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Growth Characteristics as Affected by Polyethylene Film-Mulching in Sesame

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ABSTRACT: This study was carried out to investigate varietal differences on growth characteristics under the conditions of PE film-mulching and non-mulching in sesame. At maturing stage from 76 to 95 days after sowing, Yangbaeckkae, non-branching plant type, under non-mulching showed larger leaf area index (LAI) than that of film-mulching, while plant height and the number of capsules per plant were similar to those of film-mulching. LAI of Ahnsankkae, branching plant type, under non-mulching was similar to film-mulching, while plant height and the number of capsules per plant were smaller than those of film-mulching. Net assimilation rate (NAR) of two varieties under non-mulching was lower at seedling stage from 25 to 35 days after sowing but higher at flowering stage from 45 to 55 days after sowing. At maturing stage from 66 to 77 days after sowing, NAR and crop growth rate (CGR) of Yangbaeckkae under non-mulching were greater than those of film-mulching, whereas those of Ahnsankkae under non-mulching were lesser than those of film-mulching. Yield under non-mulching was decreased by 7% in Yangbaeckkae and 33% in Ahnsankkae compared with that of film-mulching, therefore Yangbaeckkae was more adaptable for non-mulching than Ahnsankkae. Main factors decreasing yield of Yangbaeckkae under non-mulching were small LAI, NAR, and CGR at the stage of young seedling, and small number of capsules at early maturing stage from first flowering to 20 days after first flowering.

Keywords **:** sesame, growth characteristics, net assimilation rate, crop growth rate, film-mulching, non-mulching, plant type

Sesame (*Sesamum indicum* L.) is the traditional oil crop that have been used as a condiment through the ages in Korea. Optimal duration of sesame growth was about 120 days from May 10 to September 10 under the climatic condition of Korea. Inflorescence normally started from June 25 and ended August 30 under PE film-mulching condition of transparent, whereas started from July 5 and ended September 5 under black PE film-mulching condition, respectively (Lee *et al.*, 1980; Lee *et al.*, 1984). Yield of sesame was greatly increased by PE film-mulching method developed at the beginning of 1980s. PE film-mulching raise soil temperature at the time of sowing and the early growth stage, and preserve soil moisture properly, and suppress weeds' growth (Kim *et al.*, 1979; Lee *et al.*, 1986; Oh *et al.*, 1994). PE film-mulching partly obstructs perfect mechanization because of manual labour to thin out sesame seedlings but mechanized non-mulching sowing system enables to omit thinning. PE film-mulching has an other demerit to bring about environmental pollution by PE film itself. Besides, non-film mulching culture can save the labor to mulch PE film and to thin out seedlings, but it has three demerits to delay the germination of sesame and to accelerate the growth of weeds and to wash the surface of soil. Nowadays, to improve the international competitiveness of sesame in Korea, it is strongly requested to develop integrated mechanization system in order to cut down production cost. There was few studies on the varietal differences of growth under the conditions of PE film-mulching and non-muching. Therefore, this experiment was carried out to investigate varietal differences on dry matter production and growth analysis of different plant types between PE film-mulching and non-mulching and to get basic information for selection of varieties that can highly adapt under non-mulching culture in sesame.

MATERIALS AND METHODS

Two varieties of sesame, Yangbaeckkae and Ahnsankkae were released; Yangbaeckkae was belong to NTB plant type of non-branch, tricapsule, and bicarpels, and Ahnsankkae was BMB plant type of branch, monocapsule, and bicarpels. Two varieties were sown under two different conditions of polyethylene (PE) film mulching and non-mulching. This experiment was carried out at the field of National Crop Experiment Station (NCES), Suwon in 2001. Sowing date was May 25 and the black PE film of 0.015 mm punched by interspace of 30×10 cm was mulched on soil surface with furrow width of 70 cm. Experimental plot was arrayed by randomized block design with 3 replications and each plot size was 9 m^2. Fertilizer was applied as basal release before

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planting with N-P_2O_5-K_2O of 80-40-90 kg/ha. Other cultural practices were conducted according to standard cultural methods developed by NCES. Growth analysis were investigated at 14 (June 8), 25 (June 19), 35 (June 29), 45 (July 9), 55 (July 19), 66 (July 30), 76 (August 9), 87 (August 20), and 95 (August 28) days after sowing, respectively. CGR and NAR were calculated by the following formulas (Kim & Yang, 1984). CGR(g/m^2/day): $1/F\times(W_2-W_1)/(t_2-t_1)$, NAR ($g/m^2$/day): $(InW_2-InW_1)/(t_2-t_1)\times(In\ A_2-InA_1)/(A_2-A_1)$, F: investigated ground area (cm^2), W: top dry weight (g/plant), A: leaf area index (LAI), t: dates investigated.

RESULTS AND DISCUSSION

Plant height of Yangbaeckkae under non-mulching was shorter than that of film-mulching until 76 days after sowing, but similar to that of film-mulching since 76 days after sowing. Plant height of Ahnsankkae under non-mulching was shorter than that of film-mulching during all duration of growth. Plant height of two varieties did not show significant differences at harvesting season, but showed especially shorter height at 35~45 days after sowing (Fig. 1).

The number of capsules per plant of Yangbaeckkae under non-mulching condition was smaller than that of film-mulching until 76 days after sowing such as plant height, but greater than that of film-mulching since 76 days after sowing and similar to that of film-mulching at harvest season. The number of capsules per plant of Ahnsankkae under non-mulching was constantly smaller than film-mulching during all growth duration (Fig. 2).

Top dry weight of Yangbaeckkae showed the peak at 87 days after sowing both of film-mulching and non-mulching, whereas that of Ahnsankkae showed 76 days after under film-mulching and 87 days under non-mulching. Top dry weight of Yangbaeckkae under non-mulching was lighter than that of film-mulching until 66 days after sowing, but heavier than that of film-mulching at 76~87 days such as the number of capsules per plant. Top dry weight of Ahnsankkae under non-mulching was lighter than that of film mulching during all growth duration (Fig. 3).

LAI of Yangbaeckkae showed the peak at 66 days after sowing under film-mulching, while at 70 days under non-mulching. LAI of Ahnsankkae showed the peak at 70 days under film-mulching, while 73 days after sowing under non-mulching. Kang *et al.* (1994) reported that LAI of sesame

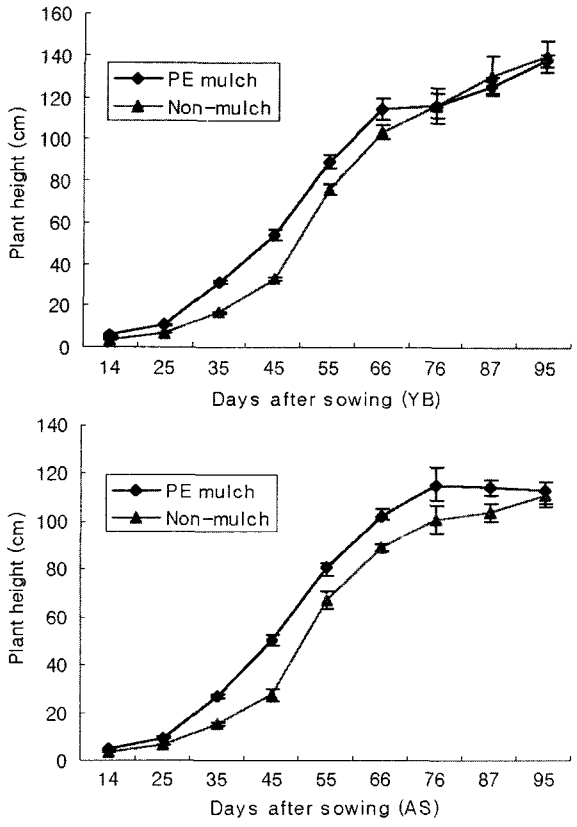

Fig. 1. Plant height in PE film-mulching and non-mulching conditions of two sesame cultivars (top: Yangbaeckkae, bottom: Ahnsankkae).

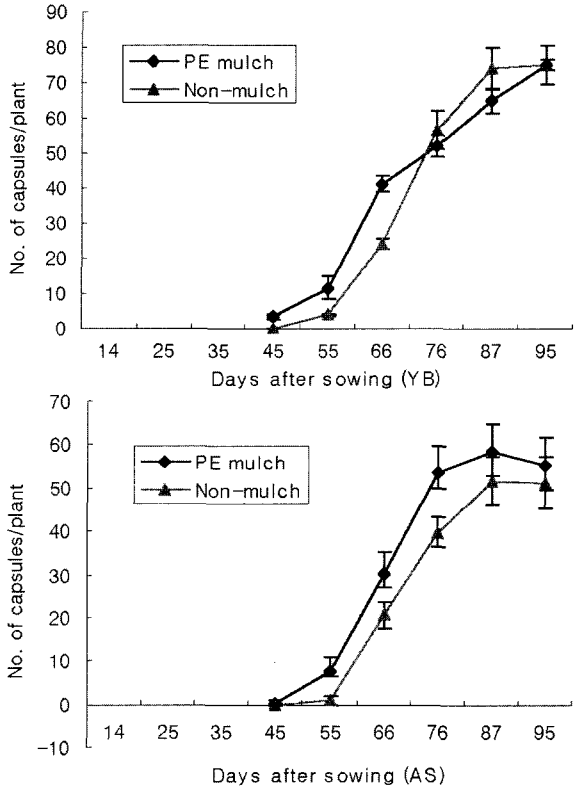

Fig. 2. Number of capsules per plant in PE film-mulching and non-mulching conditions of two sesame cultivars (top: Yangbaeckkae, bottom: Ahnsankkae).

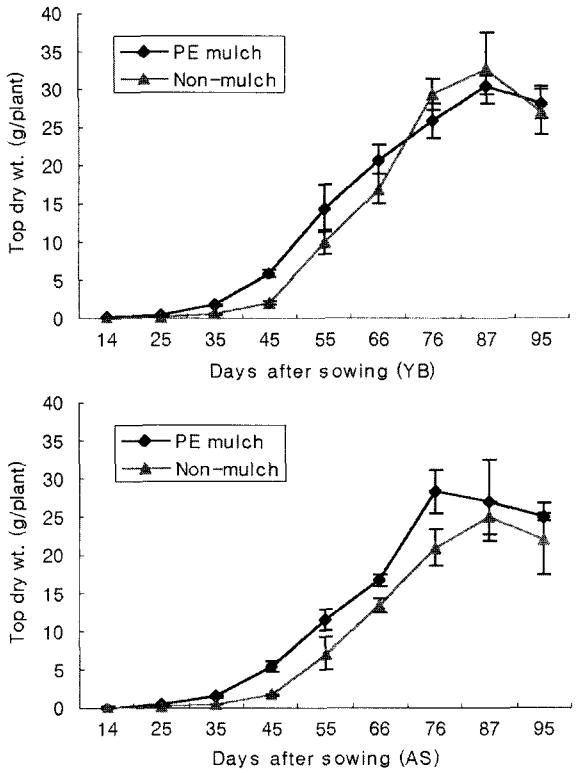

Fig. 3. Top dry weight per plant in PE film-mulching and non-mulching conditions of two sesame cultivars (top: Yangbaeckkae, bottom: Ahnsankkae).

showed great variance by varieties. LAI of Yangbaeckkae under non-mulching was smaller than that of film-mulching until 66 days after sowing, but larger than that of film-mulching since 70 days after sowing. LAI of Ahnsankkae in non-mulching was smaller than that of film-mulching until 76 days after sowing, and similar to film-mulching since 76 days after sowing. LAI of two varieties between film-mulching and non-mulching showed great differences at flowering stage, 45 days after sowing (Fig. 4).

Yangbaeckkae and Ahnsankkae showed different pattern of NAR between film-mulching and non-mulching conditions. NAR of Yangbaeckkae under non-mulching was smaller at seedling stage from 25 to 35 days after sowing, but larger than that of film-mulching since 45 days after sowing. NAR of Ahnsankkae under non-mulching was smaller at seedling stage, 25~35 days after sowing, and at maturing stage, 66~76 days after sowing, but larger than that of film-mulching at flowering stage, 45~66 days after sowing (Fig. 5). NAR of two varieties were lowest at 25~35 days and highest at 14~25 days after sowing. Kim & Yang (1984) reported that NAR of rice was highest at early growth stage and lowest at late growth stage and Kim & Song (1975) reported that NAR showed varietal differences between indica and japonica types.

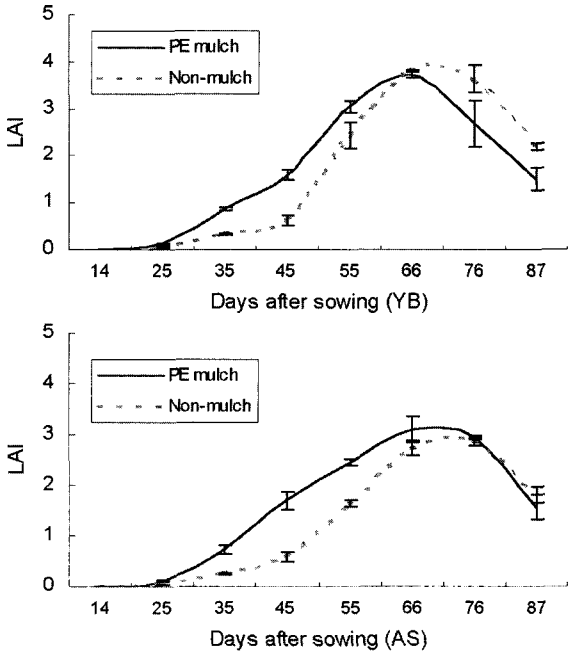

Fig. 4. LAI in PE film-mulching and non-mulching conditions of two sesame cultivars (top: Yangbaeckkae, bottom: Ahnsankkae).

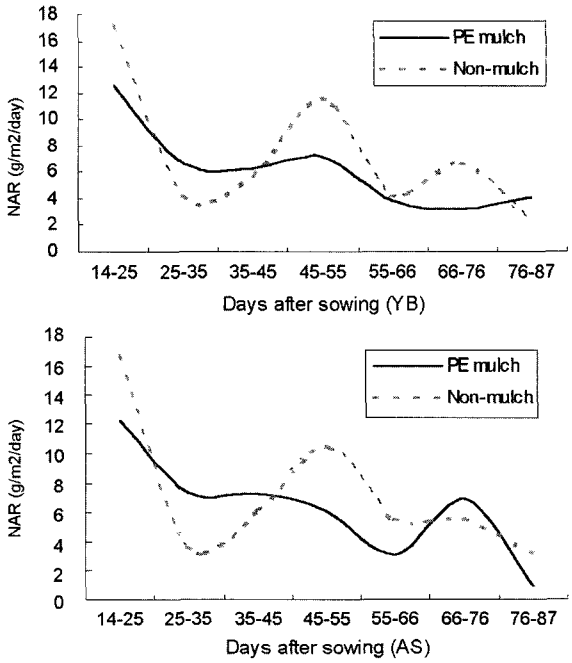

Fig. 5. NAR in PE film-mulching and non-mulching conditions of two sesame cultivars (top: Yangbaeckkae, bottom: Ahnsankkae).

CGR of two varieties showed distinct differences between film-mulching and non-mulching. CGR of Yangbaeckkae showed the peak at 45~55 days after sowing under film-

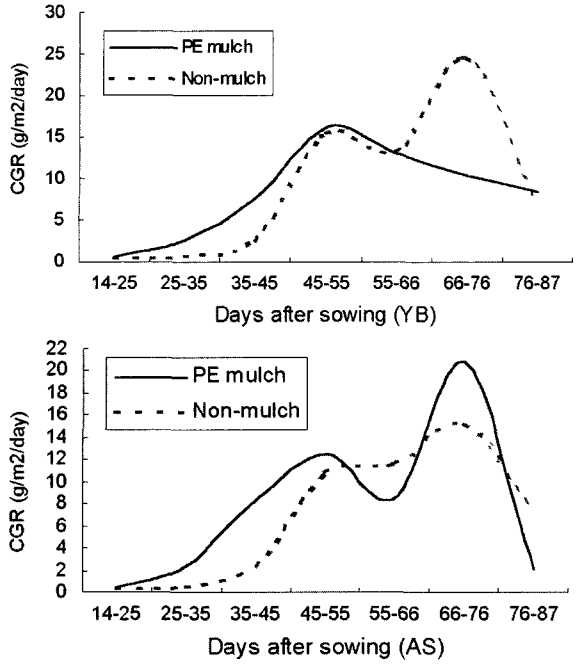

Fig. 6. CGR in PE film-mulching and non-mulching conditions of two sesame cultivars (top: Yangbaeckkae, bottom: Ahnsankkae).

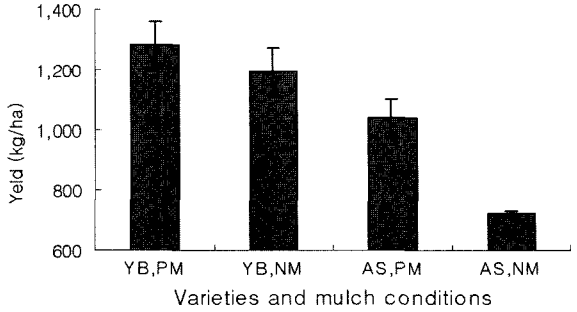

Fig. 7. Yield in PE film-mulching and non-mulching conditions of two sesame cultivars (YB: Yangbeackkae, AS: Ahnsankkae, PM: PE film mulching, NM: non-mulching).

mulching, but 66~76 days after sowing under non-mulching. CGR of Ahnsankkae showed the peak at 66~76 days after sowing under both condition of film-mulching and non-mulching. CGR under non-mulching for maturing stage, 66~76 days after sowing was higher in Yangbaeckkae, whereas lower in Ahnsankkae than that of PE film-mulching (Fig. 6). Kim & Song (1975) reported that CGR of rice was highest at heading stage ,and the increase of LAI promoted CGR and positively affected on dry matter production.

Yield of Yangbaeckkae under film-mulching and non-mulching was 1,180 and 1,100 kg/ha, respectively, and it was decreased by 7% under non-mulching compared with film-mulching. Yield of Ahnsankkae under film-mulching and non-mulching was 940 and 630 kg/ha, respectively, and it was decreased by 33% under non-mulching compared with film-mulching (Fig. 7). Consequently, yield of Yangbaeckkae under non-mulching was decreased less than that of Ahnsankkae because Yangbaeckkae showed smaller reduction of NAR at 25~35 days after sowing, and greater increase of NAR and CGR at 66~77 days after sowing than those of film-mulching. And the decrease of yield of Yangbaeckkae under non-mulching was caused by smaller LAI, NAR, and CGR from seedling to flowering stage, and lesser capsule per plant until 20 days after flowering than those of film-mulching.

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