夏大豆籽粒成熟期根叶衰老特性的研究

刘 莹[1],张孟臣[2],杨春燕[2]

(1. 河北工程大学 农学院,河北 邯郸 056038; 2. 河北省农林科学院 粮油作物研究所,河北 石家庄 050031)

摘 要:以在冀中南地区夏播表现相对高产和低产的6个大豆品种为材料,通过测定鼓粒始期至成熟期根系和叶片的生理性状,探讨了大豆籽粒成熟期根、叶衰老之间的关系。结果表明:根、叶生理参数之间高度相关,不同产量类型大豆品种根系可溶蛋白含量、可溶糖含量、SOD活性衰退幅度均小于叶片,表明在生育后期叶片衰老先于根系;不同产量类型间比较,相对高产品种较相对低产品种根、叶各生理指标衰退速率慢,相对高产品种根系较叶片衰老的进程显著落后于相对低产品种。应在栽培上重视养根护叶及育种中加强根系生理性状的选择,延缓衰老进程进而获得高产。

关键词:夏大豆;籽粒成熟期;根叶;衰老

中图分类号:S565.1 **文献标识码**:A **文章编号**:1000-9841(2010)02-0244-03

Senescence of Root and Leaf Phsiological Traits during Seed-filling of Summer Growing Soybean

LIU Ying[1],ZHANG Meng-chen[2],YANG Chun-yan[2]

(1. Academy of Agronomy, Hebei University of Engineering, Handan 056038, Hebei; 2. Institute of Cereal and Oil Crop, Hebei Academy of Agricultural and Forestry Sciences, Shijiazhuang 050031, Hebei, China)

Abstract: Six soybean cultivars with different yield level from mid-south of Hebei province were planted in field trail, and physiological traits including soluble protein content(SPC), soluble sugar content(SSC) and superoxcide dismutase (SOD) of root and leaf were measured, in order to investigate the relationship between root and leaf senescence during seed filling. The physiological parameters of root took on high positive correlation with that of leaf. There were smaller decrease percentage of SPC, SSC and SOD activity in root than that of leaf. The senescence process of root and leaf were slower in relative high yield type than in relative low yield type. Compared with leaf, the root had slower senescence rate significantly in relative high yield type than in relative low yield type. Results suggest that the senescence of leaf occurred prior to root, and it is necessary to maintain the function of root and leaf during soybean seed filling process.

Key words: Summer soybean; Seed maturity stage; Root and leaf; Senescence

随着国民经济的发展和人民生活水平的提高以及加工业、食品业和畜牧业的发展,大豆的需求量急剧增加,供求矛盾日益突出。目前扩大大豆种植面积的潜力有限,而提高单产还有很大空间和潜力,通过培育高产大豆品种进而增加大豆产量是提高国产大豆竞争力的主要途径[1]。

大豆的正常发育过程是地上部的光合作用和地下部根群的吸收水分、养分的统一过程。长期以来,围绕产量的形成,对大豆地上部分生长特性及调节控制已经做了大量的研究[1-4]。随着对根系认识的逐渐深化,肥水对根系特性的影响[5-8]、根系形态性状与产量的关系[9-13]等方面已有相关的研究。大豆籽粒发育过程中植株生理功能是决定其产量潜力的重要因素,根叶的衰老对大豆生育后期产量形成有重要影响,但相关研究结果不尽一致[14-16]。现以黄淮地区不同产量类型大豆品种为材料,对其成熟期根、叶生理性状的衰老动态变化进行研究,旨在为探讨二者之间的关系,进而为应用科学栽培措施延缓大豆生育后期植株生理功能衰退提供理论参考。

1 材料与方法

1.1 供试材料

选取相对高产品种冀豆12、中黄4号、冀豆15,相对低产品种豫豆2号 、鲁豆4号、胜利3号为材料,各品种的生育期均为100 d左右。

收稿日期:2009-10-26

基金项目:河北省自然基金资助项目(C2008000721);邯郸市科技局资助项目(200610115-2)。

第一作者简介:刘莹(1966-),女,副教授,博士,研究方向为大豆遗传育种。E-mail: lyzf2004@126.com。

1.2　试验设计

试验于 2009 年在河北邯郸农科院实验农场进行。随机排列,5 行小区,行长 3 m,行距 50 cm,3 次重复。在中间 2 行自 8 月 31 日(鼓粒始期)起每隔 5 d 取样。叶片采自倒数第 3 功能叶,根系使用内径 7 cm,钻深 10 cm 的自制根钻取样,取样时以植株为中心,在其两边间距植株 2 cm、12 cm、22 cm 分别钻取 0 ~ 10 cm、10 ~ 20 cm 深度的土柱,用流水仔细冲洗后,收集根系进行测定。

1.3　测定项目与方法

考马斯亮蓝法测定可溶蛋白含量,蒽酮法测定可溶性糖含量,氮蓝四唑法测定 SOD 活性,TTC 法测定根系活力。

2　结果与分析

2.1　根、叶有关生理指标的动态变化

2.1.1　*可溶性蛋白含量*　不同产量类型品种生育后期根、叶可溶性蛋白含量均表现随生育进程逐渐降低趋势(图 1),二者相关系数达 0.936。根、叶降低的幅度不同,与鼓粒初始相比,降幅分别为 64.30%、73.77%,根系降低幅度低于叶片。

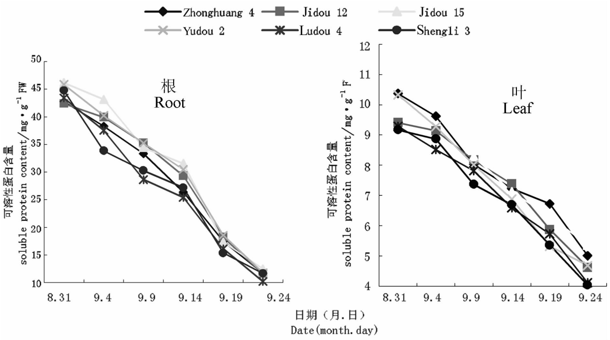

图 1　根系与叶片可溶性蛋白含量动态变化

Fig. 1　Changes of soluble protein in root and leaf

2.1.2　*可溶性糖含量*　不同产量类型品种生育后期根、叶可溶性糖含量均表现随生育进程逐渐降低趋势(图2),二者相关系数达0.957。与鼓粒初始相比,根、叶降幅分别为 53.53%、69.33%,根系降低幅度低于叶片。

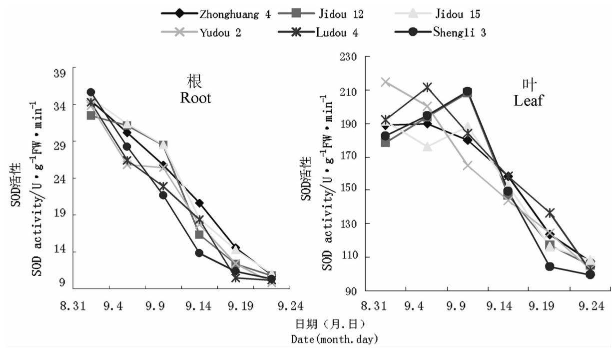

图 2　根系与叶片可溶性糖含量动态变化

Fig. 2　Changes of soluble sugar in root and leaf

2.1.3　*SOD 活性*　不同产量类型品种生育后期根、叶 SOD 活性均表现随生育进程逐渐降低趋势(图 3),二者相关系数达 0.867。与鼓粒初始相比,根、叶降幅分别为 45.26%、53.00%,根系降低幅度低于叶片。

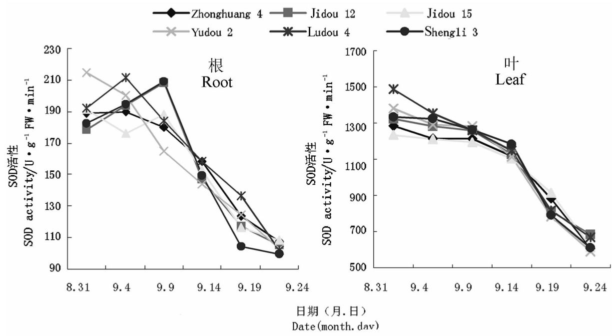

图 3　根系与叶片 SOD 活性动态变化

Fig. 3　Changes of SOD in root and leaf

2.2　不同产量类型大豆根、叶衰老速率比较

不同产量类型间比较,相对高产品种较相对低产品种根、叶各生理指标衰退速率慢,特别表现在根系上,即相对高产品种根系较叶片衰老的进程显著落后于相对低产品种(表 2)。

表 2　不同产量类型大豆品种根、叶生理参数衰退百分率

Table 2　Decreasing percentage of physiological parameters of root and leaf between soybean varieties with different yield/%

产量类型 Yield type	根系 root				叶片 leaf		
	可溶性蛋白含量 Soluble protein content	可溶性糖含量 Soluble protein content	SOD 活性 SOD activity	根系活力 Root reductive activity	可溶性蛋白含量 Soluble protein content	可溶性糖含量 Soluble protein content	SOD 活性 SOD activity
相对高产 Relative high yield	62.56	51.59	42.35	65.75	72.68	67.92	50.43
相对低产 Relative low yield	65.68(4.23)	55.47(6.98)	48.18(12.10)	67.92	74.87(2.92)	70.74(3.99)	55.56(9.23)
显著性测验 Notable test	**	**	**	**	*	**	**

** 表示在 0.01 水平下显著,括号中数字为相对低产类型较相对高产类型衰退速率的百分率。

** meant significant difference at 0.01 level. Values in parentheses were decrease percentage of relative low yield type compared to relative high yield type.

3 讨论

根叶功能的衰老密切相关。Salah 等的研究表明,推迟叶片衰老可提高根系固氮能力进而提高种子产量[15],Noodén 等认为,根系伤流液中矿物质的减少导致了叶片功能的衰退[16]。结果表明,大豆生育后期叶片的衰老进程快于根系,这与 Taiichiro 等的研究结果相符[17-18]。该研究中根系与叶片生理性状高度相关表明,生育后期根系和叶片功能之间具有密切的联系,生产中如喷施叶面肥等措施推迟叶片的衰老进程可以相应调控根系的生理功能,而前期中耕施肥等促根生长措施又对后期叶片延长功能期至关重要[19]。

大豆荚中所含的氮、磷有很大部分是在籽粒发育过程中由根部供给的[19],因此大豆生育后期根系的作用不容忽视。在结果中,不同产量类型间,相对高产品种根系较叶片衰老的进程显著落后于相对低产品种,表明在大豆品种产量提高过程中,伴随着叶片生理性状的改良,根系生理功能得到了进一步的提高。因此,在大豆高产育种中,应注重培育后期根系发达、不早衰的新品种[20],并将根系性状的选育列入到育种计划中。

参考文献

[1] 赵团结,盖钧镒,李海旺,等.超高产大豆育种研究的进展与讨论[J].中国农业科学,2006,39(1):29-37.(Zhao T J, Gai J Y, Li H W, et al. Advances in breeding for super high-yielding soybean cultivars[J]. Scientia Agricultura Sinica, 2006,39(1):29-37.)

[2] Ojima M, Kawashima R. Studies on the seed production of soybean Ⅷ. The ability of photosynthesis of F_3 lines having different photosynthesis in their F_2 generations[J]. Proceedings of the Crop Science Society of Japan,1969, 39:440-445.

[3] Morrison M J, Voldeng H V, Cober E R. Physiological changes from 58 years of genetic improvement of short-season soybean cultivars in Canada[J]. Agronomy Journal,1999,91:685-689.

[4] Specht J E, Hume D J, Kumudini S V. Soybean yield potential-A genetic and physiological perspective[J]. Crop Science, 1999, 39:1560-1570.

[5] 张含彬,任万军,杨文钰,等.不同施氮量对套作大豆根系形态与生理特性的影响[J].作物学报,2007,33(1):107-112.(Zhang H B , Ren W J , Yang W Y, et al. Effects of different nitrogen levels on morphological and physiological characteristics of relay planting soybean root[J]. Acta Agronomica Sinica,2007, 33 (1):107-112.)

[6] Gahoonia T S, Nielsen N E. Variation in root hairs of soybean cultivars doubled soil phosphorus uptake[J]. Euphytica, 1997,98:177-182.

[7] 杜天庆, 闫心柏, 苗果园.不同微肥处理对大豆根系及地上部相关性的影响[J].山西农业大学学报,2006,(2):159-163.(Du T Q, Yan X B, Miao G Y. Effects of microelement fertil izers on the correlation between soybean root system and aerial parts[J]. Journal of Shanxi Agriculture University,2006(2):159-163.)

[8] Bhattarai S P, Midmore D J, Pendergast L. Yield, water-use efficiencies and root distribution of soybean, chickpea and pumpkin under different subsurface drip irrigation depths and oxygation treatments in vertisols[J]. Irrigation Science, 2008,26(5):439-450.

[9] 杨秀红,吴宗璞,张国栋.不同年代大豆品种根系性状演化的研究[J],中国农业科学,2001,34(3):60-63.(Yang X H, Wu Z P, Zhang D. Evolution of root characters of soybean varieties of different ages[J]. Scientia Agricultura Sinica,2001,34(3):60-63.)

[10] 傅金民, 董钻.大豆根系生长与产量的关系[J].大豆科学, 1987,6(4): 261-279.(Fu J M, Dong Z. The relation of root growth and yield in soybean[J]. Soybean Science, 1987,6(4):261-279.)

[11] Pantalone V R, Rebetzke G J, Burton W, et al. Phenotypic evaluation of root traits in soybean and applicability to plant breeding [J]. Crop Science,1996,36:456-459.

[12] 金剑, 王光华, 刘晓冰.东北黑土区高产大豆 R5 期根系分布特征[J]. 中国油料作物学报,2007, 29 (3):266- 271.(Jin J, Wang G H, Liu X B. Characteristics of root distribution at R5 stage in high yielding soybean in black soil[J]. Chinese Journal of Oil Crop Sciences,2007,29(3):266-271.

[13] Migue R. The vertical distribution of below ground biomass in grassland communities in relation to grazing regime and habitat characteristics[J]. Journal of Vegetal Science,1995,6:63-72.

[14] Minch F R, Sunmeeifield R J, Carbonmetabolism M C. Nitrogen assimilation and seed yield of cowpea grown in an adverse temperature gime[J]. Experimental Botany,1980,31:1327-1347.

[15] Abu-Shakra S S, Phillips D A, Huffaker R C. Nitrogen fixation and delayed leaf senescence in soybeans[J]. Science,1978,199:973-975.

[16] Noodén L D, Mauk C S. Changes in the mineral composition of soybean xylem sap during monocarpic senescence and alterations by depodding[J]. Physiologia Plantarum,1987,70(4):735-742.

[17] Ookawa T, Nishiyama M. Differences in leaf senescence among reciprocally grafted plants of two soybean cultivars, enrei and tachinagaha[J]. Plant Product Science,1999,2(1) : 51-52.

[18] Nooden L D, Letham D S. Cytokinin Metabolism and signalling in the soybean plant[J]. Plant Physiology,1993,20(5):639-653.

[19] Hayati R, Egli D B, Crafts S J. Carbon and nitrogen supply during seed filling and leaf senescence in soybean[J]. Crop Science, 1995,35:1063-1069.

[20] 田佩占.大豆品种根系的生态类型研究[J].作物学报,1984,10(3):173-177.(Tian P Z. The research on root ecology type in soybean[J]. Acta Agronomica Sinica,1984,10(3):173-177.)