Effect of rippled canopy on light competition between Soybean and Redroot pigweed (Amaranthus retroflexus) in Sole and Intercropping

Pershangi Hosseini\textsuperscript{a}, Goudarz Ahmdvand\textsuperscript{a}, Mostafa Oveisi\textsuperscript{b}, Hamid Rahimian Mashhadi\textsuperscript{b} and Hassan Alizadeh\textsuperscript{b}

Contact information: \textsuperscript{a} Department of Agronomy and Plant Breeding, Bu-Ali Sina University, Hamedan, Iran. \textsuperscript{b} Department of Agronomy and Plant Breeding, University of Tehran, Karaj, Iran. *Corresponding author email: hoseini.p@gmail.com

ABSTRACT
Field experiment was conducted to evaluate effect of canopy structure on growth analysis, light absorption and weed competition of two soybean cultivars in sole and mix cropping. A factorial design based on randomized complete block with three replications was carried out in field research station, University of Tehran, Karaj. Two soybean cultivars including Clark (tall) and Interprice (dwarf) were planted in sole and intercropping in competition with redroot pigweed at densities of 0, 2, 4 and 8 plant/m\textsuperscript{2}. Light absorption and canopy structure assessed in canopy closure. The results realized that, in mixed cropping Redroot pigweed had less CGR (4 g/m\textsuperscript{2}d) and less cumulative biomass (234 g/m\textsuperscript{2}) compared to sole cropping. Canopy surface in intercropping increased 20\% compared to the sole cropping and the light extinction is occurred in 60 cm of soybean high. Light absorption in the development time of canopy for Clark and Interprice were 84\% and 64\% respectively. This two cultivars supplementary complete each other for light absorption because of the height difference between them and inter specific competition dominated by intra specific competition.

Keywords: light competition, canopy structure, tall and dwarf cultivars

INTRODUCTION
Intercropping is one of the beneficial systems for achieving sustainable agriculture. A matchable mixed cropping is an effective approach for utilization environmental resources and it can be more useful than a single cropping (Fukai & Trenbath, 1993). In implementation of mixed cropping for sustainable systems should be noted that, compatible plants are those have the biggest difference in the use and uptake of resources (Vandermeer, 1989). Light in weed-crop ecosystem adjust many aspects of growth, development and competition, it can’t be saved and must be consumed immediately, so the principles for light competition is different from other sources. Ability of shading on adjacent plants and absorb more part of the radiation determine competitive ability of species (Stoller et al., 1987). Light inhibitory effect of one specie on another species is one of the main competition factors and affected by leaf area index and light extinction coefficient (Mclachlan et al., 1993). Canopy displays spatial arrangement of foliage on a plant population. In mixed canopy, light absorption affected by LAI, plant height, leaf area vertical distribution of species (Zand et al., 2004; Rajcan & Swanton, 2001). This study carry out to evaluate effect of tow soybean cultivars mix cropping with different growth characteristics (tall and dwarf) on redroot pigweed control and studying intercropping as a management tool in sustainable agriculture.
MATERIALS & METHODS
Field experiment was conducted in 2008 at research station of Tehran University in Karaj. The experimental design was a factorial arrangement based on Completely Randomized Block with three replications. Two soybean cultivars including Clark (tall) and Interprice (dwarf) were planted in sole and intercropping (one row Clark and the other Interprice) in competition with redroot pigweed at different density (0, 2, 4 and 8 plant/m\(^2\)). Soybean seeds planted manually in 60 cm between rows and 7 cm on the rows. At the same time weed seeds planted in different densities on both sides of rows. Plant’s sampling (0.5 m\(^2\)) for both crop and weed collected from 45 days after planting to the end of growing season. Leaf area meter used for measurement of LAI and dry biomass of plants weighted after placing them in 70 °C oven.

To measure canopy surface, since the canopy started to close until canopy closure, canopy of each plot three times (one per week) measured three times (weekly) with an area measurement tool (a textile with 0.5 meter width and 6 length) (Khwaja Hosseini, 1991).

In time of canopy closure, canopy structure divided in 30 cm’s layers and amount of sun radiation in top of canopy, different 30 cm’s layers and ground surface measured by Solarimeter (model: LICOR 191 SB LICOR INC.LINCOLN NE 685041) in noon and clear sky. Then LAI and biomass of each layer separately measured.

Model INTERCOM (Kropff et al., 1993) used for light competition and light absorption by every species in canopy closure, that is; in the canopy with compact LAI radiation from top to down decreases exponentially.

Light competition and light absorption in canopy closure for samples fitted by INTERCOM model (Kropff et al., 1993), that is; in the canopy with compact LAI, radiation from top to down decreases exponentially.

Experimental data were analyzed by SAS (ver. 9.1) and SigmaPlot (ver. 11) was used to fit models.

RESULTS AND DISCUSSION
Weed’s CGR and Biomass: Redroot pigweed in Interprice sole cropping (the dwarf cultivar) had the maximum of biomass cumulative (more than 400 g/m\(^2\)) in compare with Clark (the tall cultivar). Biomass cumulative of redroot pigweed in Clark was less than 300 g/m\(^2\). Also, redroot pigweed in mixed cropping had lowest cumulative biomass (234 g/m\(^2\)) (fig. 1). The maximum of redroot pigweed CGR in mixed cropping was 4 g/m\(^2\)d and happened in 70 days after planting, while the maximum CGR for sole cropping was 10 and 9 g/ m\(^2\)d and occurred in 75 and 85 days after cropping for Clark and Interprice respectively (fig. 1).

Canopy level increasing: In time of canopy closure, two soybean cultivars made a rippled canopy that had a wider surface compare to sole canopy. The rippled canopy could absorb more solar radiation and probably rise light efficacy. Also more radiation penetrate into the sides of canopy (Koocheki et al., 2010; Khwaja Hosseini, 1991). Intercropping canopy enhancement in weed free was 20 percent compare to sole cropping, and weed biomass showed 15 % decrease in high density.
Fig. 1- Pigweed cumulative dry matter and CGR in

sole and intercropping during the growth period.

Fig. 2- Cumulative LAI (left) and cumulative absorbed light (right) of two soybean cultivars in sole-and intercropping.

**LAI and light absorption:** LAI in Interprice was lower than Clark at al. LAI of both cultivar in intercropping compare to sole cropping decreased in 60 cm height and this reduce was more in down layers (fig. 2, left) because in mixed canopy down layers gets less light and, then leaves concentrate in up layer of canopy. Intercropping compare to sole absorbed more light in top layer of soybean canopy and extinction happened in height of 60 cm. However, soybean LAI decrease in down layer also less light was available for weed (fig. 2, left). Clark had maximum LAI and absorbed 84% of light, max absorbed light for Interprice was 65 percent of radiation. This tow cultivar for light absorption acted supplementary because of the height difference between them. In the other word, intra-species competition dominated inter-species competition and raised light absorption in intercropping (fig. 2, right). In mixed cropping of Corn and Bean light absorption was 20-50% more than sole cropping (Watiki et al., 1993).

**CONCLUSIONS**
1. Morphological differences between two cultivar of soybean rise canopy surface for receiving radiation, increase light’s absorb in soybean and decrease it in redroot pigweed.
2. Due to dominance of Clark (tall cultivar) more utility of this kind of canopy was for Clark than Interprice.
3. This kind of intercropping could be used as an ecological method to reduce weed competitive ability, decline using herbicide in IPM and sustainable agriculture.

REFERENCES CITED