果樹整枝修剪

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摘 要

休眠期修剪可以增加新梢生長及減少樹幹周徑及根生長。短剪較疏剪有較多新生長。夏季修剪較休眠期修剪刺激生長。短剪可以除去頂端優勢，從相關性抑制作用中釋放基部芽。休眠期修剪通常能增加葉中之氮、磷及鉀量，但是會減少鈣及鎂量，夏季修剪則增加葉及果實內鈣及鎂量。修剪能間接增加光合作用，此因修剪增進樹冠內光線透入及分佈狀態。夏季修剪如果剪去果實附近之葉，往往會減少果實內碳水化合物量。修剪對樹體健康有所貢獻，可使噴藥工作方便及除去病害感染來源，在另一方面，嚴厲修剪會刺激徒長枝發生，則促進火傷病的蔓延。短剪較疏剪會壓制果芽形成，幼年旺盛樹較老年不旺盛樹對果芽形成尤受影響。休眠期及夏季修剪均能增進著果。修剪會減少果實產量，尤以較年幼樹爲然，此因修剪會壓制果芽形成及剪去已形成果芽所致。修剪與結果規則性成正相關。蘋果樹行較重休眠期修剪，雖可生產過大形果實，果實內含有豐富氮量，但含鈣量少，造成果實不耐儲藏。夏季修剪對果形大小影響雖不及休眠期修剪明顯，但能增進蘋果著色，增加含鈣量，使果實耐於儲藏。整枝修剪可用在果樹特殊栽培管理中，如樹形養成及矮化、果實產期調節、促進花芽形成或發育及防止樹勢衰弱等應用技術。

關鍵字：生長素，激勃素，細胞分裂素，樹冠，短剪，疏剪，休眠期修剪，夏季修剪。

前 言

整枝修剪是在果園中重要栽培管理作業。果樹定植後至根群與地上部生長恢復後，就需有整枝修剪工作。幼年樹修剪注重整枝工作，目的在養成强壯枝幹及適當樹形，以利將來開花結果及栽培管理作業。成年樹修剪則注重調節結果作用及維持適當樹勢，不但能提高果實產量及品質，有利噴藥、疏果及收穫等管理作業，獲得較高經濟效益。

修剪後果樹直接或間接影響生理作用。修剪後枝條所剩下部分爲恢復樹體平衡，一些促進生長荷爾蒙可能擔任傳導作用去重建失去器官，側芽被刺激生長，枝幹被誘起分枝，葉部光合作用增加，乾物質分配亦改變[38]。由於同化物及無機養分流向重建新梢上，枝幹及新根生產量則減少。由於部分養分輸往新生分生組織以供其生育，果芽形成受阻。嚴厲的修剪果樹促使枝幹上發生强壯新梢，同化物不易供給果實發育需用，卻直接將養分輸往新梢。因此修剪後生理影響明顯，可作栽培技術上參考。

樹體生理上作用

㈠果樹生長反應

短剪及疏剪對果樹新梢生長有不同反應。休眠期修剪有刺激新梢生長作用，在重量修剪情形下，可能會減少新梢生長。冬季休眠期修剪通常對果樹生長反應有下列幾種：(1)被修剪枝條上所發出新梢多於未修剪者。(2)修剪後樹形大小與未修剪者不同。(3)在相同程度修剪情形下，被修剪枝上長出新梢大小與修剪前枝條長度成正相關[26,28]。修剪樹與未修剪樹不同點在：(1)修剪失去頂端分生組織及頂芽，使下方芽發出。(2)修剪失去形成層面積或改變形成層所佔比例。(3)在夏季修剪會減少一部分葉。如果增加修剪量，新梢重量雖可增加，然而幹徑增加量卻會減少[29]。新梢生長反應不但受修剪量影響，對於修剪方式亦有不同。在相同修剪量情形下，短剪較疏剪可誘致多量新梢生長[40,41]。夏季修剪能使樹體矮化，並能增加果芽形成及提高果實品質，在密植園可限制樹形大小及增進果實品質[8,36]。修剪後果樹生長反應受栽培品種、根砧、樹勢及樹齡而定[43]。夏季修剪與休眠期修剪及未修剪樹比較，它可以減少幼年樹新梢生長[29,41]。夏季修剪對於成年結果樹可以延緩樹幹生長，並減少根生長及限制樹冠容積擴大[51]。但是夏季修剪對於減少新梢生長是無效的[51,52]。夏季修剪可以緩慢蘋果樹生長而增進果距發育[18]。夏季修剪可將光合物儲存在木質部，幼年樹新梢生長需要葉內光合物供給，成年樹生長多由在枝幹或根內儲藏養分供給。雖然夏季修剪可以抑制樹幹周徑增加，在樹體內碳水化合物量仍在臨界水準以上。

㈡生長相關性

新梢頂端及幼葉可以抑制側芽發育，二年生枝梢頂端芽可以形成長梢，基部芽則發育成距或保持休眠狀態。修剪新梢頂部可除去頂端優勢，從相關抑制作用中釋放芽及改變樹型。許多學者解釋這種生長相關性及頂端優勢，乃在新梢頂端產生生長素，抑制側芽生長，生長中頂芽先取由根部輸送來的養分及荷爾蒙，並將同化物儲藏在主軸內，因此壓制其他側芽生長。如果早日摘去頂芽，使下方芽發育成强壯側枝[39]。如果在休眠期短剪枝梢，可使强壯側枝數增加數倍，長梢與短距比例亦有顯著增加[35]。在熱帶氣候下，羅美蘋果旺盛頂端優勢可用摘葉、屈枝及短剪等方法來克服[3]。

㈢葉及果實內無機養分量

有些試驗研究說明休眠期及夏季修剪可以影響葉及果實內無機養分含量。通常休眠期修剪可刺激新梢生長及減少果實產量，低產量通常與果實內高濃度無機養分有關，因爲根部所吸收無機養分容易被這少量果實吸收。休眠期修剪可以增加果實內氮、鉀及磷量，減少鈣及鎂量[22,23,45]。大量休眠期修剪可以減少蘋果樹含鈣量，由於修剪可以增大果形，但在果實內含鈣量卻降低，此因枝葉快速生長所致。在夏季旭蘋果品種新梢上摘心，顯著增加在葉內鈣、磷、鎂、鐵及錳量。經夏季修剪所增加蘋果果實內鈣量與所摘去競爭性葉有關，可增加果實內積聚量[47]。

㈣葉面積、光合作用及呼吸作用

修剪能影響葉面積，葉構造及透光度，直接或間接影響光合作用。休眠期大量修剪雖然可以減少生長初期葉面積，由於新梢生長快速，可使葉面積恢復相等或大於未修剪樹葉面積

[35,39]。夏季修剪可減少蘋果幼年樹達三分之一葉面積量[29]。休眠期修剪可以間接影響光合作用，有利光線透入樹冠內結果區域，如果行較多短剪，可能誘起大量徒長性新梢在樹冠外圍，阻礙光線透入樹冠內。生長中新梢頂端是同化物强烈接受者[56]。活化的新梢可自成長葉中流入同化物[24,48]。除去新梢頂部可招致在新梢及葉部同化物積聚量。蘋果新梢行環狀剝皮可引起葉內光合產物積聚及減少光合率[17,37]。然而將生長中新梢行短剪，腋芽分生組織立刻被刺激而發育[4,37]。在枝條基部葉所形成同化物主要供給枝幹及根部[16,33,34,48]。葉隨年齡增加，光合作用隨之下降[19]。盆栽年幼蘋果樹行夏季修剪後，可增加淨光合作用、暗期呼吸作用及蒸散作用[30]。

(五)碳水化合物儲存量

有許多試驗研究認爲修剪可引起樹體總乾物量變化。修剪後有較多乾物重進入新梢內，由於大量新梢生長就會減少樹體內碳水化合物儲存量，影響果芽形成。休眠期修剪會減少蘋果枝條內澱粉及可溶性糖類，但是增加水分及含氮量[20]。疏剪有利於光線透入樹冠內部，增加光合率及果實內可溶性固形物量，間接改進果色。相反地，短剪可刺激新梢生長而造成遮陰，於是減少果實內可溶性固形物量。密植蘋果園內常需要强烈修剪[22,23]。如果在葡萄休眠期修剪後結果母蔓上留有許多芽，果實產量雖可增加，但是減少果內可溶性固形物量[44]，蘋果樹行夏季修剪時，若剪除果實附近葉片，就會減少果實內可溶性固形物量[13,32]。蘋果果距側枝內同化物可輸送至接近之果實上[53,54]。

(六)荷爾蒙

修剪會改變果樹擔任荷爾蒙庫源的分生組織數量，亦擾亂根系與地上部間供給荷爾蒙平衡。休眠期修剪後地上部樹體內生長素、激勃素及細胞分裂素等三種促進生長荷爾蒙高於未修剪者。修剪後樹體內三種荷爾蒙有波動變化。細胞分裂素最高量在五月下旬，生長素最高量在六月上旬，激勃素最高量在六月下旬，在五月中旬是芽發育迅速期，在修剪後幹內細胞分裂素量四倍高於未修剪樹所含量。細胞分裂素起源於根部，輸送至新梢，修剪樹上芽數減少成爲細胞分裂素的庫。細胞分裂素在韌皮部移動擔任重要任務，可刺激芽體發育及誘導生長素合成。因此在修剪樹最初細胞素增加，隨即升起生長素活動。激勃素含量的增加亦是最初細胞分裂素及生長素增加的結果。

(七)耐寒性

休眠期修剪會影響果樹在當年冬季的耐寒性。例如在晚秋或早冬修剪會打破休眠期而減少耐寒性[57]。夏季修剪對果樹耐寒性影響依據修剪時間及程度而定，例如由於夏季修剪引起枝梢第二次生長而降低果樹耐寒性，因爲修剪所刺激新稍長無充足時間去得到耐寒性。

(八)樹體健康

修剪後之傷口可以影響樹體健康，會增加病原感染的可能性，例如：銀葉病Stereum purpureum Pers.及火傷病Erwinia amylovora (Burr) Winslow et al.等皆可自傷口侵入。在另一方面，修剪可使樹冠開展及矮化，有利農藥撒佈而達到病蟲害防治效果。修剪後蘋果樹較

未修剪者病害爲少，其原因部分由於除去感染源，另部分因爲達到噴藥效果[14,15]。輕度修剪蘋果及梨樹較重修剪者少於感染火傷病[5]，因爲强烈修剪刺激徒長枝發生，徒長枝易感染火傷病[2]。在另一方面，除去病害感染部分可減少感染來源[5]。夏季修剪會激勵火傷病在果園中傳染，宜設法避免採用[5]。傷口癒合速度主要依據溫度及修剪方式而定。高濕度雖可加速癒合，但是增加病原菌感染可能性。採用塗料及油乳劑覆蓋傷口可以防止組織乾燥。加用生長荷爾蒙（細胞分裂素、IAA、NAA）可促進癒合組織形成及痊癒[5,7]。在冬季及早春傷口癒合緩慢，對於銀葉病感染具有較大敏感性[12]。

開花結果上作用

㈠花芽形成

由於成年樹休眠期修剪刺激新稍旺盛生長會減少花芽形成，特別在(1)幼年生長旺盛果樹，(2)接木在生長旺盛根砧上，(3)在短果距上形成果芽品種，(4)短剪會刺激生長者[36]。枝條適度或緩慢生長是花芽形成絕對必要的。在生長旺盛新梢頂端生長素可以抑制花芽形成[33,34]。低氮量，使用生長延緩劑及屈枝法可以限制新梢生長，促進及增加花芽形成。在乾旱季節生長緩慢時，果樹花芽形成較早及數量較多。矮化樹完成密集生長較速，著生果實較旺盛樹爲多。遮蔭或除葉限制同化物供給，可能減少甚至擾亂花芽形成。在另一方面，採用環狀剝皮或屈枝增加枝條內同化物供給量，可以增加花芽形成[25,27,33]。緩慢花芽形成原因並非缺乏同化物，乃爲荷爾蒙失常所致。在頂部被剪去後，由於根部供給荷爾蒙不平衡，在分生組織減少時，樹上綠色部分產生荷爾蒙不能被利用。修剪樹的新梢快速生長載負甚多促進生長荷爾蒙，阻止花芽發生。夏季修剪對花芽形成影響與果樹種類及品種、樹勢、修剪方式及修剪時間有關。早期對旺盛果樹行短剪，可能刺激第二次生長而擾亂花芽發生進行。矮性果樹晚期短剪對花芽發生無害。同樣地，在夏季除去徒長枝也不會影響結果枝上花芽形成。

㈡著果

果樹著果似乎亦與樹勢有關，通常旺盛成年樹較年幼樹著果良好，接木在矮性根砧較旺盛根砧上良好。採用果距型較標準型良好[21]。一般休眠期修剪可以增加著果率。修剪樹的良好著果因在在留下枝幹中增加水及氮，並不是由於增加光合物所致[10]。修剪增加著果乃因生長荷爾蒙直接造成。然而在留果中荷爾蒙任務必須考慮到養分分佈[9,58]。夏季新梢摘心亦能增加著果，因爲發育中新梢與果實有養分競爭現象。頂端新梢具有較强碳水化合物及養分之入庫力[1]。剪去生長中新梢頂端能增進蘋果留果率[43]。

㈢果實產量及規則性結果

多數試驗結果認爲修剪對果實產量及結果規則性有很大影響。然而所產生的效果依據樹齡、根砧、栽培品種、生長狀態及修剪方式而定。通常休眠期修剪會延遲及壓制年幼的果樹結果[11,15,35,40,41]。修剪刺激幼年樹生長、延長營養生長期及延遲生殖作用進行。被修剪樹減少產量乃因樹冠變小所致。休眠期修剪較夏季修剪更爲減少果實產量[40,44]，其中短剪較疏剪爲甚。修剪樹上所減少花芽數易被所增加著果數所補償。所獲得大形果實亦可獲得較多產量。例如一些多產性蘋果品種，被修剪樹上平均果重100-150g，未修剪樹上平均果重只有50-70g。

對於一些具有隔年結果習性的蘋果品種，在結果年冬季果芽數甚多時，行强烈修剪可刺激下年將形成結果枝生長良好[50]。

㈣果實品質

成年樹修剪主要理由可獲得較高品質的果實。休眠期修剪會減少花芽數及結果數，可獲得較大形果實[11,15]。少量大型疏剪有利於光線透入樹冠內部，不會刺激多數新梢生長，通常會增進果實著色[11,46]。相對的行短剪會減少果實著色[36]。蘋果著色不良可能由於密集新梢生長及遮蔭所引起[36]。强烈修剪蘋果樹可產生軟弱、含氮多而低鈣量的較大形果實，此種果實不耐儲藏[22,23,45]，容易感染苦斑病。蘋果夏季修剪可除去强競爭性鈣的新梢尖端，則增加果實含鈣量而減少苦斑病發生[47]。由於夏季修剪減少葉面積及同化物庫，通常會減少果實內可溶性固形物量[13,32]。在夏季修剪樹上果實較未修剪樹易暴露於陽光下，可加速果實成熟。

果樹栽培技術應用

㈠ 樹形養成：

(1)自然型整枝：圓頭形、半圓形及開心形等。

(2)人工型整枝：籬壁形、棚架形。

㈡ 樹形矮化：去頂、除心 、低幹整枝。

㈢ 果實產期調節：摘心、短剪 、疏剪 、斷根、去葉等。

㈣ 樹勢維持 ：疏剪 、短剪 、疏花 、疏果、更新修剪等。

㈤ 花果形成或促進 ：環狀剝皮、刻傷、屈枝等。

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Training and Pruning of Fruit Trees

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ABSTRACT

Training and pruning of fruit trees is an important management in the orchard. Dormant pruning increases the growth of new shoots but decreases the growth of the trunk and roots. Shoot heading results in more new growth than shoot thinning. Summer pruning stimulates less growth than dormant pruning. Dormant pruning usually increases the contant of N, K and P but decreases the content of Ca and Mg. However, summer pruning increases the photosynthesis indirectly as a result of improving light interception and distribution within the tree canopy. Pruning may contribute to tree health by facilitating spraying operations and by removing sources of infection diseases. Shoot heading suppresses fruit bud formation to greater extent than shoot thinning. Both dormant and summer pruning increases fruit setting. Pruning has a positive influence on the regularity of bearing. Summer pruning increases the calcium content of apple and improves storage quality. The pruning application of fruit trees could be summarized as follow : (1) training of tree forms. (2) dwarfing of fruit trees. (3) forcing culture of fruit trees. (4) maintenance of tree vigor and (5) formation and promotion of flowers and fruits.

Key Words : Auxins, Gibberellins, Cytokinins, Canopy, Shoot heading, Shoot thinning, Dormant pruning, Summer pruning