective mechanisms of ripening apple fruit ***Plant Science*** 2010, **178**(3):281-288.**[PAM-2000]**
21. Sun X, Fu T, Chen N, Guo J, Ma J, Zou M, Lu C, Zhang L: The Stromal Chloroplast Deg7 Protease Participates in the Repair of Photosystem II after Photoinhibition in Arabidopsis. ***Plant Physiology*** 2010, **152**:1263-1273.**[PAM-2000]**
22. Sun X, Ouyang M, Guo J, Ma J, Lu C, Adam Z, Zhang L: The thylakoid protease Deg1 is involved in photosystem-II assembly in *Arabidopsis thaliana*. ***The Plant Journal*** 2010:in press.**[PAM-2000]**
23. Wei L, Guo J, Ouyang M, Sun X, Ma J, Chi W, Lu C, Zhang L: LPA19, A PSB27 homolog in Arabidopsis thaliana, facilitates D1 protein precursor processing during PSII biogenesis. ***Journal of Biological Chemistry*** 2010:in press.**[PAM-2000]**
24. Wen L, Chen T, Zhang M, Wang Y, Zhang Y, Duan Z, An L, Jian Q, Peng R: Seasonal changes in anthocyanin contents and in activities of xanthophyll and ascorbate–glutathione cycles in *Sabina* species derived from different environments. ***Acta Physiologiae Plantarum*** 2010:in press.**[PAM-2000]**
25. Weng J-H, Jhaung L-H, Lin R-J, Chen H-Y: Relationship between photochemical efficiency of photosystem II and the photochemical reflectance index of mango tree: merging data from different illuminations, seasons and leaf colors.

Tree Physiology 2010:in press.**[PAM-2000]**

26. Wu L-q, Lv Y-l, Meng Z-x, Chen J, Guo S-X: The promoting role of an isolate of dark-septate fungus on its host plant *Saussurea involucrata* Kar. et Kir. . ***Mycorrhiza*** 2010, **20**(2):127-135.**[PAM-2100]**

27. Xiong X, James VA, Zhang H, Altpeter F: Constitutive expression of the barley HvWRKY38 transcription factor enhances drought tolerance in turf and forage grass (*Paspalum notatum* Flugge). ***Molecular Breeding*** 2010, **25**:419-432.**[PAM-2100]**

28. Xue Y, Peng R, Xiong A, Li X, Zha D, Yao Q: Over-expression of heat shock protein gene *hsp26* in *Arabidopsis thaliana* enhances heat tolerance ***Biologia Plantarum*** 2010, **54**(1):105-111.**[PAM-2100]**

29. Yin Y, Li S, Liao W, Lu Q, Wen X, Lu C: Photosystem II photochemistry, photoinhibition, and the xanthophyll cycle in heat-stressed rice leaves. ***Journal of Plant Physiology*** 2010:in press.**[PAM-2000]**

30. Yin Z, Meng F, Song H, He X, Xu X, Yu D: Mapping quantitative trait loci associated with chlorophyll a fluorescence parameters in soybean (*Glycine max* (L.) Merr.) ***Planta*** 2010, **231**(4):875-885.**[PAM-2100]**

31. Zell MB, Fahnenstich H, Maier A, Saigo M, Voznesenskaya EV, Edwards GE, Andreo C, Schleifenbaum F, Zell C, Drincovich MF *et al*: Analysis of Arabidopsis with Highly Reduced Levels of Malate and Fumarate Sheds Light on the Role of These Organic Acids as Storage Carbon Molecules. ***Plant Physiology*** 2010, **152**:1251-1262.**[PAM-2000]**

32. Zhang S, Song J, Wang H, Feng G: Effect of salinity on seed germination, ion content and photosynthesis of cotyledons in halophytes or xerophyte growing in Central Asia. ***Journal of Plant Ecology*** 2010:in press.**[PAM-2100]**

33. 卜令铎, 张仁和, 常宇, 薛吉全, 韩苗苗: 苗期玉米叶片光合特性对水分胁迫的响应. ***生态学报*** 2010, **30**(5):1184-1191.**[PAM-2100]**

34. 陈鹭真, 王文卿, 张宜辉, 丽 黄, 赵春磊, 杨盛昌, 杨志伟, 陈粤超, 徐华林, 钟才荣 *et al*: 2008年南方低温对我国红树植物的破坏作用. ***植物生态学报*** 2010, **34**(2):186-194.**[PAM-2100]**

35. 陈友根, 陈劲枫, 李为观, 崔利, 陈龙正: 甜瓜属不同倍性异源多倍体光合特性及超微结构研究. ***南京农业大学学报*** 2010, **33**(1):32-36.**[PAM-2100]**

36. 杨淑萍, 危常州, 梁永超: 盐胁迫对不同基因型海岛棉光合作用及荧光特性的影响. ***中国农业科学*** 2010, **43**(8):in press.**[PAM-2100]**

37. Bally J, Nadai M, Vitel M, Rolland A, Dumain R, Dubald M: Plant Physiological Adaptations to the Massive Foreign Protein Synthesis Occurring in Recombinant Chloroplasts. ***Plant Physiology*** 2009, **150**:1474-1481.**[PAM-2500]**

38. Baumann HA, Morrison L, Stengel DB: Metal accumulation and toxicity measured by PAM—Chlorophyll fluorescence in seven species of marine macroalgae ***Ecotoxicology and Environmental Safety*** 2009, **72**(4):1063-1075.**[PAM-2000]**

39. Buma AGJ, Sjollema SB, van de Poll WH, Klamer HJC, Bakkerb\ JF: Impact of the antifouling agent Irgarol 1051 on

marine phytoplankton species ***Journal of Sea Research*** 2009, **61**(3):133-139.**[PAM-2000, WATER-PAM]**

40. Cai W, Ji D, Peng L, Guo J, Ma J, Zou M, Lu C, Zhang L: LPA66 Is Required for Editing psbF Chloroplast Transcripts in Arabidopsis. ***Plant Physiology*** 2009, **150**:1260-1271.**[PAM-2000, PAM-100]**

41. Ding S, Lu Q, Zhang Y, Yang Z, Wen X, Zhang L, Lu C: Enhanced sensitivity to oxidative stress in transgenic tobacco plants with decreased lutathione reductase activity leads to a decrease in ascorbate pool and ascorbate redox state ***Plant Molecular Biology*** 2009, **69**(5):577-592.**[PAM-2000]**

42. Dutta S, Mohanty S, Tripathy BC: Role of Temperature Stress on Chloroplast Biogenesis and Protein Import in Pea. ***Plant Physiology*** 2009, **150**:1050-1061.**[PAM-2100]**

43. Else MA, Janowiak F, Atkinson CJ, Jackson MB: Root signals and stomatal closure in relation to photosynthesis, chlorophyll a fluorescence and adventitious rooting of flooded tomato plants. ***Annals of Botany*** 2009, **103**:313-323.**[PAM-2000]**

44. Fredersdorf J, Müller R, Becker S, Wiencke C, Bischof K: Interactive effects of radiation, temperature and salinity on different life history stages of the Arctic kelp *Alaria esculenta* (Phaeophyceae) ***Oecologia*** 2009, **160**(3):483-492.**[PAM-2100, WATER-PAM]**

45. Giannelli L, Scoma A, Torzillo G: Interplay between light intensity, chlorophyll concentration and culture mixing on the hydrogen production in sulfur-deprived *Chlamydomonas reinhardtii* cultures grown in laboratory photobioreactors. ***Biotechnology and Bioengineering*** 2009, **104**(1):76-90.**[PAM-2100]**

46. Guo W-D, Guo Y-P, Liu J-R, Mattson N: Midday depression of photosynthesis is related with carboxylation efficiency decrease and D1 degradation in bayberry (*Myrica rubra*) plants ***Scientia Horticulturae*** 2009, **123**(2):188-196.**[PAM-2000, HCM-1000]**

47. Hauck M, Willenbruch K, Leuschner C: Lichen Substances Prevent Lichens from Nutrient Deficiency ***Journal of Chemical Ecology*** 2009, **35**(1):71-73.**[PAM-2100]**

48. Häusler RE, Geimer S, Kunz HH, Schmitz J, Dörmann P, Bell K, Hetfeld S, Guballa A, Flügge U-I: Chlororespiration and Grana Hyperstacking: How an Arabidopsis Double Mutant Can Survive Despite Defects in Starch Biosynthesis and Daily Carbon Export from Chloroplasts. ***Plant Physiology*** 2009, **149**:515-533.**[PAM-2100]**

49. Hu M-J, Guo Y-P, Shen Y-G, Guo D-P, Li D-Y: Midday depression of photosynthesis and effects of mist spray in citrus. ***Annals of Applied Biology*** 2009, **154**(1):143-155.**[PAM-2000]**

50. Jampeetong A, Brix H: Oxygen stress in *Salvinia natans*: Interactive effects of oxygen availability and nitrogen source ***Environmental and Experimental Botany*** 2009, **66**(2):153-159.**[PAM-2000]**

51. Jing YX, Li GL, Gu BH, Yang DJ, Xiao L, Liu RX, Peng CL: Leaf gas exchange, chlorophyll fluorescence and growth responses of *Melaleuca alternifolia* seedlings to flooding and subsequent recovery ***Photosynthetica*** 2009,

47(4):595-601.**[PAM-2100]**

52. Kato Y, Miura E, Ido K, Ifuku K, Sakamoto W: The Variegated Mutants Lacking Chloroplastic FtsHs Are Defective in D1 Degradation and Accumulate Reactive Oxygen Species. ***Plant Physiology*** 2009, **151**:1790-1801.**[PAM-2000]**

53. Li S, Zhang K, Zhou S, Zhang L, Chen Q: Use of dewatered municipal sludge on Canna growth in pot experiments with a barren clay soil ***Waster Management*** 2009, **29**(6):1860-1876.**[PAM-2100]**

54. Liu W-J, Chen Y-E, Tian W-J, Du J-B, Zhang Z-W, Xu F, Zhang F, Yuan S, Lin H-H: Dephosphorylation of photosystem II proteins and phosphorylation of CP29 in barley photosynthetic membranes as a response to water stress ***Biochimica et Biophysica Acta*** 2009, **1787**(10):1238-1245.**[PAM-2100]**

55. Luo M-H, Yuan S, Chen Y-E, Liu W-J, Du J-B, Lei T, Wang M-B, Lin H-H: Effects of salicylic acid on the photosystem 2 of barley seedlings under osmotic stress ***Biologia Plantarum*** 2009, **53**(4):663-669.**[PAM-2100]**

56. Major JE, Mosseler A, Barsi DC, Corriveau-Dupuis B, Campbell M: Impact of three silvicultural treatments on growth, light-energy processing, and related needle-level adaptive traits of *Pinus strobus* from two regions ***Forest Ecology and Management*** 2009, **257**(1):168-181.**[PAM-2000]**

57. Melgar JC, Guidi L, Remorini D, Agati G, Degl'innocenti E, Castelli S, Baratto MC, Faraloni C, Tattini M: Antioxidant defences and oxidative damage in salt-treated olive plants under contrasting sunlight irradiance. ***Tree Physiology*** 2009, **29**:1187-1198.**[PAM-2000]**

58. Naumann JC, Young DR, Anderson JE: Spatial variations in salinity stress across a coastal landscape using vegetation indices derived from hyperspectral imagery. ***Plant Ecology*** 2009, **202**(2):285-297.**[PAM-2000]**

59. Olivé I, García-Sánchez MP, Brun FG, Vergara JJ, Pérez-Lloréns JL: Interactions of light and organic matter under contrasting resource simulated environments: the importance of clonal traits in the seagrass *Zostera noltii* ***Hydrobiologia*** 2009, **629**(1):199-208.**[PAM-2000]**

60. Paul A, Hauck M, Leuschner C: Iron and phosphate uptake in epiphytic and saxicolous lichens differing in their pH requirements ***Environmental and Experimental Botany*** 2009, **67**(1):133-138.**[PAM-2100]**

61. Paul A, Hauck M, Leuschner C: Iron and phosphate uptake explains the calcifuge–calcicole behavior of the terricolous lichens *Cladonia furcata* subsp. *furcata* and *C. rangiformis* ***Plant and Soil*** 2009, **319**(1-2):49-56.**[PAM-2100]**

62. Peguero-Pina JJ, Gil-Pelegrín E, Morales F: Photosystem II efficiency of the palisade and spongy mesophyll in *Quercus coccifera* using adaxial/abaxial illumination and excitation light sources with wavelengths varying in penetration into the leaf tissue ***Photosynthesis Research*** 2009, **99**(1):49-61.**[PAM-2000]**

63. Rao B, Liu Y, Wang W, Hu C, Li D, Lan S: Influence of dew on biomass and photosystem II activity of cyanobacterial crusts in the Hopq Desert, northwest China ***Soil Biology and Biochemistry*** 2009, **41**(12):2387-2393.**[PAM-2100]**

64. Szalai G, Janda T: Effect of Salt Stress on the Salicylic Acid Synthesis in Young Maize (*Zea mays* L.) Plants. ***Journal***

of Agronomy and Crop Science 2009, **195**(3):165-171.**[PAM-2000]**

65. Takahashi S, Milward SE, Fan D-Y, Chow WS, Badger MR: How Does Cyclic Electron Flow Alleviate Photoinhibition in *Arabidopsis*? ***Plant Physiology*** 2009, **149**:1560-1567.**[PAM-2000]**

66. Takahashi S, Whitney SM, Badger MR: Different thermal sensitivity of the repair of photodamaged photosynthetic machinery in cultured *Symbiodinium* species. ***Proc Natl Acad Sci USA*** 2009, **106**:3237-3242.**[PAM-2000]**

67. Torzillo G, Scoma A, Faraloni C, Ena A, Johanningmeier U: Increased hydrogen photoproduction by means of a sulfur-deprived *Chlamydomonas reinhardtii* D1 protein mutant. ***Internal Journal of Hydrogen Energy*** 2009, **34**(10):4529-4536.**[PAM-100, PAM-2100]**

68. Wang H, Feng T, Peng X, Yan M, Tan X: Up-regulation of chloroplastic antioxidant capacity is involved in alleviation of nickel toxicity of *Zea mays* L. by exogenous salicylic acid ***Ecotoxicology and Environmental Safety*** 2009, **72**(5):1354-1362.**[PAM-2000]**

69. Xu H, Zhang J, Zeng J, Jiang L, Liu E, Peng C, He Z, Peng X: Inducible antisense suppression of glycolate oxidase reveals its strong regulation over photosynthesis in rice. ***Journal of Experimental Botany*** 2009, **60**(6):1799-1809.**[PAM-2000]**

70. Xu S-j, Liu C-j, Jiang P-a, Cai W-m, Wang Y: The effects of drying following heat shock exposure of the desert moss *Syntrichia caninervis* ***Science of The Total Environment*** 2009, **407**(7):2411-2419.**[PAM-2100]**

71. Yang F, Xiao X, Zhang S, Korpelainen H, Li C: Salt stress responses in *Populus cathayana* Rehder ***Plant Science*** 2009, **176**(5):669-677.**[PAM-2000]**

72. Yang L, Liu N, Ren H, Wang J: Facilitation by two exotic *Acacia*: *Acacia auriculiformis* and *Acacia mangium* as nurse plants in South China. ***Forest Ecology and Management*** 2009, **257**(8):1786-1793.**[PAM-2100]**

73. Yang L, Ren H, Liu N, Wang J: The shrub Rhodomyrtus tomentosa acts as a nurse plant for seedlings differing in shade tolerance in degraded land of South China. ***Journal of Vegetation Science*** 2009, **21**(2):262-272.**[PAM-2100]**

74. Yao X, Liu Q: The effects of enhanced ultraviolet-B and nitrogen supply on growth, photosynthesis and nutrient status of *Abies faxoniana* seedlings ***Acta Physiologiae Plantarum*** 2009, **31**(3):523-529.**[PAM-2100]**

75. Yin C, Pang X, Chen K: The effects of water, nutrient availability and their interaction on the growth, morphology and physiology of two poplar species ***Environmental and Experimental Botany*** 2009, **67**(1):196-203.**[PAM-2100]**

76. Yin H, Lai T, Cheng X, Jiang X, Liu Q: Warming effect on growth and physiology of seedlings of *Betula albo-sinensis* and *Abies faxoniana* under two contrasting light conditions in subalpine coniferous forests of western Sichuan, China ***Frontiers of Forestry in China*** 2009, **4**(4):432-442.**[PAM-2100]**

77. Zarco-Tejada PJ, Berni JAJ, Suárez L, Sepulcre-Cantó G, Morales F, Miller JR: Imaging chlorophyll fluorescence with an airborne narrow-band multispectral camera for vegetation stress detection ***Remote Sensing of Environment*** 2009,

113(6):15.**[GFS-3000, PAM-2100]**

78. Zhang LL, Wen DZ, Fu SL: Responses of photosynthetic parameters of Mikania micrantha and Chromolaena odorata to contrasting irradiance and soil moisture ***Biologia Plantarum*** 2009, **53**(3):517-522.**[PAM-2100]**

79. Zhang Y, Zhang Q, Luo P, Wu N: Photosynthetic response of *Fragaria orientalis* in different water contrast clonal integration ***Ecological Research*** 2009, **24**(3):617-625.**[PAM-2100]**

80. Zhang Y-L, Zhang H-Z, Feng G-Y, Tian J-S, Zhang1 W-F: Leaf diaheliotropic movement can improve carbon gain and water use efficiency and not intensify photoinhibition in upland cotton (*Gossypium hirsutum* L.) ***Photosynthetica*** 2009, **47**(4):609-615.**[PAM-2100]**

81. Zheng Y-L, Feng Y-L, Lei Y-B, Yang C-Y: Different photosynthetic responses to night chilling among twelve populations of *Jatropha curcas* ***Photosynthetica*** 2009, **47**(4):559-566.**[PAM-2100]**

82. 卜令铎, 张仁和, 韩苗苗, 薛吉全, 常宇: 干旱复水激发玉米叶片补偿效应的生理机制. ***西北农业学报*** 2009, **18**(2):88-92.**[PAM-2100]**

83. 陈娟: 水稻花后颖壳和果皮光合特性的研究. ***安徽农业科学*** 2009, **37**(13):5897-5900.**[PAM-2100]**

84. 高天鹏, 王东, 高海宁, 张华, 张庆, 安黎哲, 王爱勤: 保水剂对旱地马铃薯产量及叶片叶绿素荧光动力学参数的影响. ***兰州大学学报*** 2009, **45**(3):67-72.**[PAM-2100]**

85. 郭卫东, 郑建树, 张真真, 陈文荣, 郭延平: 短暂低温对佛手光合生理的影响. ***生态学报*** 2009, **29**(5):2287-2293.**[GFS-3000, PAM-2100]**

86. 黄红英, 窦新永, 孙蓓育, 邓斌, 吴国江, 彭长连: 两种不同生态型麻疯树夏季光合特性的比较. ***生态学报*** 2009, **29**(6):2861-2867.**[PAM-2100]**

87. 解婷婷, 苏培玺, 丁松爽: 黑河中游边缘绿洲不同水分条件对青贮玉米叶片光合特性及产量的影响. ***西北农业学报*** 2009, **18**(6):127-133.**[PAM-2100]**

88. 柯裕州, 周金星, 卢楠, 张旭东, 孙启祥: 盐胁迫对桑树幼苗光合生理及叶绿素荧光特性的影响. ***林业科学研究*** 2009, **22**(2):200-206.**[PAM-2100]**

89. 马红群, 洪鸿, 周忆堂, 胡丽涛, 梁丽娇, 吴能表: NaHSO3对UV-B辐射增强下菠菜幼苗光合作用的影响. ***园艺学报*** 2009, **36**(3):369-376.**[PAM-2100]**

90. 倪纪恒, 陈学好, 陈春宏, 徐强: 补充不同光质对温室黄瓜生长发育、光合和前期产量的影响. ***中国农业科学*** 2009, **42**(7):2615-2623.**[PAM-2000]**

91. 宋莉英, 孙兰兰, 张强, 李伟华, 彭长连: 高温对入侵种三裂叶蟛蜞菊叶片PSII功能和光能分配的影响. ***植物生理学通讯*** 2009, **45**(5):464-468.**[PAM-2100]**

92. 吴雪霞, 陈建林, 查丁石: 低温胁迫对茄子幼苗叶片气体交换、PSⅡ光化学效率和光能分配的影响. ***浙江农业学报*** 2009, **21**(2):139-143.**[PAM-2100]**

93. 吴雪霞, 于力, 朱为民: 外源一氧化氮对NaCl胁迫下番茄幼苗叶绿素荧光特性的影响. ***中国生态农业学*** 2009, **17**(4):746-751.**[PAM-2100]**

94. 夏建荣, 余锦兰: 高浓度CO2对小新月菱形藻胞外碳酸酐酶活性和光合作用的影响. ***广州大学学报*** 2009, **8**(3):49-53.**[PAM-2100]**

95. 钟泰林, 李根有, 石柏林: 遮荫对南五味子光合特性的影响. ***中草药*** 2009, **40**(3):466-469.**[PAM-2100]**

96. Belnap J, Phillips SL, Flint S, Money J, Caldwell M: Global change and biological soil crusts: effects of ultraviolet augmentation under altered precipitation regimes and nitrogen additions. ***Global Change Biology*** 2008, **14**(3):670-686.**[PAM-2000]**

97. Biswas DK, Xu H, Li YG, Liu MZ, Chen YH, Sun JZ, Jiang GM: Assessing the genetic relatedness of higher ozone sensitivity of modern wheat to its wild and cultivated progenitors/relatives. ***J Exp Bot*** 2008, **59**(4):951-963.**[PAM-2000]**

98. Borghi M, Tognetti R, Monteforti G, Sebastiani L: Responses of two poplar species (*Populus alba* and *Populus x canadensis*) to high copper concentrations. ***Environmental and Experimental Botany*** 2008, **62**(3):290-299.**[PAM-2000]**

99. Busch F, Huner NPA, Ensminger I: Increased Air Temperature during Simulated Autumn Conditions Impairs Photosynthetic Electron Transport between Photosystem II and Photosystem I. ***Plant Physiology*** 2008, **147**(1):402-414.**[PAM-2100]**

100. Chen Q, Wang LF, Su N, Qin HD, Niu HB, Wang JL, Zhai HQ, Wan JM: Photosystem 2 photochemistry and pigment composition of a yellow mutant of rice (*Oryza sativa* L.) under different irradiances ***Photosynthetica*** 2008, **46**(1):35-39.**[PAM-2000]**

101. Chi W, Ma J, Zhang D, Guo J, Chen F, Lu C, Zhang L: The PPR Protein DG1 is Involved in the Regulation of Early Chloroplast Development and Chloroplast Gene Expression in *Arabidopsis thaliana*. ***Plant Physiology*** 2008, **147**:573-584.**[PAM-2000]**

102. Duan J, Li J, Guo S, Kang Y: Exogenous spermidine affects polyamine metabolism in salinity-stressed *Cucumis sativus* roots and enhances short-term salinity tolerance ***Journal of Plant Physiology*** 2008, **165**(15):1620-1635.**[PAM-2100]**

103. Fang J, Chai C, Qian Q, Li C, Tang J, Sun L, Huang Z, Guo X, Sun C, Liu M *et al*: Mutations of genes in synthesis of the carotenoid precursors of ABA lead to pre-harvest sprouting and photo-oxidation in rice. ***The Plant Journal*** 2008, **54**(2):177-189.**[PAM-2100]**

104. Gong H, Tang Y, Wang J, Wen X, Zhang L, Lu C: Characterization of photosystem II in salt-stressed cyanobacterial *Spirulina platensis* cells ***Biochimica et Biophysica Acta*** 2008, **1777**:488-495.**[PAM-2100]**

105. González-Pérez S, Quijano C, Romero N, Melø TB, Radi R, Arellano JB: Peroxynitrite inhibits electron transport on

the acceptor side of higher plant photosystem II ***Archives of Biochemistry and Biophysics*** 2008, **473**(1):25-33.**[PAM-2000]**

106. Hauck M, Jürgens S-R: Usnic acid controls the acidity tolerance of lichens ***Environmental Pollution*** 2008, **156**(1):115-122.**[PAM-2100]**

107. Jung S, Back K, Yang K, Kuk YI, Chon S-U: Defence response produced during photodynamic damage in transgenic rice overexpressing 5-aminolevulinic acid synthase ***Photosynthetica*** 2008, **46**(1):3-9.**[PAM-2000]**

108. Koniger M, Delamaide JA, Marlow ED, Harris GC: *Arabidopsis* thaliana leaves with altered chloroplast numbers and chloroplast movement exhibit impaired adjustments to both low and high light. ***Journal of Experimental Botany*** 2008, **59**(9):2285-2297.**[PAM-2000]**

109. Kotabová E, Kaňa R, Kyseláková H, Lípová L, Novák O, Ilík P: A pronounced light-induced zeaxanthin formation accompanied by an unusually slight increase in non-photochemical quenching: A study with barley leaves treated with methyl viologen at moderate light ***Journal of Plant Physiology*** 2008, **165**(15):1563-1571.**[PAM-2000]**

110. Lange PR, Geserick C, Tischendorf G, Zrenner R: Functions of Chloroplastic Adenylate Kinases in *Arabidopsis*. ***Plant Physiology*** 2008, **146**(2):492-504.**[IMAGING-PAM, PAM-2000]**

111. Matringe M, Ksas B, Rey P, Havaux M: Tocotrienols, the unsaturated forms of vitamin E, can function as antioxidants and lipid protectors in tobacco leaves. ***Plant Physiology*** 2008, **147**:764-778.**[PAM-2000]**

112. Muraoka H, Noda H, Uchida M, Ohtsuka T, Koizumi H, Nakatsubo T: Photosynthetic characteristics and biomass distribution of the dominant vascular plant species in a high Arctic tundra ecosystem, Ny-Ålesund, Svalbard: implications for their role in ecosystem carbon gain ***Journal of Plant Research*** 2008, **121**(2):137-145.**[PAM-2100]**

113. Pattanaik B, Roleda MY, Schumann R, Karsten U: Isolate-specific effects of ultraviolet radiation on photosynthesis, growth and mycosporine-like amino acids in the microbial mat-forming cyanobacterium *Microcoleus chthonoplastes*. ***Planta*** 2008, **227**(4):907-916.**[PAM-2000]**

114. Roleda MY, Dethleff D, Wiencke C: Transient sediment load on blades of *Arctic Saccharina latissima* can mitigate UV radiation effect on photosynthesis ***Polar Biology*** 2008, **31**(6):765-769.**[PAM-2100]**

115. Schippers JHM, Nunes-Nesi A, Apetrei R, Hille J, Fernie AR, Dijkwel PP: The *Arabidopsis onset of leaf death5* Mutation of Quinolinate Synthase Affects Nicotinamide Adenine Dinucleotide Biosynthesis and Causes Early Ageing. ***The Plant Cell*** 2008, **20**:2909-2925.**[PAM-2000]**

116. Suárez L, Zarco-Tejada PJ, Sepulcre-Cantó G, Pérez-Priego O, Miller JR, Jiménez-Muñoz JC, Sobrino J: Assessing canopy PRI for water stress detection with diurnal airborne imagery ***Remote Sensing of Environment*** 2008, **112**(2):560-575.**[PAM-2100]**

117. Takahashi S, Whitney S, Itoh S, Maruyama T, Badger M: Heat stress causes inhibition of the de novo synthesis of

antenna proteins and photobleaching in cultured *Symbiodinium*. ***Proc Natl Acad Sci USA*** 2008, **105**:4203-4208.**[PAM-2000]**

118. Tattini M, Traversi ML: On the mechanism of salt tolerance in olive (*Olea europaea* L.) under low- or high-Ca^{2+} supply ***Environmental and Experimental Botany*** 2008, **65**(1):72-81.**[PAM-2000]**

119. Tronconi MA, Fahnenstich H, Gerrard Weehler MC, Andreo CS, Flugge U-I, Drincovich MF, Maurino VG: Arabidopsis NAD-Malic Enzyme Functions As a Homodimer and Heterodimer and Has a Major Impact on Nocturnal Metabolism. ***Plant Physiology*** 2008, **146**(4):1540-1552.**[PAM-2000]**

120. Wang N, Yu F-H, Li P-X, He W-M, Liu F-H, Liu J-M, Dong M: Clonal Integration Affects Growth, Photosynthetic Efficiency and Biomass Allocation, but not the Competitive Ability, of the Alien Invasive Alternanthera philoxeroides under Severe Stress. ***Annals of Botany*** 2008, **101**(5):671-678.**[PAM-2100]**

121. Wodala B, Deak Z, Vass I, Erdei L, Altorjay I, Horvath F: In Vivo Target Sites of Nitric Oxide in Photosynthetic Electron Transport as Studied by Chlorophyll Fluorescence in Pea Leaves. ***Plant Physiology*** 2008, **146**(4):1920-1927.**[PAM-2000]**

122. Wu FZ, Bao WK, Li FL, Wu N: Effects of water stress and nitrogen supply on leaf gas exchange and fluorescence parameters of *Sophora davidii* seedlings ***Photosynthetica*** 2008, **46**(1):40-48.**[PAM-2100]**

123. Yamane K, Kawasaki M, Taniguchi M, Miyake H: Correlation between Chloroplast Ultrastructure and Chlorophyll Fluorescence Characteristics in the Leaves of Rice (*Oryza sativa* L.) Grown under Salinity. ***Plant Production Science*** 2008, **11**(1):139-145.**[PAM-2100]**

124. Yang X, Liang Z, Wen X, Lu C: Genetic engineering of the biosynthesis of glycinebetaine leads to increased tolerance of photosynthesis to salt stress in transgenic tobacco plants ***Plant Molecular Biology*** 2008, **66**(1-2):73-86.**[PAM-2000]**

125. Yang YQ, Yao Y: Photosynthetic responses to solar UV-A and UV-B radiation in low-and high-altitude populations of *Hippophae rhamnoides* ***Photosynthetica*** 2008, **46**(2):307-311.**[PAM-2100]**

126. Yin HJ, Liu Q, Lai T: Warming effects on growth and physiology in the seedlings of the two conifers *Picea asperata* and *Abies faxoniana* under two contrasting light conditions ***Ecological Research*** 2008, **23**(2):459-469.**[PAM-2100]**

127. Zhao B, Wang J, Gong H, Wen X, Ren H, Lu C: Effects of heat stress on PSII photochemistry in a cyanobacterium *Spirulina platensis* ***Plant Science*** 2008, **175**(4):556-564.**[PAM-2000]**

128. 陈屏昭, 康道坤, 武卫华, 薛梅, 吴银梅, 郭延平: 叶绿素荧光仪饱和脉冲光作用前后温州蜜柑叶温的变化. ***生态学杂志*** 2008, **27**(3):339-343.**[PAM-2000]**

129. 关广晟, 屠乃美, 肖汉乾, 朱列书, 朱英华, 王中美: 镁对烟草生长及叶片叶绿素荧光参数的影响. ***植物营养与肥料学报*** 2008, **14**(1):151-155.**[PAM-2000]**

130. 关岚岚, 刘楠, 韦强, 简曙光: 华南地区8种藤本植物叶绿素荧光特性对模拟二氧化硫污染的响应. ***热带亚热带***

植物学报 2008, **16**(2):95-103.**[PAM-2100]**

131. 黄金丽, 李伟, 孟凡珍, 胡丽萍, 张振贤: 转反义GVDE基因烟草的叶绿素荧光参数及抗氧化酶活性的变化. *中国农业科学* 2008, **41**(1):308-313.**[PAM-2100]**

132. 罗宏海, 张亚黎, 张旺锋, 白慧东, 何在菊, 杜明伟, 张宏芝: 新疆滴灌棉花花铃期干旱复水对叶片光合特性及产量的影响. *作物学报* 2008, **34**(1):171-174.**[PAM-2100]**

133. 宋维民, 周海燕, 贾荣亮, 赵昕, 冯丽, 谭会娟: 土壤逐渐干旱对4种荒漠植物光合作用和海藻糖含量的影响. *中国沙漠* 2008, **28**(3):449-454.**[PAM-2000]**

134. 孙锦, 李娟, 郭世荣, 李军, 李晶: 不同菠菜品种对海水胁迫的生理响应差异. *西北植物学报* 2008, **28**(4):737-744.**[PAM-2100]**

135. 孙晓方, 何家庆, 黄训端, 平江, 葛结林: 不同光强对加拿大一枝黄花生长和叶绿素荧光的影响. *西北植物学报* 2008, **28**(4):752-758.**[PAM-2100]**

136. 张亚黎, 罗宏海, 张旺锋, 樊大勇, 何在菊, 白慧东: 土壤水分亏缺对陆地棉花铃期叶片光化学活性和激发能耗散的影响. *植物生态学报* 2008, **32**(3):681-689.**[PAM-2100]**

137. 张治平, 汪良驹, 姚泉洪: 过量合成ALA转基因烟草叶片光合与叶绿素荧光特性的研究. *西北植物学报* 2008, **28**(6):1196-1202.**[PAM-2100]**

138. 郑蓉, 黄耀华, 连巧霞, 郑清芳, 郑维鹏: 刚竹属13个竹种叶绿素荧光特性比较. *江西农业大学学报* 2008, **30**(2):263-267.**[PAM-2100]**

139. 朱英华, 屠乃美, 肖汉乾, 关广晟, 王辉, 蔡奇, 邓力超, 危跃, 易迪, 黄泽春 *et al*: 硫对烟草叶片光合特性和叶绿素荧光参数的影响. *生态学报* 2008, **28**(3):1000-1005.**[PAM-2000]**

140. Dong H, Deng Y, Mu J, Lu Q, Wang Y, Xu Y, Chu C, Chong K, Lu C, Zuo J: The *Arabidopsis Spontaneous Cell Death1* gene, encoding a -carotene desaturase essential for carotenoid biosynthesis, is involved in chloroplast development, photoprotection and retrograde signalling. ***Cell Research*** 2007, **17**:458-470.**[PAM-2000]**

141. Flexas J, Diaz-Espejo A, Berry JA, Cifre J, Galmes J, Kaldenhoff R, Medrano H, Ribas-Carbo M: Analysis of leakage in IRGA's leaf chambers of open gas exchange systems: quantification and its effects in photosynthesis parameterization. ***J Exp Bot*** 2007, **58**(6):1533-1543.**[PAM-2000]**

142. Fredersdorf J, Bischof K: Irradiance of photosynthetically active radiation determines ultraviolet-susceptibility of photosynthesis in *Ulva lactuca* L.(Chlorophyta). ***Phycological Research*** 2007, **55**(4):295-301.**[PAM-2100]**

143. Gomez I, Orostegui M, Huovinen P: Morpho-functional patterns of photosynthesis in the south pacific kelp *Lessonia nigrescens*: effects of UV radiation on ^{14}C fixation and primary photochemical reactions. ***Journal of Phycology*** 2007, **43**(1):55-64.**[PAM-2000]**

144. Guidi L, Mori S, Degl'Innocenti E, Pecchiab S: Effects of ozone exposure or fungal pathogen on white lupin leaves as

determined by imaging of chlorophyll a fluorescence ***Plant Physiology and Biochemistry*** 2007, **45**(10-11):851-857.**[IMAGING-PAM, PAM-2000/PAM-2100]**

145. Guo J-W, Guo J-K, Zhao Y, Du L-F: Changes of Photosystem II Electron Transport in the Chlorophyll-deficient Oilseed Rape Mutant Studied by Chlorophyll Fluorescence and Thermoluminescence. ***Journal of Integrative Plant Biology*** 2007, **49**(5):698-705.**[PAM-2100]**

146. Jochum GM, Mudge KW, Thomas RB: Elevated temperatures increase leaf senescence and root secondary metabolite concentrations in the understory herb *Panax quinquefolius* (Araliaceae). ***Am J Bot*** 2007, **94**(5):819-826.**[PAM-2000]**

147. Lamote M, Johnson LE, Lemoine Y: Interspecific differences in the response of juvenile stages to physical stress: fluorometric responses of fucoid embryos to variation in meteorological conditions. ***Journal of Phycology*** 2007, **43**(6):1164-1176.**[PAM-2000]**

148. Ma J, Peng L, Guo J, Lu Q, Lu C, Zhang L: LPA2 is required for efficient assembly of photosystem II in *Arabidopsis thaliana*. ***The Plant Cell*** 2007, **19**:1980-1993.**[PAM-2000, PAM-100]**

149. Schumann U, Prestele J, O'Geen H, Brueggeman R, Wanner G, Gietl C: Requirement of the C_3HC_4 zinc RING finger of the *Arabidopsis* PEX10 for photorespiration and leaf peroxisome contact with chloroplasts. ***Proc Natl Acad Sci USA*** 2007, **104**(3):1069-1074.**[PAM-2000]**

150. Sun X, Peng L, Guo J, Chi W, Ma J, Lu C, Zhang L: Formation of DEG5 and DEG8 complexes and their involvement in the degradation of photodamaged photosystem II reaction center D1 protein in Arabidopsis. ***The Plant Cell*** 2007, **19**:1347-1361.**[PAM-2000]**

151. Tzvetkova-Chevolleau T, Hutin C, Noël LD, Goforth R, Carde J-P, Caffarri S, Sinning I, Groves M, Teulon J-M, Hoffman NE *et al*: Canonical Signal Recognition Particle Components Can Be Bypassed for Posttranslational Protein Targeting in Chloroplasts. ***The Plant Cell*** 2007, **19**:1635-1648.**[PAM-2000]**

152. Wittmann C, Pfanz H: Temperature dependency of bark photosynthesis in beech (*Fagus sylvatica* L.) and birch (*Betula pendula* Roth.) trees. ***J Exp Bot*** 2007, **58**(15-16):4293-4306.**[PAM-2000]**

153. Zhou Y, Lam HM, Zhang J: Inhibition of photosynthesis and energy dissipation induced by water and high light stresses in rice. ***Journal of Experimental Botany*** 2007, **58**(5):1207-1217.**[PAM-2000/PAM-2100]**

154. Zhu S-Q, Yu C-M, Liu X-Y, Ji B-H, Jiao D-M: Changes in Unsaturated Levels of Fatty Acids in Thylakoid PSII Membrane Lipids During Chilling-induced Resistance in Rice. ***Journal of Integrative Plant Biology*** 2007, **49**(4):463-471.**[PAM-2000]**

155. 耿伟, 王春艳, 薛绪掌, 王卫光: 负压供水下盆栽大豆叶片的光合生理研究. ***节水灌溉*** 2007(1):5-8.**[PAM-2100]**

156. 王北洪, 马智宏, 左海涛, 高洪文, 黄文江: 再生水对3种紫花苜蓿光合特性及产量的影响. ***安徽农学通报*** 2007, **13**(14):28-32.**[PAM-2100]**

157. 武立权, 沈圣泉, 王荣富, 舒庆尧: 水稻黄叶突变体光合特性的日变化 ***核农学报*** 2007, **21**(5):425-429.**[PAM-2100]**

158. 徐凯, 郭延平, 张上隆, 吴慧敏: 不同氮素水平下二氧化碳加富对草莓叶片光抑制的影响. ***应用生态学报*** 2007, **18**(1):87-93.**[PAM-2000/PAM-2100]**

159. 张永江, 黄文江, 王纪华, 刘良云, 马智宏, 李佛琳: 基于Fraunhofer 线的小麦条锈病荧光遥感探测. ***中国农业科学*** 2007, **40**(1):78-83.**[PAM-2100]**

160. 周相娟, 梁宇, 沈世华, 荆玉祥: 接种根瘤菌和遮光对大豆固氮和光合作用的影响. ***中国农业科学*** 2007, **40**(3):478-484.**[PAM-2000]**

161. Antal TK, Volgusheva AA, Kukarskikh GP, Krendeleva TE, Tusov VB, Rubin AB: Examination of chlorophyll fluorescence in sulfur-deprived cells of *Chlamydomonas reinhardtii* ***Biophysics*** 2006, **51**(2):251-257.**[PAM-2000]**

162. Bertamini M, Muthuchelian K, Nedunchezhian N: Shade effect alters leaf pigments and photosynthetic responses in Norway spruce (*Picea abies* L.) grown under field conditions. ***Photosynthetica*** 2006, **44**(2):227-234.**[PAM-2000]**

163. Eggert A, Haubner N, Klausch S, Karsten U, Schumann R: Quantification of algal biofilms colonising building materials: chlorophyll a measured by PAM-fluorometry as a biomass parameter. ***Biofouling*** 2006, **22**(1-2):79-90.**[PAM-2000, IMAGING-PAM]**

164. Galmes J, Medrano H, Flexas J: Acclimation of Rubisco specificity factor to drought in tobacco: discrepancies between in vitro and in vivo estimations. ***J Exp Bot*** 2006, **57**(14):3659-3667.**[PAM-2000]**

165. Gray DW, Cardon ZG, Lewis LA: Simultaneous collection of rapid chlorophyll fluorescence induction kinetics, fluorescence quenching parameters, and environmental data using an automated PAM-2000/CR10X data logging system. ***Photosynthesis Research*** 2006, **87**(3):295-301.**[PAM-2000]**

166. Häubner N, Schumann, Karsten U: Aeroterrestrial microalgae growing in biofilms on facades—response to temperature and water stress. ***Microbial Ecology*** 2006, **51**(3):285-293.**[PAM-2000]**

167. Huang C, He W, Guo J, Chang X, Su P, Zhang L: Increased sensitivity to salt stress in an ascorbate-deficient Arabidopsis mutant. ***Journal of Experimental Botany*** 2006, **56**:3041-3049.**[PAM-2000]**

168. Kummerová M, Barták M, Dubová J, Tříska J, Zubrová E, Zezulka Š: Inhibitory effect of fluoranthene on photosynthetic processes in Lichens detected by chlorophyll fluorescence. ***Ecotoxicology*** 2006, **15**(2):121-131.**[PAM-2000]**

169. Lizana C, Wentworth M, Martinez JP, Villegas D, Meneses R, Murchie EH, Pastenes C, Lercari B, Vernieri P, Horton P *et al*: Differential adaptation of two varieties of common bean to abiotic stress: I. Effects of drought on yield and photosynthesis. ***Journal of Experimental Botany*** 2006, **57**:685-697.**[PAM-2000]**

170. Ma J-F, Guo J-K, Peng L-W, Chen C-Y, Zhang L-X: Decrease of Photosystem II Photochemistry in *Arabidopsis* ppt1

Mutant Is Dependent on Leaf Age. ***Journal of Integrative Plant Biology*** 2006, **48**(12):1409-1414.**[PAM-2100]**

171. Naidoo G: Factors contributing to dwarfing in the mangrove *Avicennia marina*. ***Annals of Botany*** 2006, **97**:1095-1101.**[PAM-2100]**

172. O'Neill PM, Shanahan JF, Schepers JS: Use of chlorophyll fluorescence assessments to differentiate corn hybrid response to variable water conditions ***Crop Science*** 2006, **46**:681-687.**[PAM-2000]**

173. Peng L, Ma J, Chi W, Guo J, Zhu S, Lu Q, Lu C, Zhang L: Low PSII Accumulation is involved in efficient assembly of photosystem II in *Arabidopsis thaliana*. ***The Plant Cell*** 2006, **18**:955-969.**[PAM-2000]**

174. Peng L-W, Guo J-K, Ma J-F, Chi W, Zhang L-X: Photosynthetic Properties of Photosystem II in *Arabidopsis thaliana* Ipa1 Mutant. ***Journal of Integrative Plant Biology*** 2006, **48**(12):1424-1430.**[PAM-2100]**

175. Quigg A, Kevekordes K, Raven JA, Beardall J: Limitations on microalgal growth at very low photon fluence rates: the role of energy slippage ***Photosynthesis Research*** 2006, **88**(3):299-310.**[PAM-2000, PHYTO-PAM]**

176. Ranjbarfordoei A, Samson R, Damme PV: Chlorophyll fluorescence performance of sweet almond [*Prunus dulcis* (Miller) D. Webb] in response to salinity stress induced by NaCl ***Photosynthetica*** 2006, **44**(4):513-522.**[PAM-2000]**

177. Rautenberger R, Bischof K: Impact of temperature on UV-susceptibility of two *Ulva* (Chlorophyta) species from Antarctic and Subantarctic regions. ***Polar Biology*** 2006, **29**(11):988-996.**[PAM-2100]**

178. Rossini S, Casazza AP, Engelmann ECM, Havaux M, Jennings RC, Soave C: Suppression of both ELIP1 and ELIP2 in *Arabidopsis thaliana* does not affect tolerance to photoinhibition and photooxidative stress. ***Plant Physiology*** 2006, **141**:1264-1273.**[PAM-2000]**

179. Subrahmanyam D, Subash N, Haris A, Sikka AK: Influence of water stress on leaf photosynthetic characteristics in wheat cultivars differing in their susceptibility to drought ***Photosynthetica*** 2006, **44**(1):125-129.**[PAM-2000]**

180. Veres S, Tóth VR, Láposi R, Oláh V, Lakatos G, Mészáros I: Carotenoid composition and photochemical activity of four sandy grassland species. ***Photosynthetica*** 2006, **44**(2):255-261.**[PAM-2000]**

181. Wagner A, Michalek W, Jamiolkowska A: Chlorophyll fluorescence measurements as indicators of fusariosis severity in tomato plants. ***Agronomy Research*** 2006, **Specil issue**(4):461-464

182. Wong CE, Li Y, Labbe A, Guevara D, Nuin P, Whitty B, Diaz C, Golding GB, Gray GR, Weretilnyk EA *et al*: Environmental stress and adaptaton to stress:transcriptional profiling implicates novel interactions between abiotic stress and hormonal responses in Thellungiella, a close relative of Arabidopsis. ***Plant Physiology*** 2006, **140**:1437-1450.**[PAM-2000]**

183. Yang Y, Sulpice R, Himmelbach A, Meinhard M, Christmann A, Grill E: Fibrillin expression is regulated by abscisic acid response regulators and is involved in abscisic acid-mediated photoprotection ***Proc Natl Acad Sci USA*** 2006, **103**(15):6061-6066.**[PAM-2000]**

184. Yaronskaya E, Vershilovskaya I, Poers Y, Alawady AE, Averina N, Grimm2 B: Cytokinin effects on tetrapyrrole biosynthesis and photosynthetic activity in barley seedlings. ***Planta*** 2006, **24**(3):700-709.**[PAM-2000]**

185. Yin CY, Berninger F, Li CY: Photosynthetic responses of *Populus przewalski* subjected to drought stress ***Photosynthetica*** 2006, **44**(1):62-68.**[PAM-2100]**

186. 李燕宏, 洪健, 谢礼, 杨勇, 周雪平, 蒋德安: 蚕豆萎蔫病毒2号分离物侵染对蚕豆叶片光合活性和叶绿体超微结构的影响. ***植物生理与分子生物学学报*** 2006, **32**(4):490-496.**[PAM-2100]**

187. 刘良云, 张永江, 王纪华, 赵春江: 利用夫琅和费暗线探测自然光条件下的植被光合作用荧光研究. ***遥感学报*** 2006, **10**(1):130-137.**[PAM-2100]**

188. 陆胜民: 臭氧降解蔬菜中乐果残留及对其品质的影响. ***中国食品学报*** 2006, **6**(1):129－132.**[PAM-2000]**

189. 罗青红, 李志军, 伍维模, 韩路: 胡杨、灰叶胡杨光合及叶绿素荧光特性的比较研究. ***西北植物学报*** 2006, **26**(5):983-988.**[PAM-2100]**

190. 王立丰, 李良璧, 白克智, 匡廷云: 高浓度$LaCl_3$抑制黄瓜(*Cucumis sativus* Linn)光系统Ⅱ(PS Ⅱ) 活性. ***中国稀土学报*** 2006, **23**(6):770-774.**[PAM-2000]**

191. 王晓静, 张裕, 张立新, 毕玉蓉: NCS对离体萝卜子叶转绿期间叶绿素荧光参数及类囊体膜蛋白复合物的影响. ***西北植物学报*** 2006, **26**(2):259-265.**[PAM-2000]**

192. 徐凯, 郭延平, 张上隆, 戴文圣, 符庆功: 不同氮营养水平下草莓叶片光合作用对高CO2浓度的适应. ***植物生理与分子生物学学报*** 2006, **32**(4):473-480.**[PAM-2000]**

193. 衣英华, 樊大勇, 谢宗强, 陈芳清: 模拟淹水对枫杨和栓皮栎气体交换、叶绿素荧光和水势的影响. ***植物生态学报*** 2006, **30**(6):960-968.**[PAM-2100]**

194. 于海秋, 彭新湘, 严小龙, 曹敏建: 缺磷对不同磷效率基因型大豆光合日变化的影响. ***沈阳农业大学学报*** 2006, **36**(5):519-522.**[PAM-2000]**

195. Bertamini M, Muthuchelian K, Rubinigg M, Zorer R, Nedunchezhian N: Photoinhibition of photosynthesis in leaves of grapevine (*Vitis vinifera* L. cv. Riesling). Effect of chilling nights ***Photosynthetica*** 2005, **43**(4):551-557.**[PAM-2000]**

196. Bigras FJ: Photosynthetic response of white spruce families to drought stress. ***New Forests*** 2005, **29**(2):135-148.**[PAM-2000]**

197. D'Haese D, Vandermeiren K, Asard H, Horemans N: Other factors than apoplastic ascorbate contribute to the differential ozone tolerance of two clones of *Trifolium repens* L. ***Plant Cell and Environment*** 2005, **28**(5):623-632.**[PAM-2000]**

198. Ebbert V, Adams III WW, Mattoo AK, Sokolenko A, Demmig-Adams B: Up-regulation of a photosystem II core protein phosphatase inhibitor and sustained D1 phosphorylation in zeaxanthin-retaining, photoinhibited needles of overwintering Douglas fir. ***Plant Cell and Environment*** 2005, **28**(2):232-240.**[PAM-2000]**

199. Endo T, Kawase D, Sato F: Stromal over-reduction by high-light stress as measured by decreases in P700 oxidation by far-red light and its physiological relevance. ***Plant Cell and Physiology*** 2005, **46**(5):775-781.**[PAM-100, PAM-2000]**

200. Ensminger I, Foerster J, Hagen C, Braune W: Plasticity and acclimation to light reflected in temporal and spatial changes of small-scale macroalgal distribution in a stream ***Journal of Experimental Botany*** 2005, **56**(418):2047-2058.**[PAM-2000]**

201. Fan D-Y, Gao R-F: Where is the site of the "oxygen burst" located during light induction in dark-adapted leaves? A study using photoacoustic techniques. ***Journal of Integrative Plant Biology*** 2005, **47**(5):567-578.**[PAM-2000]**

202. Favory J-J, Kobayshi M, Tanaka K, Peltier G, Kreis M, Valay J-G, Lerbs-Mache S: Specific function of a plastid sigma factor for *ndhF* gene transcription. ***Nucleic Acid Research*** 2005, **33**:5991-5999.**[PAM-2000]**

203. Feild TS, Brodribb TJ: A unique mode of parasitism in the conifer coral tree Parasitaxus ustus (Podocarpaceae). ***Plant Cell and Environment*** 2005, **28**:1316-1325.**[PAM-2100]**

204. Feild TS, Sage TL, Czerniak C, Iles WJD: Hydathodal leaf teeth of *Chloranthus japonicus* (Chloranthaceae) prevent guttation-induced flooding of the mesophyll. ***Plant Cell and Environment*** 2005, **28**:1179-1190.**[PAM-2100]**

205. Grassi G, Magnani F: Stomatal, mesophyll conductance and biochemical limitations to photosynthesis as affected by drought and leaf ontogeny in ash and oak trees. ***Plant Cell and Environment*** 2005, **28**(7):834-849.**[PAM-2000]**

206. Guéra A, Calatayud A, Sabater B, Barreno E: Involvement of the thylakoidal NADH-plastoquinone-oxidoreductase complex in the early responses to ozone exposure of barley (*Hordeum vulgare* L.) seedlings ***Journal of Experimental Botany*** 2005, **56**(409):205-218.**[PAM-2000]**

207. Haldimann P, Feller U: Growth at moderately elevated temperature alters the physiological response of the photosynthetic apparatus to heat stress in pea (*Pisum sativum* L.) leaves. ***Plant Cell and Environment*** 2005, **28**(3):302-317.**[PAM-2000]**

208. Han Y-S, Han T: UV-B induction of UV-B protection in *Ulva pertusa* (Chlorophyta). ***Journal of Phycology*** 2005, **41**(3):523-530.**[PAM-2000]**

209. Havaux M, Eymery F, Porfirova S, Rey P, Dormann P: Vitamin E protects against photoinhibition stress in *Arabidopsis thaliana*. ***The Plant Cell*** 2005, **17**:3451-3469.**[PAM-2000]**

210. Huang C, He W, Guo J, Chang X, Su P, Zhang L: Increased sensitivity to salt stress in an ascorbate-deficient *Arabidopsis* mutant. ***Journal of Experimental Botany*** 2005, **56**(422):3041-3049.**[PAM-2000]**

211. Ifuku K, Yamamoto Y, Ono T-a, Ishihara S, Sato F: PsbP protein, but not PsbQ protein, is essential for the regulation and stabilization of photosystem II in higher plants. ***Plant Physiology*** 2005, **139**:1175–1184.**[PAM-2000]**

212. Jeon M-W, Ali MB, Hahn E-J, Paek K-Y: Effects of photon flux density on the morphology, photosynthesis and growth of a CAM orchid, *Doritaenopsis* during post-micropropagation acclimatization. ***Plant Growth Regulation*** 2005,

45(2):139-147.**[PAM-2000]**

213. Ji B-H, Tan H-H, Zhou R, Jiao D-M, Shen Y-G: Promotive Effect of Low Concentrations of NaHSO3 on Photophosphorylation and Photosynthesis in Phosphoenolpyruvate Carboxylase Transgenic Rice Leaves. ***Journal of Integrative Plant Biology*** 2005, **47**(2):178-186.**[PAM-2000]**

214. Jompuk C, Fracheboud Y, Stamp P, Leipner J: Mapping of quantitative trait loci associated with chilling tolerance in maize (*Zea mays* L.) seedlings grown under field conditions ***Journal of Experimental Botany*** 2005, **56**(414):1153-1163.**[PAM-2000]**

215. Kanwischer M, Porfirova S, Bergmüller E, Dörmann P: Alterations in tocopherol cyclase activity in transgenic and mutant plants of *Arabidopsis* affect tocopherol content, tocopherol composition, and oxidative stress. ***Plant Physiology*** 2005, **137**:713-723.**[PAM-2000]**

216. Kosourov S, Makarova V, Fedorov AS, Tsygankov A, Seibert M, Ghirardi ML: The effect of sulfur re-addition on H_2 photoproduction by sulfur-deprived green algae. ***Photosynthesis Research*** 2005, **85**(3):295-305.**[PAM-2000]**

217. Manetas Y, Pfanz H: Spatial heterogeneity of light penetration through periderm and lenticels and concomitant patchy acclimation of corticular photosynthesis ***Trees*** 2005, **19**(4):409-414.**[IMAGING-PAM, PAM-2000]**

218. Monson R, Sparks J, Rosenstiel T, Scott-Denton L, Huxman T, Harley P, Turnipseed A, Burns S, Backlund B, Hu J: Climatic influences on net ecosystem CO2 exchange during the transition from wintertime carbon source to springtime carbon sink in a high-elevation, subalpine forest. ***Oecologia*** 2005, **146**(1):130-147.**[PAM-2000]**

219. Oguchi R, Hikosaka K, Hirose T: Leaf anatomy as a constraint for photosynthetic acclimation: differential responses in leaf anatomy to increasing growth irradiance among three deciduous trees. ***Plant Cell and Environment*** 2005, **28**(7):916-927.**[PAM-2000]**

220. Paepe AD, Grauwe LD, Bertrand S, Smalle J, van der Straeten D: The *Arabidopsis* mutant *eer2* has enhanced ethylene responses in the light ***Journal of Experimental Botany*** 2005, **56**(419):2409-2420.**[PAM-2000]**

221. Peñuelas J, Llusia J, Asensio D, Munne-Bosch S: Linking isoprene with plant thermotolerance, antioxidants and monoterpene emissions. ***Plant Cell and Environment*** 2005, **28**:278-286.**[PAM-2000]**

222. Pérez-Priego O, Zarco-Tejada PJ, Miller JR, Sepulcre-Cantó G, Fereres E: Detection of water stress in Orchard trees with a high-resolution spectrometer through chlorophyll fluorescence in-filling of the O_2-A band. ***IEEE Transactions on Geoscience and remote Sensing*** 2005, **43**(12):2860-2869.**[PAM-2100]**

223. Rassadina VV, Usatov AV, Fedorenko GM, Averina NG: Activity of the system for chlorophyll biosynthesis and structural and functional organization of chloroplasts in a plastome *en:chlorina-5* sunflower mutant ***Russian Journal of Plant Physiology*** 2005, **52**(5):606-615.**[PAM-2000]**

224. Rumeau D, Bécuwe-Linka N, Beyly A, Louwagie M, Garin J, Peltier G: New subunits NDH-M, -N, and -O, encoded

by nuclear genes, are essential for plastid Ndh complex functioning in higher plants. ***The Plant Cell*** 2005, **17**:219-232.**[PAM-2000]**

225. Shelly K, Roberts S, Heraud P, Beardall J: Interactions between UV-B exposure and phosphorus nutrition. I. Effects on growth, phosphate uptake, and chlorophyll fluorescence. ***Journal of Phycology*** 2005, **41**(6):1204-1211.**[PAM-2000, PHYTO-PAM]**

226. Shirke PA, Pathre UV: Influence of leaf-to-air vapour pressure deficit (*VPD*) on the biochemistry and physiology of photosynthesis in *Prosopis juliflora*. ***Journal of Experimental Botany*** 2005, **55**(405):2111-2120.**[PAM-2000]**

227. Siffel P, Santrucek J: Diurnal course of photochemical activity of winter-adapted Scots pine at subzero temperatures ***Photosynthetica*** 2005, **43**(3):395-402.**[PAM-2000]**

228. Skillman JB, Garcia M, Virgo A, Winter K: Growth irradiance effects on photosynthesis and growth in two co-occurring shade-tolerant neotropical perennials of contrasting photosynthetic pathways. ***American Journal of Botany*** 2005, **92**:1811-1819.**[PAM-2000]**

229. Souza GM, Ribeiro RV, de Oliveira RF, Machado EC: Network connectance and autonomy analyses of the photosynthetic apparatus in tropical tree species from different successional groups under contrasting irradiance conditions. ***Revista Brasileira de Botanica*** 2005, **28**(1):47-59.**[PAM-2000]**

230. Takabayashi A, Kishine M, Asada K, Endo T, Sato F: Differential use of two cyclic electron flows around photosystem I for driving CO2-concentration mechanism in C4 photosynthesis. ***Proc Natl Acad Sci USA*** 2005, **102**(46):16898-16903.**[PAM-2000]**

231. Tang Y, Wen X, Lu C: Differential changes in degradation of chlorophyll–protein complexes of photosystem I and photosystem II during flag leaf senescence of rice. ***Plant Physiology and Biochemistry*** 2005, **43**:193-201.**[PAM-2000]**

232. van de Poll WH, van Leeuwe MA, Roggeveld J, Buma AGJ: Nutrient limitation and high irradiance acclimation reduce PAR and UV-induced viability loss in the antarctic diatom *Chaetoceros brevis* (Bacillariophyceae). ***Journal of Phycology*** 2005, **41**(4):840-850.**[PAM-2000]**

233. Wang Q, Lu C, Zhang Q: Midday photoinhibition of two newly developed super-rice hybrids. ***Photosynthetica*** 2005, **43**:277-281.**[PAM-2000]**

234. Wen X, Gong H, Lu C: Heat stress induces an inhibition of excitation energy transfer from phycobilisomes to photosystem II but not to photosystem I in a cyanobacterium Spirulina platensis. ***Plant Physiology and Biochemistry*** 2005, **43**:389–395.**[PAM-2000]**

235. Wen X, Gong H, Lu C: Heat stress induces a reversible inhibition of electron transport at the acceptor side of photosystem II in a cyanobacterium Spirulina platensis. ***Plant Science*** 2005, **168**:1471–1476.**[PAM-2000]**

236. Wen X, Qiu N, Lu Q, Lu C: Enhanced thermotolerance of photosystem II in salt-adapted plants of the halophyte

Artemisia anethifolia. ***Planta*** 2005, **220**:486-497.**[PAM-2000]**

237. Wodala B, Deák Z, Vass I, Erdei L, Horváth F: Nitric oxide modifies photosynthetic electron transport in pea leaves. ***Acta Biologica Szegediensis*** 2005, **49**(1-2):7-8.**[PAM-2000]**

238. Yang X, Liang Z, Lu C: Genetic engineering of the biosynthesis of glycinebetaine enhances photosynthesis against high temperature stress in transgenic tobacco plants. ***Plant Physiology*** 2005, **138**:2299-2309.**[PAM-2000]**

239. Yang X, Lu C: Photosynthesis is improved by exogenous glycinebetaine in salt-stressed maize plants. ***Physiologia Plantarum*** 2005, **124**:343-352.**[PAM-2000]**

240. Zgallai H, Steppe K, Lemeur R: Photosynthetic, physiological and biochemical responses of tomato plants to polyethylene glycol-Induced water deficit. ***Journal of Integrative Plant Biology*** 2005, **47**(12):1470-1478.**[PAM-2000]**

241. Živanović BD, Pang J, Shabala S: Light-induced transient ion flux responses from maize leaves and their association with leaf growth and photosynthesis. ***Plant Cell and Environment*** 2005, **28**(3):340-352.**[PAM-2000]**

242. 韩志国, 贺立静, 顾继光, 许忠能, 韩博平: 束生刚毛藻脱水和复水过程中光合作用的变化. ***生态学杂志*** 2005, **24**(11):1291-1294.**[PAM-2100]**

243. 韩志国, 雷腊梅, 韩博平: 利用调制荧光仪在线监测叶绿素荧光. ***生态科学*** 2005, **23**(3):246-249.**[PAM-2100]**

244. 韩志国, 雷腊梅, 韩博平: 光-暗循环中三角褐指藻和具齿原甲藻快速光曲线的变化. ***热带海洋学报*** 2005, **24**(6):13-21.**[PAM-2100]**

245. 胡文新, 彭少兵, 高荣孚, Ladha JK: 新株型水稻的光合效率. ***中国农业科学*** 2005, **38**(11):2205-2210.**[PAM-2000]**

246. 廖飞勇, 叶海燕, 吕梁: 不同浓度$NaHSO_3$ 对油桐光合特性的影响. ***西南林学院学报*** 2005, **25**(3):5-9.**[PAM-2000]**

247. 刘辉, 郭延平, 胡美君: 杨梅光合作用的低温光抑制. ***热带亚热带植物学报*** 2005, **13**(4):338-342.**[PAM-2000, HCM-1000]**

248. 刘晶, 周树峰, 陈华, 韩和平, 李银心: 农杆菌介导的双价抗盐基因转化番茄的研究. ***中国农业科学*** 2005, **38**(8):1636－1644.**[PAM-2000]**

249. 龙明华, 唐小付, 于文进, 廖易, 黄文浩, 秦荣耀: 不同钙素水平对厚皮甜瓜叶片光合作用和保护酶活性的影响. ***广西植物*** 2005, **25**(1):77-82.**[PAM-100]**

250. 吴凯朝, 唐军, 黄诚梅, 苏俊波, 李杨瑞, 叶燕萍: 果蔗脱毒苗田间叶绿素荧光和群体冠层结构. ***亚热带农业研究*** 2005, **1**(2):18-20.**[PAM-2000]**

251. 徐凯, 郭延平, 张上隆: 不同光质对草莓叶片光合作用和叶绿素荧光的影响. ***中国农业科学*** 2005, **38**(2):369-375.**[PAM-2000, HCM-1000]**

252. 徐凯, 郭延平, 张上隆, 周慧芬, 郑毅: 草莓叶片光合作用对强光的响应及其机理研究. ***应用生态学报*** 2005,

16(1):73-78.**[PAM-2000, HCM-1000]**

253. 张旺锋, 樊大勇, 谢宗强, 蒋晓晖: 濒危植物银杉幼树对生长光强的季节性光合响应. ***生物多样性*** 2005, **13**(5):387-397.**[PAM-2100]**

254. 张燕琴, 李方, 郭延平, 陈昆松: 叶片叶绿素荧光参数用作采后切花菊衰老指标. ***浙江大学学报*** 2005, **31**(6):683-688.**[PAM-2000]**

255. 周海燕, 张景光, 李新荣, 王新平, 赵亮, 龙利群: 生态脆弱带不同区域近缘优势灌木的生理生态学特性. ***生态学报*** 2005, **25**(1):168-175.**[PAM-2000]**

256. 左园园, 刘庆, 林波, 何海: 短期增强UV-B辐射对青榨槭幼苗生理特性的影响. ***应用生态学报*** 2005, **16**(9):1682-1686.**[PAM-2100]**

257. Belnap J, Phillips SL, Miller ME: Response of desert biological soil crusts to alterations in precipitation frequency. ***Oecologia*** 2004, **141**(2):306-316.**[PAM-2000]**

258. Biemelt S, Tschiersch H, Sonnewald U: Impact of altered gibberellin metabolism on biomass accumulation, lignin biosynthesis, and photosynthesis in transgenic tobacco plants. ***Plant Physiology*** 2004, **135**:254-265.**[PAM-2000]**

259. Cheeseman JM, Lovelock CE: Photosynthetic characteristics of dwarf and fringe *Rhizophora mangle* L. in a Belizean mangrove. ***Plant Cell and Environment*** 2004, **27**(6):769-780.**[PAM-2000]**

260. Cleavitt N: Comparative ecology of a lowland and a subalpine species of *Mnium* in the northern Rocky Mountains. ***Plant Ecology*** 2004, **174**:205-216.**[PAM-2000]**

261. D'Haese D, Vandermeiren K, Caubergs RJ, Guisez Y, Temmerman LD, Horemans N: Non-photochemical quenching kinetics during the dark to light transition in relation to the formation of antheraxanthin and zeaxanthin. ***Journal of Theoretical Biology*** 2004, **227**:175-186.**[PAM-2000]**

262. Ensminger I, Sveshnikov D, Campbell DA, Funk C, Jansson S, Lloyd J, Shibistova O, Öquist G: Intermittent low temperatures constrain spring recovery of photosynthesis in boreal Scots pine forests. ***Global Change Biology*** 2004, **10**:1-14.**[PAM-2000]**

263. Fujibe T, Saji H, Arakawa K, Yabe N, Takeuchi Y, Yamamoto KT: A methyl viologen-resistant mutant of Arabidopsis, which is allelic to ozone-sensitive *rcd1*, is tolerant to supplemental ultraviolet-B irradiation. ***Plant Physiology*** 2004, **134**:275-285.**[PAM-2000]**

264. Havaux M, Dall'Osto L, Cuiné S, Giuliano G, Bassi R: The effect of zeaxanthin as the only xanthophyll on the structure and function of the photosynthetic apparatus in *Arabidopsis thaliana*. ***The Journal of Biological Chemistry*** 2004, **279**(14):13878-13888.**[PAM-2000]**

265. Hieber AD, Kawabata O, Yamamoto HY: Significance of the lipid phase in the dynamics and functions of the xanthophyll cycle as revealed by PsbS overexpression in tobacco and in-vitro de-epoxidation in

monogalactosyldiacylglycerol micelles ***Plant Cell and Physiology*** 2004, **45**(1):92-102.**[PAM-2000]**

266. Ji B-H, Zhu S-Q, Jiao D-M: A limited photosynthetic C_4-microcycle and its physiological function in transgenic rice plant expressing the maize *PEPC* gene. ***Acta Botanica Sinica*** 2004, **46**(5):542-551.**[PAM-2000]**

267. Kasukabe Y, He L, Nada K, Misawa S, Ihara I, Tachibana S: Overexpression of spermidine synthase enhances tolerance to multiple environmental stresses and up-regulates the expression of various stress-regulated genes in transgenic *Arabidopsis thaliana* ***Plant Cell and Physiology*** 2004, **45**(6):712-722.**[PAM-2000]**

268. Labate MTV, Ko K, Ko ZW, Pinto LSRC, Real MJUD, Romano MR, Barja PR, Granell A, Friso G, van Wijk KJ *et al*: Constitutive expression of pea *Lhcb1-2* in tobacco affects plant development, morphology and photosynthetic capacity. ***Plant Molecular Biology*** 2004, **55**:701-714.**[PAM-2000]**

269. Larbi A, Abadía A, Morales F, Abadía J: Fe resupply to Fe-deficient sugar beet plants leads to rapid changes in the violaxanthin cycle and other photosynthetic characteristics without significant *de novo* chlorophyll synthesis. ***Photosynthesis Research*** 2004, **79**:59-69.**[PAM-2000]**

270. Lu Q, Lu C: Photosynthetic pigment composition and photosystem II photochemistry of wheat ears. ***Plant Physiology and Biochemistry*** 2004, **42**:395-402.**[PAM-2000]**

271. McElrone AJ, Forseth IN: Photosynthetic Responses of a Temperate Liana *to Xylella fastidiosa* Infection and Water Stress. ***Journal of Phytopathology*** 2004, **152**:9-20.**[PAM-2000]**

272. Mercado JM, Sánchez-Saavedra MdP, Correa-Reyes G, Lubián L, Montero O, Figueroa FL: Blue light effect on growth, light absorption characteristics and photosynthesis of five benthic diatom strains. ***Aquatic Botany*** 2004, **78**:265-277.**[PAM-2000]**

273. Morita-Yamamuro C, Tsutsui T, Tanaka A, Yamaguchi J: Knock-out of the plastid ribosomal protein S21 causes impaired photosynthesis and sugar-response during germination and seedling development in *Arabidopsis thaliana*. ***Plant Cell and Physiology*** 2004, **45**(6):781-788.**[PAM-2000]**

274. Munné-Bosch S, Peñuelas J, Asensio D, Llusià J: Airborne ethylene may alter antioxidant protection and reduce tolerance of holm oak to heat and drought stress. ***Plant Physiology*** 2004, **136**:2937-2947.**[PAM-2000]**

275. Romero HM, Berlett BS, Jensen PJ, Pell EJ, Tien M: Investigations into the role of the plastidial peptide methionine sulfoxide reductase in response to oxidative stress in Arabidopsis. ***Plant Physiology*** 2004, **136**:3784-3794.**[PAM-2000]**

276. Rumeau D, Bécuwe-Linka N, Beyly A, Louwagie M, Garin J, Peltier G: New Subunits NDH-M, -N, and -O, Encoded by Nuclear Genes, Are Essential for Plastid Ndh Complex Functioning in Higher Plants. ***The Plant Cell*** 2004, **17**:219-232.**[PAM-2000]**

277. Salvucci ME, Crafts-Brandner SJ: Relationship between the heat tolerance of photosynthesis and the thermal stability of Rubisco activase in plants from contrasting thermal environments. ***Plant Physiology*** 2004,

134:1460-1470.**[PAM-2000]**

278. Sinsawat V, Leipner J, Stamp P, Fracheboud Y: Effect of heat stress on the photosynthetic apparatus in maize (*Zea mays* L.) grown at control or high temperature. ***Environmental and Experimental Botany*** 2004, **52**:123–129.**[PAM-2000]**

279. Sjögren LLE, MacDonald TM, Sutinen S, Clarke AK: Inactivation of the *clpC1* gene encoding a chloroplast Hsp100 molecular chaperone causes growth retardation, leaf chlorosis, lower photosynthetic activity, and a specific reduction in photosystem content. ***Plant Physiology*** 2004, **136**:4114-4126.**[PAM-2000]**

280. Verdoy D, Lucas MM, Manrique E, Covarrubias AA, de Felipe MR, Pueyo JJ: Differential organ-specific response to salt stress and water deficit in nodulated bean (*Phaseolus vulgaris*). ***Plant Cell and Environment*** 2004, **27**(6):757-767.**[PAM-2000]**

281. Wilson S, Blake C, Berges JA, Maggs CA: Environmental tolerances of free-living coralline algae (maerl): implications for European marine conservation. ***Biological Conservation*** 2004, **120**:283-293.**[PAM-2000]**

282. Xu Z-Z, Zhou G-S, Li H: Response of chlorophyll fluorescence and nitrogen level of *Leymus chinensis* seedling tho changes of soil moisture and temperature. ***Journal of Environmental Sciences*** 2004, **16**(4):666-669.**[PAM-100]**

283. Zotz G, Enslin A, Hartung W, Ziegler H: Physiological and anatomical changes during the early ontogeny of the heteroblastic bromeliad, *Vriesea sanguinolenta*, do not concur with the morphological change from atmospheric to tank form. ***Plant Cell and Environment*** 2004, **27**(11):1341-1350.**[PAM-2000]**

284. 陈丹, 张放: 水分胁迫条件下CO_2加富对枇杷叶绿素荧光及抗氧化酶的影响. ***浙江农业学报*** 2004, **16**(2):63-67.**[PAM-2000]**

285. 付东亚, 洪健, 陈集双, 吴建祥: 芜菁花叶病毒外壳蛋白在寄主植物叶绿体中的积累及其对光系统II活性的影响. ***植物生理与分子生物学学报*** 2004, **30**(1):34-40.**[PAM-2000]**

286. 郭延平, 宋丽丽, 徐凯, 张良诚: 温州蜜柑叶片光系统反应中心光能分配的变化. ***应用生态学报*** 2004, **15**(11):2087-2090.**[PAM-2000]**

287. 廖飞勇, 何平, 谢瑛: 低浓度SO_2 熏气对油桐幼苗光系统结构和功能的影响. ***农村生态环境*** 2004, **20**(1):60-64.**[PAM-2000]**

288. 王强, 温晓刚, 卢从明, 张其德: 超高产杂交稻‘华安3号’冠层不同衰老程度叶片的光合功能. ***植物生态学报*** 2004, **28**(1):39-46.**[PAM-2000]**

289. 许晓明, 张荣铣, 唐运来: 低叶绿素含量对突变体水稻吸收光能分配特性的影响. ***中国农业科学*** 2004, **37**(3):339－343.**[PAM-2000]**

290. 曾光辉, 郭延平, 刘辉, 徐凯: 冬, 春田间枇杷叶片光合机构的运转. ***果树科学*** 2004, **21**(3):233-236.**[PAM-2000]**

291. Aharon R, Shahak Y, Wininger S, Bendov R, Kapulnik Y, Galili G: Overexpression of a plasma membrane aquaporin

in transgenic tobacco Improves plant vigor under favorable growth conditions but not under drought or salt stress. ***The Plant Cell*** 2003, **15**:439-447.**[PAM-2000]**

292. Burritt DJ, Mackenzie S: Antioxidant metabolism during acclimation of *Begonia* × *erythrophylla* to high light levels. ***Annals of Botany*** 2003, **91**:783-794.**[PAM-2000]**

293. Calatayud A, Iglesias DJ, Talón M, Barreno E: Effects of 2-month ozone exposure in spinach leaves on photosynthesis, antioxidant systems and lipid peroxidation. ***Plant Physiology and Biochemistry*** 2003, **41**:839–845.**[PAM-2000]**

294. Carr H, Björk M: A methodological comparison of photosynthetic oxygen evolution and estimated electron transport rate in tropical *Ulva* (Chlorophyceae) species under different light and inorganic carbon conditions. ***Journal of Phycology*** 2003, **39**(6):1125-1131.**[PAM-2000, DIVING-PAM]**

295. Chen Y-Z, Murchie EH, Hubbart S, Horton P, Peng S: Effects of season-dependent irradiance levels and nitrogen-deficiency on photosynthesis and photoinhibition in field-grown rice (*Oryza sativa*). ***Physiologia Plantarum*** 2003, **117**:343-351.**[PAM-2000]**

296. Close D, Beadle CL, Hovenden MJ: Interactive effects of nitrogen and irradiance on sustained xanthophyll cycle engagement in *Eucalyptus nitens* leaves during winter ***Oecologia*** 2003, **134**(1):32-36.**[PAM-2000]**

297. Damesin C: Respiration and photosynthesis characteristics of current-year stems of *Fagus sylvatica*: from the seasonal pattern to an annual balance. ***New Phytologist*** 2003, **158**:465-475.**[PAM-2000]**

298. Egorova EA, Bukhov NG, Heber U, Samson G, Carpentier R: Effect of the pool size of stromal reductants on the alternative pathway of electron transfer to photosystem I in chloroplasts of intact leaves. ***Russian Journal of Plant Physiology*** 2003, **50**(4):431-440.**[PAM-100, PAM-2000]**

299. Feller IC, Whigham DF, McKee KL, Lovelock CE: Nitrogen limitation of growth and nutrient dynamics in a disturbed mangrove forest, Indian River Lagoon, Florida ***Oecologia*** 2003, **134**(3):405-414.**[PAM-2000]**

300. Figueroa FL, Conde-Álvarez R, Gómez I: Relations between electron transport rates determined by pulse amplitude modulated chlorophyll fluorescence and oxygen evolution in macroalgae under different light conditions. ***Photosynthesis Research*** 2003, **75**(3):259-275.**[PAM-2000]**

301. Figueroa FL, Escassi L, Pérez-Rodríguez E, Korbee n, Giles AD, Johnsen G: Effects of short-term irradiation on photoinhibition and accumulation of mycosporine-like amino acids in sun and shade species of the red algal genes *Porphyra*. ***Journal of Photochemistry and Photobiology B: Biology*** 2003, **69**:21-30.**[PAM-2000]**

302. Gesch RW, Kang I-H, Gallo-Meagher M, Vu JCV, Boote KJ, Allen LH, R J, Bowes G: Rubisco expression in rice leaves is related to genotypic variation of photosynthesis under elevated growth CO_2 and temperature. ***Plant Cell and Environment*** 2003, **26**(12):1941-1950.**[PAM-2000]**

303. Häder D-P, Lebert M, Helbling EW: Effects of solar radiation on the Patagonian rhodophyte *Corallina officinatis* (L.).

Photosynthesis Research 2003, **78**(2):119-132.**[PAM-2000]**

304. Havaux M, Lütz C, Grimm B: Chloroplast membrane photostability in *chlP* transgenic tobacco plants deficient in tocopherols. ***Plant Physiology*** 2003, **132**:300-310.**[PAM-2000]**

305. Hutin C, Nussaume L, Moise N, Moya I, Kloppstech K, Havaux M: Early light-induced proteins protect *Arabidopsis* from photooxidative stress ***Proc Natl Acad Sci USA*** 2003, **100**(8):4921-4926.**[PAM-2000]**

306. Iriti M, Faoro F: Does benzothiadiazole-induced resistance increase fitness cost in bean? ***Journal of Plant Pathology*** 2003, **85**(4):265-270.**[PAM-2000]**

307. Jia H, Lu C: Effects of abscisic acid on photoinhibition in maize plants. ***Plant Science*** 2003, **165**:1403-1410.**[PAM-2000]**

308. Jia H-S, Li D-Q: State transition, is it a photochemical or non-photochemical process in leaf in response to irradiance? ***Acta Botanica Sinica*** 2003, **45**(12):1428-1433.**[PAM-2000]**

309. Kato MC, Hikosaka K, Hirotsu N, Makino A, Hirose T: The excess light energy that is neither utilized in photosynthesis nor dissipated by photoprotective mechanisms determines the rate of hotoinactivation in photosystem II. ***Plant Cell and Physiology*** 2003, **44**(3):318-325.**[PAM-2000]**

310. Kelly AA, Froehlich JE, Dörmann P: Disruption of the two digalactosyldiacylglycerol synthase genes *DGD1* and *DGD2* in Arabidopsis reveals the existence of an additional enzyme of galactolipid synthesis ***The Plant Cell*** 2003, **15**:2694-2706.**[PAM-2000]**

311. Krause GH, Grube E, Virgo A, Winter K: Sudden exposure to solar UV-B radiation reduces net CO_2 uptake and photosystem I efficiency in shade-acclimated tropical tree seedlings. ***Plant Physiology*** 2003, **131**:745-752.**[PAM-2000, PAM-100]**

312. Kuk YI, Shin JS, Burgos NR, Hwang TE, Han O, Cho BH, Jung S, Guh JO: Antioxidative enzymes offer protection from chilling damage in rice plants. ***Crop Science*** 2003, **43**:2109-2117.**[PAM-2000]**

313. Lamote M, EvaDarko, Schoefs B, Lemoine Y: Assembly of the photosynthetic apparatus in embryos from *Fucus serratus* L. ***Photosynthesis Research*** 2003, **77**(1):45-52.**[PAM-2000]**

314. Lu C, Jiang G, Wang B, Kuang T: Photosystem II photochemistry and photosynthetic pigment composition in salt-adapted halophyte Artimisia anethifolia grown under outdoor conditions. ***Journal of Plant Physiology*** 2003, **160**:403-408.**[PAM-2000]**

315. Lu C, Qiu N, Lu Q: Photoinhibition and the xanthophyll cycle are not enhanced in the salt-acclimated halophyte *Artimisia anethifolia*. ***Physiologia Plantarum*** 2003, **118**:532-537.**[PAM-2000]**

316. Lu C, Qiu N, Lu Q, Wang B, Kuang T: PS II photochemistry, thermal energy dissipation, and the xanthophyll cycle in *Kalanchoë daigremontiana* exposed to a combination of water stress and high light. ***Physiologia Plantarum*** 2003,

118:173-182.**[PAM-2000]**

317. Lu C, Qiu N, Wang B, Zhang J: Salinity treatment shows no effects on photosystem II photochemistry but increases the resistance of photosystem II to heat stress in halophyte *Suaeda salsa*. ***Journal of Experimental Botany*** 2003, **54**:851-860.**[PAM-2000]**

318. Lu Q, Wen X, Lu C, Zhang Q, Kuang T: Photoinhibition and photoprotection in senescent leaves of field-grown wheat plants. ***Plant Physiology and Biochemistry*** 2003, **41**:749-754.**[PAM-2000]**

319. Munné-Bosch S, Peñuelas J: Photo- and antioxidative protection during summer leaf senescence in *Pistacia lentiscus* L. grown under mediterranean field conditions. ***Annals of Botany*** 2003, **92**:385-391.**[PAM-2000]**

320. Niinemets Ü, Kollist H, García-Plazaola JI, Hernández A, Becerril JM: Do the capacity and kinetics for modification of xanthophyll cycle pool size depend on growth irradiance in temperate trees? ***Plant Cell and Environment*** 2003, **26**(10):1787-1801.**[PAM-2000]**

321. Ninemets Ü, Valladares F, Ceulemans R: Leaf-level phenotypic variability and plasticity of invasive *Rhododendron ponticum* and non-invasive *Ilex aquifolium* co-occurring at two contrasting European sites. ***Plant Cell and Environment*** 2003, **26**(6):941-956.**[PAM-2000]**

322. Oh M-H, Moon Y-H, Lee C-H: Increased stability of LHCII by aggregate formation during dark-induced leaf senescence in the *Arabidopsis* mutant, *ore10* ***Plant Cell and Physiology*** 2003, **44**(12):1368-1377.**[PAM-2000]**

323. Peng C-L, Gilmore AM: Contrasting changes of photosystem 2 efficiency in *Arabidopsis* xanthophyll mutants at room or low temperature under high irradiance stress ***Photosynthetica*** 2003, **41**(2):233-239.**[PAM-2000]**

324. Pérez-Rodríguez E, Aguilera J, Figueroa FL: Tissular localization of coumarins in the green alga *Dasycladus vermicularis* (Scopoli) Krasser: a photoprotective role? . ***Journal of Experimental Botany*** 2003, **54**(384):1093-1100.**[PAM-2000]**

325. Pfündel EE: Action of UV and visible radiation on chlorophyll fluorescence from dark-adapted grape leaves (*Vitis vinifera* L.). ***Photosynthesis Research*** 2003, **75**(1):29-39.**[PAM-2000]**

326. Pietrini F, Iannelli MA, Pasqualini S, Massacci A: Interaction of cadmium with glutathione and photosynthesis in developing leaves and chloroplasts of *Phragmites australis* (Cav.) Trin. ex Steudel. ***Plant Physiology*** 2003, **133**:829-837.**[PAM-100, PAM-2000, HCM-1000]**

327. Podola B, Melkonian M: A long-term operating algal biosensor for the rapid detection of volatile toxic compounds. ***Journal of Applied Phycology*** 2003, **15**:415-424.**[PAM-2000]**

328. Qiu N, Lu C: Enhanced tolerance of photosynthesis against high temperature damage in salt-adapted halophyte *Atriplex centralasiatica* plants. ***Plant Cell and Environment*** 2003, **26**:1137-1145.**[PAM-2000]**

329. Qiu N, Lu Q, Lu C: Photosynthesis, photosystem II efficiency and the xanthophyll cycle in the salt-adapted halophyte

Atriplex centralasiatica. ***New Phytologist*** 2003, **159**:479-486.**[PAM-2000]**

330. Schlüter U, Muschak M, Berger D, Altmann T: Photosynthetic performance of an *Arabidopsis* mutant with elevated stomatal density (*sdd1-1*) under different light regimes ***Journal of Experimental Botany*** 2003, **54**(383):867-874.**[PAM-2000]**

331. Tsonev TD, Hikosaka K: Contribution of photosynthetic electron transport, heat dissipation, and recovery of photoinactivated photosystem II to photoprotection at different temperatures in *Chenopodium album* leaves ***Plant Cell and Physiology*** 2003, **44**(8):828-835.**[PAM-2000]**

332. Vassilev A, Lidon F, Ramalho JC, Matos MdC, Graca Md: Effects of excess Cu on growth and photosynthesis of barley plants. Implication with a screening test for Cu tolerance. ***Journal of Central European Agriculture*** 2003, **4**(3):225-236.**[PAM-2000]**

333. Yang W-L, Hu Z-A, Wang H-X, Shan J-X, Kuang T-Y: The protective role of xanthophyll cycle in resurrection angiosperm *Boea hygrometrica* during dehydraton and rehydration. ***Acta Botanica Sinica*** 2003, **45**(3):307-310.**[PAM-2000]**

334. Zarco-Tejada PJ, Pushnik JC, Dobrowski S, Ustin SL: Steady-state chlorophyll a fluorescence detection from canopy derivative reflectance and double-peak red-edge effects ***Remote Sensing and Environment*** 2003, **84**(2):283-294.**[PAM-2000]**

335. 陈屏昭, 陈顺方, 刘忠荣, 周云, 樊钦平: 缺磷胁迫对温州蜜柑叶片光合作用的影响. ***云南农业大学学报*** 2003, **18**(2):158-162.**[PAM-2000]**

336. 陈屏昭, 陈顺方, 刘忠荣, 周云, 樊钦平: 缺磷胁迫对温州蜜柑光合作用的光抑制研究(一). ***云南农业大学学报*** 2003, **18**(3):281-285.**[PAM-2000]**

337. 陈屏昭, 刘忠荣, 罗家刚, 樊钦平, 王磊, 蒋彬: 磷和$NaHSO_3$交互作用对温州蜜柑叶片光合作用的影响. ***广东微量元素科学*** 2003, **10**(1):21-27.**[PAM-2000]**

338. 付东亚, 洪健, 陈集双, 蒋德安: 青菜和芥菜感染芜菁花叶病毒(TuMV) 后的光合特性变化. ***浙江大学学报*** 2003, **29**(6):599-602.**[PAM-2000]**

339. 郭延平, 陈屏昭, 张良诚, 张上隆: 缺磷胁迫加重柑橘叶片光合作用的光抑制及叶黄素循环的作用. ***植物营养与肥料学报*** 2003, **9**(3):359-363.**[PAM-2000]**

340. 郭延平, 苏吉虎, 王宏炜, 沈允钢, 张良诚: 亚硫酸氢钠处理减轻低温对温州蜜柑光合作用的影响. ***园艺学报*** 2003, **30**(2):195-197.**[PAM-2000]**

341. 郭延平, 周慧芬, 曾光辉, 张良诚: 高温胁迫对柑橘光合速率和光系统Ⅱ活性的影响. ***应用生态学报*** 2003, **14**(6):867～870.**[PAM-2000]**

342. 廖飞勇, 谢瑛, 何平, 范亚民: 不同光强对薇甘菊生长及光系统的影响. ***生命科学研究*** 2003,

7(4):355-359.**[PAM-2000]**

343. 宋丽丽, 郭延平, 徐凯, 张良诚: 温州蜜柑叶片光合作用光抑制的保护机理. ***应用生态学报*** 2003, **14**(1):47-50.**[PAM-2000]**

344. 许晓明, 陆巍, 唐运来, 邓志瑞, 戴新宾, 张荣铣, 匡廷云: 自然条件下杂交水稻II优129的光抑制及其恢复特性. ***中国水稻科学*** 2003, **17**(2):156-160.**[PAM-2000]**

345. 叶燕萍, 李杨瑞, 黄诚梅, 李永健, 邢永秀: 下种方式和水分胁迫对甘蔗叶片光合特性的影响. ***甘蔗*** 2003, **10**(3):1-4.**[PAM-2000]**

346. 张放, 陈丹, 张士良, 吴荣兰: 高浓度CO2对不同水分条件下枇杷生理的影响. ***园艺学报*** 2003, **30**(6):647-652.**[PAM-2000]**

347. Affek HP, Yakir D: Protection by isoprene against singlet oxygen in leaves. ***Plant Physiology*** 2002, **129**:269-277.**[PAM-2000]**

348. Barker DH, Adams III WW, Demmig-Adams B, Logan BA, Verhoeven AS, Smith SD: Nocturnally retained zeaxanthin does not remain engaged in a state primed for energy dissipation during the summer in two Yucca species growing in the Mojave Desert. ***Plant Cell and Environment*** 2002, **25**(1):95-103.**[PAM-2000]**

349. Bischof K, Peralta G, Kräbs G, van de Poll WH, Pérez-Lloréns JL, Breeman AM: Effects of solar UV-B radiation on canopy structure of *Ulva* communities from southern Spain ***Journal of Experimental Botany*** 2002, **53**(379):2411-2421.**[PAM-2000]**

350. Broin M, Cuiné S, Eymery F, Rey P: The plastidic 2-cysteine peroxiredoxin Iis a target for a yhioredoxin involved in the protection of the photosynthetic apparatus against oxidative damage ***The Plant Cell*** 2002, **14**:1417-1432.**[PAM-2000]**

351. Cousins AB, Adam NR, Wall GW, Kimball BA, Jr PJP, Ottman MJ, Leavitt SW, Webber AN: Photosystem II energy use,non-photochemical quenching and the xanthophyll cycle in *Sorghumbicolor* grown under drought and free-air CO_2 enrichment(FACE) conditions. ***Plant Cell and Environment*** 2002, **25**:1551-1559.**[PAM-2000]**

352. Crafts-Brandner SJ, Salvucci ME: Sensitivity of Photosynthesis in a C4 Plant, Maize, to Heat Stress. ***Plant Physiology*** 2002, **129**:1773-1780.**[PAM-2000]**

353. Flexas J, Escalona JM, Evain S, Gulías J, Moya I, Osmond CB, H. M: Steady-state chlorophyll fluorescence (Fs) measurements as a tool to follow variations of net CO_2 assimilation and stomatal conductance during water-stress in C_3 plants ***Physiologia Plantarum*** 2002, **114**(2):231-240.**[PAM-2000]**

354. Fracheboud Y, Ribaut J-M, Vargas M, Messmer R, Stamp P: Identification of quantitative trait loci for cold-tolerance of photosynthesis in maize (*Zea mays* L.) ***Journal of Experimental Botany*** 2002, **53**(376):1967-1977.**[PAM-2000]**

355. Gevaert F, Creach A, Davoult D, Holl A-C, Seuront L, Lemoine Y: Photo-inhibition and seasonal photosynthetic

performance of the seaweed *Laminaria saccharina* during a simulated tidal cycle: chlorophyll fluorescence measurements and pigment analysis. ***Plant Cell and Environment*** 2002, **25**:859-872.**[PAM-2000]**

356. Govindjee, Seufferheld MJ: Non-photochemical quenching of chlorophyll a fluorescence: early history and characterization of two xanthophyll-cycle mutants of *Chlamydomonas reinhardtii*. ***Functional Plant Biology*** 2002, **29**:1141-1155.**[PAM-2000]**

357. Govindjee, Spilotro P: An *Arabidopsis thaliana* mutant, altered in the -subunit of ATP synthase, has a different pattern of intensity-dependent changes in non-photochemical quenching and kinetics of the *P*-to-*S* fluorescence decay. ***Functional Plant Biology*** 2002, **29**:425-434.**[PAM-2000]**

358. He L, Nada K, Kasukabe Y, Tachibana S: Enhanced susceptibility of photosynthesis to low-temperature photoinhibition due to interruption of chill-induced increase of S-adenosylmethionine decarboxylase activity in leaves of spinach (*Spinacia oleracea* L.) ***Plant Cell and Physiology*** 2002, **43**(2):196-206.**[PAM-2000]**

359. Joët T, Cournac L, Peltier G, Havaux M: Cyclic electron flow around photosystem I in C_3 plants. In vivo control by the redox state of chloroplasts and involvement of the NADH-dehydrogenase complex ***Plant Physiology*** 2002, **128**:760-769.**[PAM-100, PAM-2000]**

360. Joët T, Genty B, Josse E-M, Kuntz M, Cournac L, Peltier G: Involvement of a plastid terminal oxidase in plastoquinone oxidation as evidenced by expression of the *Arabidopsis thaliana* enzyme in tobacco*. ***The Journal of Biological Chemistry*** 2002, **277**(35):31623-31630.**[PAM-100, PAM-2000]**

361. Kasahara M, Kagawa T, Oikawa K, Suetsugu N, Miyao M, Wada M: Chloroplast avoidance movement reduces photodamage in plants. ***Nature*** 2002, **420**:829-832.**[PAM-2000]**

362. Kato MC, Hikosaka K, Hirose T: Photoinactivation and recovery of photosystem II in *Chenopodium album* leaves grown at different levels of irradiance and nitrogen availability. ***Functional Plant Biology*** 2002, **29**:787-795.**[PAM-2000]**

363. Kwon SY, Jeong YJ, Lee HS, Kim JS, Cho KY, Allen RD, Kwak SS: Enhanced tolerances of transgenic tobacco plants expressing both superoxide dismutase and ascorbate peroxidase in chloroplasts against methyl viologen-mediated oxidative stress. ***Plant Cell and Environment*** 2002, **25**(7):873-882.**[PAM-2000]**

364. Lennartsson M, Ögren E: Causes of variation in cold hardiness among fast-growing willows (*Salix* spp.) with particular reference to their inherent rates of cold hardening. ***Plant Cell and Environment*** 2002, **25**:12791288.**[PAM-2000]**

365. Lovelock CE, Robinson SA: Surface reflectance properties of Antarctic moss and their relationship to plant species, pigment composition and photosynthetic function. ***Plant Cell and Environment*** 2002, **25**:1239-1250.**[PAM-2000]**

366. Lu C, Qiu N, Lu Q, Wang B, Kuang T: Does salt stress lead to increased susceptibility of photosystem II to photoinhibition and changes in photosynthetic pigment composition in halophyte *Suaeda salsa* grown outdoors? ***Plant***

Science 2002, **163**:1063-1068.**[PAM-2000]**

367. Lu C, Vonshak A: Effects of salinity stress on photosystem II function in cyanobacterial *Spirulina platensis* cells. ***Physiologia Plantarum*** 2002, **114**:405-413.**[PAM-2000]**

368. Lu Q, Lu C, Zhang J, Kuang T: Photosynthesis and chlorophyll fluorescence during flag leaf senescence of wheat plants grown in the field. ***Journal of Plant Physiology*** 2002, **159**:1173-1178.**[PAM-2000]**

369. Lüder UH, Wiencke C, Knoetzel J: Acclimation of photosynthesis and pigments during and after six months of darkness in *Palmaria decipiens* (Rhodophyta): a study to simulate antarctic winter sea ice cover. ***Journal of Phycology*** 2002, **38**(5):904-913.**[PAM-2000]**

370. Medrano H, Bota J, Abadía A, Sampol B, Escalona JM, Flexas J: Effects of drought on light-energy dissipation mechanisms in high-light-acclimated, field-grown grapevines. ***Functional Plant Biology*** 2002, **29**:1197-1207.**[PAM-2000]**

371. Murchie EH, Hubbart S, Chen Y, Peng S, Horton P: Acclimation of rice photosynthesis to irradiance under field conditions. ***Plant Physiology*** 2002, **130**:1999-2010.**[PAM-2000]**

372. Murchie EH, Yang J, Hubbart S, Horton P, Peng S: Are there associations between grain-filling rate and photosynthesis in the flag leaves of field-grown rice? . ***Journal of Experimental Botany*** 2002, **53**(378):2217-2224.**[PAM-2000]**

373. Niinemets Ü, Portsmuth A, Truus L: Leaf structural and photosynthetic characteristics, and biomass allocation to foliage in relation to foliar nitrogen content and tree size in three *Betula* species. ***Annals of Botany*** 2002, **89**:191-204.**[PAM-2000]**

374. Palmqvist K, Dahlman L, Valladares F, Tehler A, Sancho LG, Mattsson J-E: CO_2 exchange and thallus nitrogen across 75 contrasting lichen associations from different climate zones ***Oecologia*** 2002, **133**(3):295-306.**[PAM-2000]**

375. Peñuelas J, Llusià J: Linking photorespiration, monoterpenes and thermotolerance in *Quercus*. ***New Phytologist*** 2002, **155**:227-237.**[PAM-2000]**

376. Pierce S, Winter K, Griffiths H: The role of CAM in high rainfall cloud forests: an in situ comparison of photosynthetic pathways in Bromeliaceae. ***Plant Cell and Environment*** 2002, **25**(9):1181-1189.**[PAM-2000]**

377. Porfirova S, Bergmüller E, Tropf S, Lemke R, Dörmann P: Isolation of an *Arabidopsis* mutant lacking vitamin E and identification of a cyclase essential for all tocopherol biosynthesis ***Proc Natl Acad Sci USA*** 2002, **99**(19):12495-12500.**[PAM-2000]**

378. Rijstenbil JW: Assessment of oxidative stress in the planktonic diatom *Thalassiosira pseudonana* in response to UVA and UVB radiation ***Journal of Plankton Research*** 2002, **24**(12):1277-1288.**[PAM-2000]**

379. Roháček K: Chlorophyll fluorescence parameters: the definitions, photosynthetic meaning, and mutual relationships. ***Photosynthetica*** 2002, **40**(1):13-29.**[PAM-2000]**

380. Sinha AK, Hofmann MG, Römer U, Köckenberger W, Elling L, Roitsch T: Metabolizable and non-metabolizable sugars activate different signal transduction pathways in tomato. ***Plant Physiology*** 2002, **128**:1480-1489.**[PAM-2000]**

381. Stylinski CD, Gamon JA, Oechel WC: Seasonal patterns of reflectance indices, carotenoid pigments and photosynthesis of evergreen chaparral species. ***Oecologia*** 2002, **131**:366-374.**[PAM-2000]**

382. Takahashi S, Tamashiro A, Sakihama Y, Yamamoto Y, Kawamitsu Y, Yamasaki H: High-susceptibility of photosynthesis to photoinhibition in the tropical plant *Ficus microcarpa* L. f. cv. Golden Leaves. ***BMC Plant Biology*** 2002, **2**:1-8.**[PAM-2000]**

383. Tomaselli L, Lamenti G, Tiano P: Chlorophyll fluorescence for evaluating biocide treatments against phototrophic biodeteriogens. ***Annals of Microbiology*** 2002, **52**:197-206.**[PAM-2000]**

384. Valladares F, Pearcy RW: Drought can be more critical in the shade than in the sun: a field study of carbon gain and photo-inhibition in a Californian shrub during a dry El Niño year. ***Plant Cell and Environment*** 2002, **25**(6):749-759.**[PAM-2000]**

385. Wang Q, Zhang Q-D, Zhu X-G, Lu C-M, Kuang T-Y, Li C-Q: PS II photochemistry and xanthophyll cycle in two superhigh-yield rice hybrids, Liangyoupeijiu and Hua-an 3 during photoinhibition and subsequent restoration. ***Acta Botanica Sinica*** 2002, **44**(11):1297-1302.**[PAM-2000]**

386. Zarco-Tejada PJ, Miller JR, Mohammed GH, Noland TL, Sampson PH: Vegetation stress detection through chlorophyll a+b estimation and fluorescence effects on hyperspectral imagery. ***Journal of Environmental Quality*** 2002, **31**:1433–1441.**[PAM-2000]**

387. 陈屏昭, 樊钦平, 罗家刚, 刘忠荣, 王磊, 陈顺方: 缺磷胁迫对脐橙光合色素和光合作用的影响. ***广东微量元素科学*** 2002, **9**(12):30-34.**[PAM-2000]**

388. 樊大勇, 谢宗强, 王强, 张其德: 亚热带常绿阔叶林下一种灌木(富贵草*Pachysandra terminalis*) 对模拟光斑的光合响应. ***植物生态学报*** 2002, **26**(4):447-453.**[PAM-2000]**

389. 郭延平, 陈屏昭, 张良诚, 张上隆: 不同供磷水平对温州蜜柑叶片光合作用的影响. ***植物营养与肥料学报*** 2002, **8**(2):186-191.**[PAM-2000]**

390. 廖飞勇, 何平: 不同照度对薇甘菊光合性状的影响. ***中南林学院学报*** 2002, **22**(4):36-39.**[PAM-2000]**

391. 廖飞勇, 何平: 油桐光系统性状测定的研究. ***经济林研究*** 2002, **20**(4):19-22.**[PAM-2000]**

392. 王强, 卢从明, 张其德, 郝迺斌, 戈巧英, 董凤琴, 白克智, 匡廷云: 超高产杂交稻两优培九的光合作用、光抑制和C_4途径酶特性. ***中国科学*** 2002, **32**(6):481-487.**[PAM-2000]**

393. 王仁雷, 华春, 李霞, 张其德, 焦德茂: 光抑制条件下转PEPC 基因水稻的光合表现. ***作物学报*** 2002, **28**(3):321-326.**[PAM-2000]**

394. 张俊斌, 陈意昌, 林信辉: 台湾中低海拔乡土植物在逆境下之生长活力研究. ***水土保持研究*** 2002,

9(3):136-145.**[PAM-2000]**

395. Andersson J, Walters RG, Horton P, Janssona S: Antisense inhibition of the photosynthetic antenna proteins CP29 and CP26: implications for the mechanism of protective energy dissipation ***The Plant Cell*** 2001, **13**:1193-1204.**[PAM-2000]**

396. Barth C, Krause GH, Winter K: Responses of photosystem I compared with photosystem II to high-light stress in tropical shade and sun leaves. ***Plant Cell and Environment*** 2001, **24**(2):163-176.**[PAM-100, PAM-2000]**

397. Campbell AW, Griffin WB, Burritt DJ, Conner AJ: The importance of light intensity for pollen tube growth and embryo survival in wheat x maize crosses ***Annals of Botany*** 2001, **87**:517-522.**[PAM-2000]**

398. Coelho S, Rijstenbil JW, Sousa-Pinto I, Brown MT: Cellular responses to elevated light levels in *Fucus spiralis* embryos during the first days after fertilization. ***Plant Cell and Environment*** 2001, **24**(8):801-810.**[PAM-2000]**

399. Dring MJ, Wagner A, Lüning K: Contribution of the UV component of natural sunlight to photoinhibition of photosynthesis in six species of subtidal brown and red seaweeds. ***Plant Cell and Environment*** 2001, **24**(11):1153-1164.**[PAM-2000]**

400. Ensminger I, Xyländer M, Hagen C, Braune W: Strategies providing success in a variable habitat: III. Dynamic control of photosynthesis in *Cladophora glomerata*. ***Plant Cell and Environment*** 2001, **24**:769-779.**[PAM-2000]**

401. Feild TS, Lee DW, Holbrook NM: Why leaves turn red in autumn. The role of anthocyanins in senescing leaves of red-osier dogwood1. ***Plant Physiology*** 2001, **127**:566-574.**[PAM-2000]**

402. Franklin LA, Kräbs G, Kuhlenkamp R: Blue light and UV-A radiation control the synthesis of mycosporine-like amino acids in *Chondrus crispus* (Florideophyceae). ***Journal of Phycology*** 2001, **37**(2):257-270.**[PAM-2000]**

403. Gordillo FJL, Jiménez C, Chavarría J, Niell FX: Photosynthetic acclimation to photon irradiance and its relation to chlorophyll fluorescence and carbon assimilation in the halotolerant green alga *Dunaliella viridis*. ***Photosynthesis Research*** 2001, **68**:225-235.**[PAM-2000]**

404. He J, Lee SK, Dodd IC: Limitations to photosynthesis of lettuce grown under tropical conditions: alleviation by root-zone cooling ***Journal of Experimental Botany*** 2001, **52**(359):1323-1330.**[PAM-2000]**

405. Hymus GJ, Baker NR, Long SP: Growth in elevated CO_2 can both increase and decrease photochemistry and photoinhibition of photosynthesis in a predictable manner. *Dactylis glomerata* grown in two levels of nitrogen nutrition. ***Plant Physiology*** 2001, **127**:1204-1211.**[PAM-2000]**

406. Hymus GJ, Dijkstra P, Baker NR, Drake BG, Long SP: Will rising CO_2 protect plants from the midday sun? A study of photoinhibition of *Quercus myrtifolia* in a scrub-oak community in two seasons. ***Plant Cell and Environment*** 2001, **24**(12):1361-1368.**[PAM-2000]**

407. Joët T, Cournac L, Horvath EM, Medgyesy P, Peltier G: Increased sensitivity of photosynthesis to antimycin A induced

by inactivation of the chloroplast *ndhB* gene. Evidence for a participation of the NADH-dehydrogenase complex to cyclic electron flow around photosystem I. ***Plant Physiology*** 2001, **125**:1919-1929.**[PAM-2000]**

408. Kolb CA, Käser MA, Kopecký J, Zotz G, Riederer M, Pfündel EE: Effects of natural intensities of visible and ultraviolet radiation on epidermal ultraviolet screening and photosynthsis in grape leaves. ***Plant Physiology*** 2001, **127**:863-875.**[PAM-2000, XE-PAM]**

409. Krause GH, Koroleva OY, Dalling JW, Winter K: Acclimation of tropical tree seedlings to excessive light in simulated tree-fall gaps. ***Plant Cell and Environment*** 2001, **24**(12):1345-1352.**[PAM-2000]**

410. Lange OL, Green TGA, Heber U: Hydration-dependent photosynthetic production of lichens: what do laboratory studies tell us about field performance? . ***Journal of Experimental Botany*** 2001, **52**(363):2033-2042.**[PAM-2000]**

411. Leipner J, Oxborough K, Baker NR: Primary sites of ozone-induced perturbations of photosynthesis in leaves: identification and characterization in *Phaseolus vulgaris* using high resolution chlorophyll fluorescence imaging ***Journal of Experimental Botany*** 2001, **52**(361):1689-1696.**[PAM-2000]**

412. Loreto F, Mannozzi M, Maris C, Nascetti P, Ferranti F, Pasqualini S: Ozone quenching properties of isoprene and its antioxidant role in leaves. ***Plant Physiology*** 2001, **126**:993-1000.**[PAM-2000]**

413. Loreto F, Velikova V: Isoprene produced by leaves protects the photosynthetic apparatus against ozone damage, quenches ozone products, and reduces lipid peroxidation of cellular membranes. ***Plant Physiology*** 2001, **127**:1781-1787.**[PAM-2000]**

414. Lu C, Lu Q, Zhang J, Kuang T: Xanthophyll cycle, light energy dissipation and photosystem II down-regulation in senescent leaves of wheat plants grown in the field. ***Australia Journal of Plant Physiology*** 2001, **28**:1023-1030.**[PAM-2000]**

415. Lu C, Lu Q, Zhang J, Kuang T: Characterization of photosynthetic pigment composition, photosystem II photochemistry and thermal energy dissipation during leaf senescence of wheat plants grown in the field. ***Journal of Experimental Botany*** 2001, **52**:1805-1810.**[PAM-2000]**

416. Lu C, Zhang J, Zhang Q, Li L, Kuang T: Modification of photosystem II photochemistry in nitrogen deficient maize and wheat plants. ***Journal of Experimental Botany*** 2001, **158**:1423-1430.**[PAM-2000]**

417. Lu Q-T, Li W-H, Jiang G-M, Ge Q-Y, Hao N-B, Sun J-Z, Guo R-J: Studies on the characteristics of chlorophyll fluorescence of winter wheat flag leaves at different developing stages. ***Acta Botanica Sinica*** 2001, **43**(8):801-804.**[PAM-2000]**

418. Marek MV, Sprtova M, Angelis PD, Scarascia-Mugnozza G: Spatial distribution of photosynthetic response to long-term influence of elevated CO2 in a mediterranean *macchia* mini-ecosystem. ***Plant Science*** 2001, **160**:1125-1136.**[PAM-2000]**

419. Marwood CA, Solomon KR, Greenberg BM: Chlorophyll fluorescence as a bioindicator of effects on growth in aquatic macrophytes from mixtures of polycyclic aromatic hydrocarbons. ***Environmental Toxicology and Chemistry*** 2001, **20**(4):890-898.**[PAM-2000]**

420. Pierce S, Maxwell K, Griffiths H, Winter K: Hydrophobic trichome layers and epicuticular wax powders in Bromeliaceae. ***American Journal of Botany*** 2001, **88**:1371-1389.**[PAM-2000]**

421. Rae R, Hanelt D, Hawes I: Sensitivity of freshwater macrophytes to UV radiation: relationship to depth zonation in an oligotrophic New Zealand lake. ***Marine and Freshwater Research*** 2001, **52**:1023-1032.**[PAM-2000, DIVING-PAM]**

422. Sauer Jr, Schreiber U, Schmid R, Völker U, Forchhammer K: Nitrogen starvation-Induced chlorosis in *Synechococcus* PCC 7942. Low-level photosynthesis as a mechanism of long-term survival. ***Plant Physiology*** 2001, **126**:233-243.**[PAM-2000]**

423. Sun W-H, Verhoeven AS, Bugos RC, Yamamoto HY: Suppression of zeaxanthin formation does not reduce photosynthesis and growth of transgenic tobacco under field conditions. ***Photosynthesis Research*** 2001, **67**:41-50.**[PAM-2000]**

424. Verhoeven AS, Bugos RC, Yamamoto HY: Transgenic tobacco with suppressed zeaxanthin formation is susceptible to stress-induced photoinhibition. ***Photosynthesis Research*** 2001, **67**:27-39.**[PAM-2000]**

425. Vonshak A, Torzillo G, Masojidek J, Boussiba S: Sub-optimal morning temperature induces photoinhibition in dense outdoor cultures of the alga *Monodus subterraneus* (Eustigmatophyta). ***Plant Cell and Environment*** 2001, **24**(10):1113-1118.**[PAM-2000]**

426. Wei J, Yu H, Zhong Z-P, Kuang T-Y, Ben G-Y: Comparison of photosynthetic adaptability between *Kobresia humilis* and *Polygonum viviparum* on Qinghai plateau. ***Acta Botanica Sinica*** 2001, **43**(5):486-489.**[PAM-2000]**

427. Werner C, Ryel RJ, Correia O, Beyschlag W: Effects of photoinhibition on whole-plant carbon gain assessed with a photosynthesis model. ***Plant Cell and Environment*** 2001, **24**(1):27-40.**[PAM-2000]**

428. Youssefian S, Nakamura M, Orudgev E, Kondo N: Increased cysteine biosynthesis capacity of transgenic tobacco overexpressing an *O*-acetylserine(thiol) lyase modifies plant responses to oxidative stress. ***Plant Physiology*** 2001, **126**:1001-1011.**[PAM-2000]**

429. Zarco-Tejada PJ, Miller JR, Mohammed GH, Noland TL, Sampson PH: Estimation of chlorophyll fluorescence under natural illumination from hyperspectral data ***International Journal of Applied Earth Observation and Geoinformation*** 2001, **3**(4):321-327.**[PAM-2000]**

430. Zhu X-G, Wang Q, Zhang Q-D, Lu C-M, Kuang T-Y: Effects of photoinhibition and its recovery on photosynthetic functions of winter wheat under salt stress. ***Acta Botanica Sinica*** 2001, **43**(12):1250-1254.**[PAM-2000A]**

431. 陈启林，山仑，程智慧：低温下光照对黄瓜叶片光合特性的影响．***中国农业科学*** 2001, **34**(6):632－

636.**[PAM-2000]**

432. 郭书奎, 赵可夫: NaCl胁迫抑制玉米幼苗光合作用的可能机理. ***植物生理学报*** 2001, **27**(6):461-466.**[PAM-2000]**

433. 张其德, 蒋高明: 12个不同基因型冬小麦的光合能力. ***植物生态学报*** 2001, **25**(5):532-536.**[PAM-2000]**

434. Allen DJ, Ratner K, Giller YE, Gussakovsky EE, Shahak Y, Ort DR: An overnight chill induces a delayed inhibition of photosynthesis at midday in mango (*Mangifera indica* L.) ***Journal of Experimental Botany*** 2000, **51**(352):1893-1902.**[PAM-2000]**

435. Arntz AM, DeLucia EH, Jordan N: From fluorescence to fitness: variation in photosynthetic rate affects fecundity and suvivorship. ***Ecology*** 2000, **81**(9):2567-2576.**[PAM-2000]**

436. Bungard RA, Scholes JD, Press MC: The influence of nitrogen on rain forest dipterocarp seedlings exposed to a large increase in irradiance. ***Plant Cell and Environment*** 2000, **23**(11):1183-1194.**[PAM-2000]**

437. Dai X-B, Cao S-Q, Xu X-M, Lu W, Zhang R-X, Xu C-C, Chen Y-D, Kuang T-Y: Study on a mutant with low content chlorophyll b in a high yielding rice and its photosynthesis properties. ***Acta Botanica Sinica*** 2000, **42**(12):1289-1294.**[PAM-2000]**

438. DeLucia EH, Thomas RB: Photosynthetic responses to CO2 enrichment of four hardwood species in a forest understory. ***Oecologia*** 2000, **122**:11-19.**[PAM-2000]**

439. Ensminger I, Hagen C, Braune W: Strategies providing success in a variable habitat: II. Ecophysiology of photosynthesis of *Cladophora glomerata*. ***Plant Cell and Environment*** 2000, **23**:1129-1136.**[PAM-2000]**

440. Gussakovsky EE, Shahak Y, van Amerongen H, Barzda V: Circularly polarized chlorophyll luminescence reflects the macro-organization of grana in pea chloroplasts. ***Photosynthesis Research*** 2000, **65**:83-92.**[PAM-2000]**

441. Gussakovsky EE, Shahak Y, vanAmerongen H, Barzda V: Circularly polarized chlorophyll luminescence reflects the macro-organization of grana in pea chloroplasts. ***Photosynthesis Research*** 2000, **65**:83-92.**[PAM-2000]**

442. Kitao M, Lei TT, Koike T, Tobita H, Maruyama Y: Susceptibility to photoinhibition of three deciduous broadleaf tree species with different successional traits raised under various light regimes. ***Plant Cell and Environment*** 2000, **23**(1):81-89.**[PAM-2000]**

443. Lu C, Chau CW, Zhang J: Acute toxicity of excess mercury on the photosynthetic performance of cyanobacterium, *S. Platensis* - assement by chlorophyll fluorescence analysis. ***Chemosphere*** 2000, **41**:191-196.**[PAM-2000]**

444. Lu C, Zhang J: Photosystem II photochemistry and its sensitivity to heat stress in maize plants as affected by nitrogen deficiency. ***Journal of Plant Physiology*** 2000, **157**:124-130.**[PAM-2000]**

445. Lu C, Zhang J: Heat induced multiple effects on PSII in wheat plants. ***Journal of Plant Physiology*** 2000, **156**:259-265.**[PAM-2000]**

446. Lu C, Zhang J: Role of light iin the response of PSII photochemistry to salt stress in the cyanobacterium *Spirulina*

platensis. ***Journal of Experimental Botany*** 2000, **51**(346):911-917.**[PAM-2000]**

447. Lu C, Zhang J: Photosynthetic CO_2 assimilation, chlorophyll fluorescence and photoinhibition as affected by nitrogen deficiency in maize plants. ***Plant Science*** 2000, **151**:135-143.**[PAM-2000]**

448. Morales F, Belkhodja R, Abadia A, Abadia J: Photosystem II efficiency and mechanisms of energy dissipation in iron-deficient, field-grown pear trees (*Pyrus communis* L.). ***Photosynthesis Research*** 2000, **63**:9-21.**[PAM-100, PAM-2000]**

449. Muraoka H, Tang Y, Terashima I, Koizumi H, Washitani I: Contributions of diffusional limitation, photoinhibition and photorespiration to midday depression of photosynthesis in *Arisaema heterophyllum* in natural high light. ***Plant Cell and Environment*** 2000, **23**(3):235-250.**[PAM-2000]**

450. Nogués S, Baker NR: Effects of drought on photosynthesis in Mediterranean plants grown under enhanced UV-B radiation ***Journal of Experimental Botany*** 2000, **51**(348):1309-1317.**[PAM-2000]**

451. Palmqvist K, Sundberg B: Light use efficiency of dry matter gain in five macro-lichens: relative impact of microclimate conditions and species-specific traits. ***Plant Cell and Environment*** 2000, **23**(1):1-14.**[PAM-2000]**

452. Ralph PJ: Herbicide toxicity of *Halophila ovalis* assessed by chlorophyll a fluorescence. ***Aquatic Botany*** 2000, **66**:141-152.**[PAM-2000]**

453. Robinson SA, Wasley J, Popp M, Lovelock CE: Desiccation tolerance of three moss species from continental Antarctica. ***Australia Journal of Plant Physiology*** 2000, **27**:379-388.**[PAM-2000]**

454. Sagert S, Schubert H: Acclimation of *Plamaria palmata* (Rhodophyta) to light intensity comparison between artificial and natural light fields. ***Journal of Phycology*** 2000, **36**(6):1119-1128.**[PAM-2000, PAM-100]**

455. Saradhi PP, Suzuki I, Katoh A, Sakamoto A, Sharmila P, Shi D-J, Murata N: Protection against the photo-induced inactivation of the photosystem II complex by abscisic acid. ***Plant Cell and Environment*** 2000, **23**(7):711-718.**[PAM-2000]**

456. Singsaas EL, Ort DR, Delucia EH: Diurnal regulation of photosynthesis in understory saplings. ***New Phytologist*** 2000, **145**:39-49.**[PAM-2000]**

457. Skotnica J, Matoušková M, Nauš J, Lazár D, Dvořák L: Thermoluminescence and fluorescence study of changes in Photosystem II photochemistry in desiccating barley leaves. ***Photosynthesis Research*** 2000, **65**:29-40.**[PAM-2000]**

458. Strong GL, Bannister P, Burritt D: Are mistletoes shade plants? CO_2 assimilation and chlorophyll fluorescence of temperate mistletoes and their hosts. ***Annals of Botany*** 2000, **85**:511-519.**[PAM-2000]**

459. Valladares F, Wright SJ, Lasso E, Kitajima K, Pearcy RW: Plastic phenotypic response to light of 16 congeneric shrubs from a panamanian rainforest. ***Ecology*** 2000, **81**(7):1925-1936.**[PAM-2000]**

460. Venema JH, Eekhof M, van Hasselt PR: Analysis of low-temperature tolerance of a tomato (*Lycopersicon esculentum*)

cybrid with chloroplasts from a more chilling-tolerant *L. hirsutum* accession. ***Annals of Botany*** 2000, **85**:799-807.**[PAM-100, PAM-2000]**

461. Wang Q, Zhang Q-D, Jiang G-M, Lu C-M, Kuang T-Y, Wu S, Li C-Q, Jiao D-M: Photosynthetic characteristics of two superhigh-yield hybrid rice. ***Acta Botanica Sinica*** 2000, **42**(12):1285-1288.**[PAM-2000]**

462. Wang S-W, Xu C-C, Bai K-Z, Zhang Q-D, Li L-B, Kuang T-Y, Li J-Y, Li Z-S: Comparative study on photoinhibition between two wheat genotypes. ***Acta Botanica Sinica*** 2000, **42**(12):1300-1303.**[PAM-2000]**

463. Xu C-C, Li L, Kuang T: The inhibited xanthophyll cycle is responsible for the increase in sensitivity to low temperature photoinhibition in rice leaves fed with glutathione. ***Photosynthesis Research*** 2000, **65**:107-114.**[PAM-2000]**

464. Zarco-Tejada PJ, Miller JR, Mohammed GH, Noland TL: Chlorophyll fluorescence effects on vegetation apparent reflectance: I. leaf-level measurements and model simulation. ***Remote Sensing and Environment*** 2000, **74**:582-595.**[PAM-2000]**

465. Zarco-Tejada PJ, Miller JR, Mohammed GH, Noland TL, Sampson PH: Chlorophyll fluorescence effects on vegetation apparent reflectance - II. Laboratory and airborne canopy-level measurements with hyperspectral data ***Remote Sensing and Environment*** 2000, **74**(3):596-608.**[PAM-2000]**

466. 关义新, 林葆, 凌碧莹: 光氮互作对玉米叶片光合色素及其荧光特性与能量转换的影响. ***植物营养与肥料学报*** 2000, **6**(2):152-158.**[PAM-2000]**

467. 郭延平, 张良诚, 洪双松, 沈允钢: 温州蜜柑叶片气体交换和叶绿素荧光对低温的响应. ***植物生理学报*** 2000, **26**(2):88-94.**[PAM-2000]**

468. 李卫华, 卢庆陶, 郝乃斌, 戈巧英, 张其德, 蒋高明, 杜维广, 匡廷云: 大豆C_4途径与光系统Ⅱ光化学功能的相互关系. ***植物学报*** 2000, **42**(7):689-692.**[PAM-2000]**

469. 张其德, 刘合芹, 张建华, 李建民: 限水灌溉对冬小麦旗叶某些光合特性的影响. ***作物学报*** 2000, **26**(6):869-873.**[PAM-2000]**

470. 张其德, 张建华: 限水灌溉和不同施肥方式对冬小麦旗叶某些光合功能的影响. ***植物营养与肥料学报*** 2000, **6**(1):24-29.**[PAM-2000]**

471. Adams III WW, Demmig-Admas B, Logan BA, Barker DH, Osmond CB: Rapid changes in xanthophyll cycle-dependent energy dissipation and photosystem II efficiency in two vines, *Stephania japonica* and *Smilax australis*, growing in the understory of an open Eucalyptus forest. ***Plant Cell and Environment*** 1999, **22**(2):125-136.**[PAM-2000]**

472. Backhausen J, Scheibe R: Adaptation of tobacco plants to elevated CO_2: influence of leaf age on changes in physiology, redox states and NADP-malate dehydrogenase activity. ***Journal of Experimental Botany*** 1999,

50:665-675.**[PAM-2100]**

473. Close DC, Beadle CL, Holz GK, Ravenwood IC: A photobleaching event at the North Forest Products' Somerset nursery reduces growth of *Eucalyptus globulus* seedlings. ***Tasforests*** 1999, **11**:59-67.**[PAM-2000]**

474. Crafts-Brandner SJ, Chu C-C: Insect clip cages rapidly alter photosynthetic traits of leaves. ***Crop Science*** 1999, **39**:1896-1899.**[PAM-2000]**

475. Dai N, Schaffer A, Petreikov M, Shahak Y, Giller Y, Ratner K, Levine A, Granot D: Overexpression of Arabidopsis hexokinase in tomato plants inhibits growth, reduces photosynthesis, and induces rapid senescence. ***The Plant Cell*** 1999, **11**:1253-1266.**[PAM-2000]**

476. Endo T, Shikanai T, Takabayashi A, Asada K, Sato F: The role of chloroplastic NAD(P)H dehydrogenase in photoprotection. ***FEBS Letters*** 1999, **457**:5-8.**[PAM-2000, PAM-100]**

477. Flexas J, Escalona JM, Medrand H: Water stress induces different levels of photosynthesis and electron transport rate regulation in grapevines. ***Plant Cell and Environment*** 1999, **22**(1):39-48.**[PAM-2000]**

478. Fracheboud Y, Haldimann P, Leipner J, Stamp P: Chlorophyll fluorescence as a selection tool for cold tolerance of photosynthesis in maize (Zea mays L.). ***Journal of Experimental Botany*** 1999, **50**:1533-1540.**[PAM-2000]**

479. Franklin LA, Yakovleva I, Karsten U, Lüning K: Synthesis of mycosporine-like amino acids in *Chondrus crispus* (Florideophyceae) and the consequences for sensitivity to ultraviolet B radiation. ***Journal of Phycology*** 1999, **35**(4):682-693.**[PAM-2000]**

480. Haag-Kerwer A, Schafer H, Heiss S, Walter C, Rausch T: Cadmium exposure in *Brassica juncea* causes a decline in transpiration rate and leaf expansion without effect on photosynthesis. ***Journal of Experimental Botany*** 1999, **50**:1827-1835.**[PAM-2000, HCM-1000]**

481. Hasler R, Kleines M, Uhrig H, Hirsch H, Smets H: Overexpression of phosphoenolpyruvate carboxylase from *Corynebacterium glutamicum* lowers the CO_2 compensation point and enhances dark and light respiration in transgenic potato. ***Journal of Experimental Botany*** 1999, **50**:1231-1242.**[PAM-2000]**

482. Hong S-S, Hong T, Jiang H, Xu D-Q: Changes in the non-photochemical quenching of chlorophyll fluorescence during aging of wheat flag leaves ***photosynthetica*** 1999, **36**(4):621-625.**[PAM-2000]**

483. Hong S-S, Xu D-Q: Light-induced increase in initial chlorophyll fluorescence Fo level and the reversible inactivation of PS II reaction centers in soybean leaves ***Photosynthesis Research*** 1999, **61**(3):269-280.**[PAM-2000]**

484. Hymus GJ, Ellsworth DS, Baker NR, Long SP: Does free-air carbon dioxide enrichment affect photochemical energy use by evergreen trees in different seasons? A chlorophyll fluorescence study of mature loblolly pine. ***Plant Physiology*** 1999, **120**:1183-1191.**[PAM-2000]**

485. Klimyuk VI, Persello-Cartieaux F, Havaux M, Contard-David P, Schuenemann D, Meiherhoff K, Gouet P, Jones JDG,

Hoffman NE, Nussaume aL: A chromodomain protein encoded by the *Arabidopsis CAO* gene is a plant-specific component of the chloroplast signal recognition particle pathway that is involved in LHCP targeting. ***The Plant Cell*** 1999, **11**:87-99.**[PAM-2000]**

486. Koehn AC, Doudrick RL: Diurnal patterns of chlorophyll fluorescence and CO_2 fixation in orchard grown *Torreya taxifolia* (Arn.). ***Journal of the Torrey Botanical Society*** 1999, **126**(2):93-98.**[PAM-2000]**

487. Krause GH, Schmude C, Garden H, Koroleva OY, Winter K: Effects of solar ultraviolet radiation on the potential efficiency of photosystem II in leaves of tropical plants. ***Plant Physiology*** 1999, **121**:1349-1358.**[PAM-2000]**

488. Law RD, Crafts-Brandner SJ: Inhibition and acclimation of photosynthesis to heat stress is closely correlated with activation of Ribulose-1,5-Bisphosphate Carboxylase/Oxygenase ***Plant Physiology*** 1999, **120**:173-181.**[PAM-2000]**

489. Lu C, Torzillo G, Vonshak A: Kinetic response of photosystem II photochemistry in the cyanobacterium *Spirulina platensis* to high salinity is characterized by two distinct phases. ***Australia Journal of Plant Physiology*** 1999, **26**:283-292.**[PAM-2000]**

490. Lu C, Zhang J: Effects of water stress on photosystem II photochemistry and its thermostability in wheat plants. ***Journal of Experimental Botany*** 1999, **50**(336):1199-1206.**[PAM-2000]**

491. Lu C, Zhang J: Copper-induced inhibition of PS II photochemistry in cyanobacterium *Spirulina platensis* is stimulated by light. ***Journal of Plant Physiology*** 1999, **154**:173-178.**[PAM-2000]**

492. Lu C, Zhang J: Effects of salt stress on PSII function and photoinhibition in cyanobacterium *Spirulina platensis*. ***Journal of Plant Physiology*** 1999, **155**:740-745.**[PAM-2000]**

493. Maxwell K, Borland AM, Haslam RP, Helliker BR, Roberts A, Griffiths H: Modulation of rubisco activity during the diurnal phases of the crassulacean acid metabolism plant *Kalanchoë daigremontiana*. ***Plant Physiology*** 1999, **121**:849-856.**[PAM-2000]**

494. Murchie EH, Chen Y-Z, Hubbart S, Peng S, Horton P: Interactions between senescence and leaf orientation determine in situ patterns of photosynthesis and photoinhibition in field-grown rice. ***Plant Physiology*** 1999, **119**:553-564.**[PAM-2000]**

495. Ögren E: Fall frost resistance in willows used for biomass production. I. Characterization of seasonal and genetic variation. ***Tree Physiology*** 1999, **19**:749-754.**[PAM-2000]**

496. Ralph PJ: Photosynthetic response of *Halophila ovalis* (R. Br.) Hook. f. to combined environmental stress. ***Aquatic Botany*** 1999, **65**:83-96.**[PAM-2000]**

497. Roháček K, Barták M: Technique of the modulated chlorophyll fluorescence: basic concepts, useful parameters, and some applications. ***Photosynthetica*** 1999, **37**(3):339-363.**[PAM-100, PAM-2000]**

498. Smillie R, Hetherington S, Davies W: Photosynthetic activity of the calyx, green shoulder, pericarp, and locular

parenchyma of tomato fruit. ***Journal of Experimental Botany*** 1999, **50**:707-718.**[PAM-2000]**

499. Streatfield SJ, Weber A, Kinsman EA, Häusler RE, Li J, Post-Beittenmiller D, Kaisere WM, Pyke KA, Flügge U-I, Chory J: The phosphoenolpyruvate/phosphate translocator is required for phenolic metabolism, palisade cell development, and plastid-dependent nuclear gene expression. ***The Plant Cell*** 1999, **11**:1609-1622.**[PAM-2000]**

500. Verhoeven AS, III WWA, Demmig-Adams B, Croce R, Bassi R: Xanthophyll cycle pigment localization and dynamics during exposure to low temperatures and light stress in *Vinca major*. ***Plant Physiology*** 1999, **120**:727-737.**[PAM-2000]**

501. White AJ, Critchley C: Rapid light curves: A new fluorescence method to assess the state of the photosynthetic apparatus. ***Photosynthesis Research*** 1999, **59**:63-72.**[PAM-2000, MINI-PAM]**

502. 洪涛, 许大全: 珊瑚树和大豆叶片叶绿素荧光的非光化学猝灭. ***植物生理学报*** 1999, **25**(1):15-21.**[PAM-2000]**

503. 杨巧凤, 江华, 许大全: 小麦旗叶发育过程中光合效率的变化. ***植物生理学报*** 1999, **25**(4):408-412.**[PAM-2000]**

504. 朱新广, 张其德, 匡廷云: NaCl胁迫对PSII光能利用和耗散的影响. ***生物物理学报*** 1999, **15**(4):787-790.**[PAM-2000]**

505. Adams III WW, Barker DH: Seasonal changes in xanthophyll cycle-dependent energy dissipation in *Yucca glauca* Nuttall. ***Plant Cell and Environment*** 1998, **21**(5):501-511.**[PAM-2000]**

506. Allen D, Nogues S, Baker N: Ozone depletion and increased UV-B radiation: is there a real threat to photosynthesis? ***Journal of Experimental Botany*** 1998, **49**:1775-1788.**[PAM-2000]**

507. Caddick MX, Greenland AJ, Jepson l, Krause K-P, Qu N, Riddell KV, Salter MG, Schuch W, Sonnewald U, Tomsett AB: An ethanol inducible gene switch for plants used to manipulate carbon metabolism ***Nature Biotechnology*** 1998, **16**:177-180.**[PAM-2000]**

508. Dodd I, Critchley C, Woodall G, Stewart G: Photoinhibition in differently coloured juvenile leaves of *Syzygium* species. ***Journal of Experimental Botany*** 1998, **49**:1437-1445.**[PAM-2000]**

509. Feild TS, Nedbal L, Ort DR: Nonphotochemical reduction of the plastoquinone pool in sunflower leaves originates from chlororespiration. ***Plant Physiology*** 1998, **116**:1209-1218.**[PAM-2000]**

510. Feild TS, Zwieniecki MA, Donoghue MJ, Holbrook NM: Stomatal plugs of *Drimys winteri* (Winteraceae) protect leaves from mist but not drought. ***Proc Natl Acad Sci USA*** 1998, **95**:14256-14259.**[PAM-2000]**

511. Feller U, Crafts-Brandner SJ, Salvucci ME: Moderately high temperatures inhibit ribulose-1,5-bisphosphate carboxylase/oxygenase (Rubisco) activase-mediated activation of Rubisco. ***Plant Physiology*** 1998, **116**:539-546.**[PAM-2000]**

512. Filella I, Llusià J, Pinol J, Penuelas J: Leaf gas exchange and fluorescence of *Phillyrea latifolia*, *Pistacia lentiscus* and *Quercus ilex* saplings in severe drought and high temperature conditions. ***Environmental and Experimental Botany***

1998, **39**:213-220.**[PAM-2000]**

513. Fryer MJ, Andrews JR, Oxborough K, Blowers DA, Baker NR: Relationship between CO_2 assimilation, photosynthetic electron transport, and active O_2 metabolism in leaves of maize in the field during periods of low temperature. ***Plant Physiology*** 1998, **116**:571-580.**[PAM-2000]**

514. Geiken B, MasojÍdek J, Rizzuto M, Pompili ML, Giardi MT: Incorporation of [^{35}S]methionine in higher plants reveals that stimulation of the D1 reaction centre II protein turnover accompanies tolerance to heavy metal stress. ***Plant Cell and Environment*** 1998, **21**(12):1265-1273.**[PAM-2000]**

515. Green TGA, Schroeter B, Kappen L, Seppelt RD, Maseyk K: An assessment of the relationship between chlorophyll a fluorescence and CO_2 gas exchange from field measurements on a moss and lichen. ***Planta*** 1998, **206**:611-618.**[PAM-2000]**

516. Häder D-P, Leberta M, Figueroab FL, Jiménez C, Viñegla B, Perez-Rodriguez E: Photoinhibition in Mediterranean macroalgae by solar radiation measured on site by PAM fluorescence. ***Aquatic Botany*** 1998, **61**:225-236.**[PAM-2000]**

517. Häder D-P, Porst M, Santas R: Photoinhibition by solar radiation in the Mediterranean alga *Peyssonnelia squamata* measured on site. ***Plant Ecology*** 1998, **139**:167-175.**[PAM-2000]**

518. Hartel H, Grimm B: Consequences of chlorophyll deficiency for leaf carotenoid composition in tobacco synthesizing glutamate 1-semialdehyde aminotransferase antisense RNA: dependency on developmental age and growth light. ***Journal of Experimental Botany*** 1998, **49**:535-546.**[PAM-2000]**

519. Hetherington S, Smillie R, Davies W: Photosynthetic activities of vegetative and fruiting tissues of tomato. ***Journal of Experimental Botany*** 1998, **49**:1173-1181.**[PAM-2000]**

520. Kao W-Y, Tsai T-T: Tropic leaf movements, photosynthetic gas exchange, leaf $\delta^{13}C$ and chlorophyll a fluorescence of three soybean species in response to water availability. ***Plant Cell and Environment*** 1998, **21**(10):1055-1062.**[PAM-2000]**

521. Logan B, Demmig-Adams B, Adams W, Grace S: Antioxidants and xanthophyll cycle-dependent energy dissipation in *Cucurbita pepo* L. and *Vinca major* L. acclimated to four growth PPFDs in the field. ***Journal of Experimental Botany*** 1998, **49**:1869-1879.**[PAM-2000]**

522. Lu C, Zhang J: Thermostability of photosystem II is increased in salt-stressed sorghum. ***Australia Journal of Plant Physiology*** 1998, **25**:317-324.**[PAM-2000]**

523. Lu C, Zhang J: Changes in photosystem II function during senescence of wheat leaves. ***Physiologia Plantarum*** 1998, **104**:239-247.**[PAM-2000]**

524. Lu C, Zhang J: Modifications in photosystem II photochemistry in senescent leaves of maize plants. ***Journal of Experimental Botany*** 1998, **49**:1671-1679.**[PAM-2000]**

525. Lu C, Zhang J: Effects of water stress on photosynthesis, chlorophyll fluorescence and photoinhibition in wheat plants. ***Australia Journal of Plant Physiology*** 1998, **25**:883-892.**[PAM-2000]**

526. Lu C, Zhang J, Vonshak A: Inhibition of quantum yield of PS II electron transport in *Spirulina platensis* by osmotic stress may be explained mainly by an increase in the proportion of the Q_B-non-reducing PS II reaction centres. ***Australia Journal of Plant Physiology*** 1998, **25**:689-694.**[PAM-2000]**

527. Montané M-H, Tardy F, Kloppstech K, Havaux M: Differential control of xanthophylls and light-induced stress proteins, as opposed to light-harvesting chlorophyll a/b proteins, during photosynthetic acclimation of barley leaves to light irradiance. ***Plant Physiology*** 1998, **118**:227-235.**[PAM-2000]**

528. Niinemets Ü, Bilger W, Kull O, Tenhunen JD: Acclimation to high irradiance in temperate deciduous trees in the field: changes in xanthophyll cycle pool size and in photosynthetic capacity along a canopy light gradient. ***Plant Cell and Environment*** 1998, **21**(12):1205-1218.**[PAM-2000]**

529. Nogués S, Allen DJ, Morison JIL, Baker NR: Ultraviolet-B radiation effects on water relations, leaf development, and photosynthesis in droughted pea plants. ***Plant Physiology*** 1998, **117**:173-181.**[PAM-2000]**

530. Obeso JR, Alvarez-Santullano M, Retuerto R: Sex ratios, size distributions, and sexual dimorphism in the dioecious tree *Ilex aquifolium* (Aquifoliaceae). ***American Journal of Botany*** 1998, **85**:1602-1608.**[PAM-2000]**

531. Oxborough K, Baker NR: An instrument capable of imaging chlorophyll a fluorescence from intact leaves at very low irradiance and at cellular and subcellular levels of organization. ***Plant Cell and Environment*** 1998, **20**(12):1473-1483.**[PAM-2000]**

532. Penuelas J, Filella I, Llusia J, Siscart D, Pinol J: Comparative field study of spring and summer leaf gas exchange and photobiology of the mediterranean trees *Quercus ilex* and *Phillyrea latifolia*. ***Journal of Experimental Botany*** 1998, **49**(319):229-238.**[PAM-2000]**

533. Ralph PJ: Photosynthetic responses of *Halophila ovalis* (R. Br.) Hook. *f.* to osmotic stress. ***Journal of Experimental Marine Biology and Ecology*** 1998, **227**:203-220.**[PAM-2000]**

534. Ralph PJ: Photosynthetic response of *Halophila ovalis* (R. Br) Hook f. to thermal stress. ***Marine Ecology Progress Series*** 1998, **171**:123-130.**[PAM-2000]**

535. Ralph PJ, Burchett MD: Photosynthetic response of *Halophila ovalis* to heavy metal stress. ***Environmental Pollution*** 1998, **103**:91-101.**[PAM-2000]**

536. Ralph PJ, Burchett MD: Impact of petrochemicals on the photosynthesis of *Halophila ovalis* using chlorophyll fluorescence. ***Marine Pollution Bulletin*** 1998, **36**(6):429-436.**[PAM-2000]**

537. Roberts A, Borland A, Maxwell K, Griffiths H: Ecophysiology of the C_3-CAM intermediate *Clusia minor* L. in Trinidad: seasonal and short-term photosynthetic characteristics of sun and shade leaves. ***Journal of Experimental***

Botany 1998, **49**:1563-1573.**[PAM-2000]**

538. Santos ICF, de Almeida A-AF, Valle RR: Chlorophyll fluorescence parameters characterizing the development of two cacao genotypes infected by witches' broom ***Photosynthetica*** 1998, **35**(1):29-39.**[PAM-2000]**

539. Shikanai T, Takeda T, Yamauchi H, Sano S, Tomizawa K-I, Yokota A, Shigeoka S: Inhibition of ascorbate peroxidase under oxidative stress in tobacco having bacterial catalase in chloroplasts. ***FEBS Letters*** 1998, **428**:47-51.**[PAM-2000]**

540. Silva J, Santos R, Serôdio J, Melo RA: Light response curves for *Gelidium sesquipedale* from different depths, determined by two methods: O_2 evolution and chlorophyll fluorescence. ***Journal of Applied Phycology*** 1998, **10**:295-301.**[PAM-2000]**

541. Torzillo G, Bernardini P, Masojídek J: On-line monitoring of chlorophyll fluorescence to assess the extent of photoinhibition of photosynthesis induced by high oxygen concentration and low temperature and its effect on the productivity of outdoor cultures of *Spirulina platensis* (Cyanobacteria). ***Journal of Phycology*** 1998, **34**(3):504-510.**[PAM-2000]**

542. Verhoeven AS, Adams III WW, Demmig-Adams B: Two forms of sustained xanthophyll cycle-dependent energy dissipation in overwintering *Euonymus kiautschovicus*. ***Plant Cell and Environment*** 1998, **21**(9):893-903.**[PAM-100, PAM-2000]**

543. Williams TG, Flanagan LB: Measuring and modelling environmental influences on photosynthetic gas exchange in *Sphagnum* and *Pleurozium*. ***Plant Cell and Environment*** 1998, **21**(6):555-564.**[PAM-2000]**

544. 李新国, 许大全, 孟庆伟: 银杏叶片光合作用对强光的响应. ***植物生理学报*** 1998, **24**(4):354-360.**[PAM-2000]**

545. Hanelt D, Wiencke C, Nultsch W: Influence of UV radiation on the photosynthesis of Arctic macroalgae in the field. ***Journal of Photochemistry and Photobiology B: Biology*** 1997, **38**:40-47.**[PAM-2000]**

546. Hong S-S, Xu D-Q: Difference in response of chlorophyll fluorescence parameters to strong light between wheat and soybean leaves. ***Chinese Science Bulletin*** 1997, **42**(8):684-689.**[PAM-2000]**

547. Oxborough K, Baker NR: Resolving chlorophyll a fluorescence images of photosynthetic efficiency into photochemical and non-photochemical components – calculation of qP and Fv'/Fm' without measuring Fo'. ***Photosynthesis Research*** 1997, **54**:135-142.**[PAM-2000]**

548. Penuelas J, llusia J, Pinol J, Filella I: Photochemical reflectance index and leaf photosynthetic radiation-use-efficiency assessment in Mediterranean trees. ***Internal Journal of Remote Sensing*** 1997, **18**(13):2863-2868.**[PAM-2000]**

549. Skillman JB, Winter K: High photosynthetic capacity in a shade-tolerant crassulacean acid metabolism plant. lmplications for sunfleck use, nonphotochemical energy dissipation, and susceptibility to photoinhibition. ***Plant Physiology*** 1997, **113**:441-450.**[PAM-2000]**

550. Verhoeven AS, Demmig-Adams B, Adams III WW: Enhanced employment of the xanthophyll cycle and thermal

energy dissipation in spinach exposed to high light and N stress. ***Plant Physiology*** 1997, **113**:817-824.**[PAM-100, PAM-2000]**

551. Yun J, Hayashi T, Yazawa S, Yasuda Y, Katoh T: Degradation of photosynthetic activity of *saintpaulia* leaf by sudden temperature drop. ***Plant Science*** 1997, **127**:25-38.**[PAM-2000]**

552. 洪双松，许大全：小麦和大豆叶片荧光参数对强光响应的差异. ***科学通报*** 1997, **42**(7):753-756.**[PAM-2000]**

553. 谭新星，许大全：小麦叶片状态转换和光合作用的光换制的关系. ***科学通报*** 1997, **42**(20):2208-2212.**[PAM-2000]**

554. Blanke MM, Bacher W, Pring RJ, Baker EA: Ammonium nutrition enhances chlorophyll and glaucousness in kohlrabi. ***Annals of Botany*** 1996, **78**:599-604.**[PAM-2000]**

555. Roden JS, Ball MC: The effect of elevated [CO_2] on growth and photosynthesis of two eucalyptus species exposed to high temperatures and water deficits. ***Plant Physiology*** 1996, **111**:909-919.**[PAM-2000]**

556. Bergantino E, Dainese P, Cerovic Z, Sechi S, Bassi R: A post-translational modification of the photosystem II subunit CP29 protects maize from cold stress. ***The Journal of Biological Chemistry*** 1995, **270**(15):8474-8481.**[PAM-2000]**

557. Lovelock CE, Jackson AE, Melick DR, Seppelt RD: Reversible photoinhibition in Antarctic moss during freezing and thawing. ***Plant Physiology*** 1995, **109**:955-961.**[PAM-2000]**

558. Mohammed GH, Binder WD, Gillies SL: Chlorophyll fluorescence: a review of its practical forestry applications and instrumentation. ***Scandinavian Journal of Forestry Research*** 1995, **10**:383-410.**[PAM-100, PAM-2000]**

559. Ralph PJ, Burchett MD: Photosynthetic responses of the seagrass *Halophila ovalis* (R. Br.) Hook. f. to high irradiance stress, using chlorophyll a fluorescence. ***Aquatic Botany*** 1995, **51**:55-66.**[PAM-2000]**

560. Valentini R, Epron D, de Angelis P, Matteucci G, Dreyer E: In situ estimation of net CO_2 assimilation, photosynthetic electron flow and photorespiration in Turkey oak (*Q. cerris* L.) leaves: diurnal cycles under different levels of water supply. ***Plant Cell and Environment*** 1995, **18**:631-640.**[PAM-100, PAM-2000]**

561. Buwalda JG, Noga G: Intra-plant differences in leaf chlorophyll fluorescence parameters in perennial fruiting plants. ***New Zealand Journal of Crop and Horticultural Science*** 1994, **22**:373-380.**[PAM-2000]**

562. Hanelt D, Li J, Nultsch W: Tidal dependence of photoinhibition of photosynthesis in marine macrophytes of the South China Sea. ***Botanica Acta*** 1994, **107**:66-72.**[PAM-2000]**

563. Sarry J-E, Montillet J-L, Sauvaire Y, Havaux M: The protective function of the xanthophyll cycle in photosynthesis. ***FEBS Letters*** 1994, **353**:147-150.**[PAM-2000]**

564. Schroeter B, Green TGA, Seppelt RD, Kappen L: Monitoring photosynthetic activity of crustose lichens using a PAM-2000 fluorescence system. ***Oecologia*** 1992, **92**:457-462.**[PAM-2000]**