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Evaluation of Growth Pattern, Seed and Flower Yield of Safflower Following Winter Crops.

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Abstract. In order to evaluation of growth pattern, seed and flower yield of safflower following winter crops in northwest of Iran an experiment was carried out at the Experimental farm of Agriculture College of Sanandaj Azad University during 2003-2004 and 2004-2005 growing season. Experiment design was Strip plot as complete block base with 3 replications. The treatments included: Sowing Pattern (1 row, 2 rows), Row spacing (50,60cm) and Plant distance (5 and 10 cm). The selected safflower cultivar was IL111 as early mature cultivar that planted in June 15. In this study some characters was measured included: total dry matter, leaf dry weight, stem dry weight, crop growth rate (CGR), relative growth rate (RGR), height plant, number of axillary's stem, flower yield and seed yield. The analysis's of growth pattern was showed that total dry matter was reached to maximum in 55 day after sowing in all treatments and that decreased. Also the maximum amount of CGR was achieved in the highest density namely, 2row planting, 50cm row spacing, 5cm plant distance. RGR was the maximum in the beginning of growth period (40 days after planting) and than decreased. Results of variance analysis in two year were showed that all characters investigated were affected significantly by treatment in the %5 and %1 levels. According of results, Plant height was increased when plant density increased. Also the most number of axillary's stem was achieved in 1row, 60 cm row spacing and 10cm plant distance. The highest seed yield was achieved as rate 1593.86 kg/ha in 2row planting, 50cm row spacing and 5 cm plant distance. In this study seed yield increased in 2row planting via 1row planting, 50cm row spacing via 60cm row spacing, 5cm plant distance via 10 cm plant distance in arrangement: 26.9, 14.26 and 85.99 %. Also the highest, flower yield was achieved in the same treatment, an arrangement: 204.13 kg/ha. According of results, plant distance had the most effects on the seed yield and flower yield. Following that it was sowing pattern and row spacing

Keywords: Safflower, Growth pattern, Yield, Double cropping, Sowing pattern.

1. Introduction

The solution of the food supply problem is raised as one of the fundamental problems for the independence of the countries and for general development of the national economy. In order to increase crop production in each country where the farming area is limited, it is necessary to increase a land utilization rate by introducing the double cropping system. Double cropping system in based on growing of different short growth period crop in different period on the same land in one year.

Double cropping of corn, sunflower, Safflower, soybean, sorghum, cotton and potato after harvesting of winter cereal is a popular practice in the most area of Iran. The benefits of double cropping included as: optimum usage of land, water, agricultural machine, increasing of income farmers, and obtain ecological benefit as: increasing biodiversity, maintaining the sustainability of agricultural production systems, breaking of pest and disease cycle, infiltration of soil , increasing of soil organic matter and decreasing weeds competition.

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Safflower is a suitable oilseed crop in the arid and semiarid region and well grown in the sunny and high temperature condition that occurred after harvest of winter cereal in the Iran. In addition to, it able to meets its water requirements by drawing moisture from deep in the subsoil. It also could improve the overall N use efficiencies of cropping systems and minimize nitrate leaching to groundwater. Early ripening (decreasing rosette stage period in the warm weather), possibility of less weed competition, resistance to drought and salinity conditions, are the other characters of safflower. Yield decreases of double cropping due to shorten period of growing season can minimizing as select suitable cultivar, sowing date and sowing density. Therefore, in order to obtain safflower with high yield and quality, it is essential to determine the suitable sowing dates, density and cultivars in double cropping.

2. Materials and methods

The experiment was conducted at the Experimental farm of Agriculture College of Sanandaj Azad University in the northwestern of Iran (35° 10′ 41″ N, 46° 59′ 16″ E, 1302 H) during 2003-2004 and 2004-2005 growing season. Experiment design was Strip plot as complete block base with 3 replications. The treatments included: Sowing Pattern (1 row, 2 rows), Row spacing (50,60cm) and Plant distance (5 and 10 cm). The selected safflower cultivar was IL111 as early-mature. Grain crop was a fore crop for safflower in both two years of study. Current practices were used for soil preparation. only in second year of study, experiment was conducted in a farm about 500 m above farm of first year, in order to prevent of soil born disease because safflower in very sensitive to them. The soil type was a clay loam with a pH of 7.5 and 0.66 % organic matter. N, P, K fertilizing was applied according soil testing in both year. Plot sizes were 5 m long and consisted of 6 rows. Seed were hand-planted with high density to achieve finally of considerable plant density in 15 June. Irrigation method was as furrowing and crop was kept from of weeds by hand hoeing when necessary. Pest controlled as spraying with diazinon in the beginning of head forming. Crop harvesting carried out 99-104 days after sowing in the 22 and 27 September an arrangement in 2004 and 2005.

Also in order to study growth pattern 4 plant selected and was cutted in each plot from 40days after sowing with 15 days interval. The fallowing parameters were investigated: total dry matter, leaf dry weight, stem dry weight, crop growth rate (CGR), relative growth rate (RGR), height plant, number of axillary's stem, flower yield and seed yield. Data were statistically analyzed using SAS software and to compare treatments means Duncan method were used.

3. Results and discussion

3.1. TDM

As in figure 1, accumulation of total dry matter in the beginning of growing season increased rapidly, due to present of suitable light, long day, high temperature and low competition, but after 55 day after sowing because of changing the mentioned condition and also closer canopy and falling the old leaves, it was decreased. TDM was the most in the highest density (a2b1c1). Azari and khajehpour (2000) were found that the highest TDM decreasing occurred in high plant density in the end of growing season.

3.2. CGR

According of figure 2 crop growth rate increased till 55 day after sowing and than decreased rapidly. It seems that shading of leaves and plant competition especially in high density and also hot temperature and high respiration in august are the causing of CGR decreasing. On the other hands it showed that falling the leaves and decreasing of temperature and infiltration of light within canopy after 70 day, CGR increased a little. In this study the high CGR was showed in the highest density.

Lebaschy and bakhtiari (2008) obtained the most TDM and CGR in 29p/m2.moadikhah and et al (2004) was achieved the highest and lowest CGR in arrangements as: 25×5 and 6×10 sowing pattern.

3.3. RGR

Relative growth rate was the most in 40 day after sowing, and than decreased, but in high densities amount of decreasing was more. It was concluded that due to decreases in present space within plant, closer canopy, high competition toward uptake of water, nutrition, light, RGR was decrease more in high density.

Pordadian and khajehpour (2007) were obtained the highest TDM, CGR and RGR in closer row distance as 20 cm.Lebaschy and bakhtiari (2008) obtained the most TDM, CGR and RGR in 29p/m2, but RGR was decreased rapidly in the end of season and therefore the highest RGR obtained in lowest density.

3.4. Plant height

According the results, plant height was affected significantly by treatment ($p \leq 5$ %). As showed in figure 4 the highest plant height related to lowest density (a1b2c2).of course it was expected that in double row sowing and closer row space plant height be more, it was concluded that due to less competition it complete the rosette stage in a few time and therefore the stem elongation stage occurred as early as, but in 2 row sowing it ś reverse.

3.5. Number of axillary's stem

The sowing pattern had the most effect on this variable, as in 2row sowing number of axillary's stem decreased significantly ($p \leq 5\%$). Here, the most axillaries stem in plant was achieved in lowest density (a1b2c2). Hence the axillaries stem was the most in the area unite (2 rows sowing). In addition to that every axillaries stem was produced a one head, it seems that both flower and seed yield may increase in high density. The same results were found by ozel, et al (2002), girase, et al (1980), Ahsanzade and zaraian (1999), Azari and khajehpour (2000).

3.6. Flower yield

This variable was affected significantly by treatments also. The highest flower yield was achieved in the highest density treatment equal to: 204.13 kg/ha.

Also the lowest yield obtained from 1row planting, 60cm row spacing and 10 cm plant distance as: 77.68. Since flower of safflower have different usage in dyeing industry, food and medicine in Iran, flower yield were recorded. Ozel et al (2004) were studied the effects of different intra-row spacing on flower yield of safflower in the turkey condition, and they reported significant difference between intra-row spacing , as the most flower yield was achieved in 5 cm spacing. Azari and khajehpour (2000) were achieved 419 kg/ha flower in 30 cm row spacing. There are few reports about flower yield in safflower.

3.7. Seed yield

As seen in figure 7 the seed yield affected significantly by treatments. Based on two year data, the highest seed yield was obtained in 2row planting, 50cm row spacing and 5 cm plant distance as rate 1593.86 kg/ha. In this study seed yield increased in 2row planting via 1row planting, 50cm row spacing via 60cm row spacing, 5cm plant distance via 10 cm plant distance in arrangement: 26.9, 14.26 and 85.99 %.

Therefore it was concluded that plant distance had the most effect on the seed yield and following that sowing pattern and row spacing. Jelali and Bahrani (2001) reported that double row sowing was increased seed yield in three safflower cultivars in southern Iran. Also Koutroubas et al (2004) were observed that not only competition within plant decreased, but also seed yield increased when double row sowing conducted and row spacing decreased. Cobley, et al (1997) was found the most yield as: 2.4 t/ha from 25 cm row spacing in Italy. Ozel, et al (2004) in two year study were observed that the highest seed yield was obtained in the 5 cm plant distance in turkey.

Jelali and Bahrani (2001) reported that double row sowing was increased seed yield in southern Iran, and also they suggested that it is very suitable in saline soil. Salera (1996) was found that the most yields obtained in 40 p/m^2.

4. Conclusion

results of this study showed that double cropping of safflower followed winter cereal was successful in north western of Iran and also the highest seed yield, flower yield, TDM, CGR and RGR and were achieved in 2row planting, 50cm row spacing and 5 cm plant distance. Also it was concluded that plant distance had the most effect on the variables and following that sowing pattern and row spacing. Finally the period of growing safflower was ended in 99-104 days after sowing in the 22 and 27 September an arrangement in 2004 and 2005 and seed bed was prepared rapidly for sowing winter cereals.

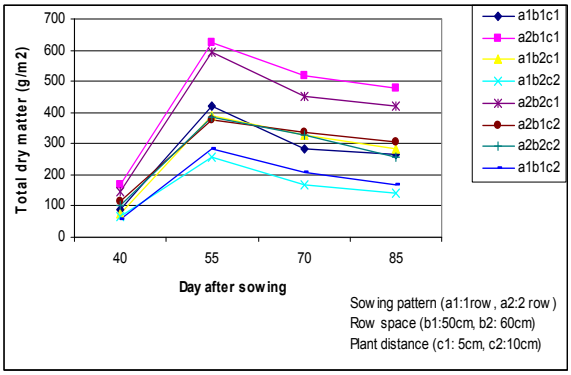

Figure 1: total dry matter variation in different density.

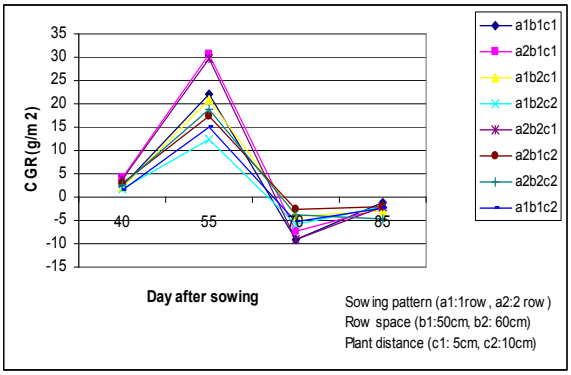

Figure 2: crop growth rate variation in different density.

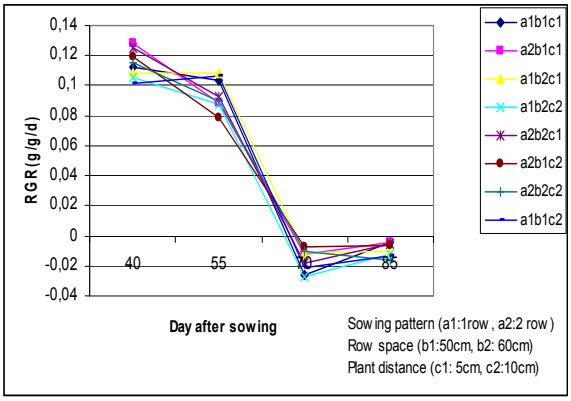

Figure 3: Relative growth rate variation in different density.

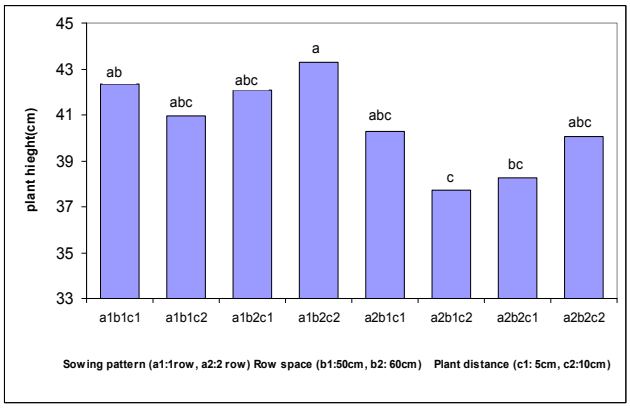

Figure 4: plant height variation in different density.

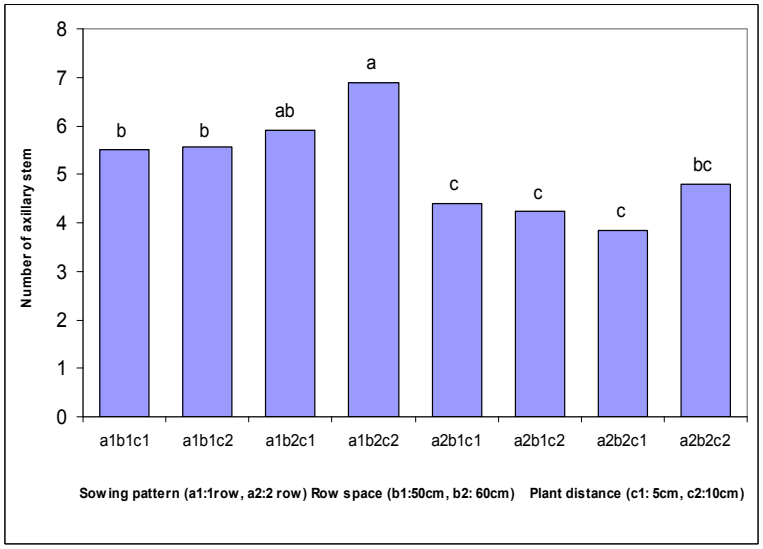

Figure 5: number of axillaries stems variation in different density.

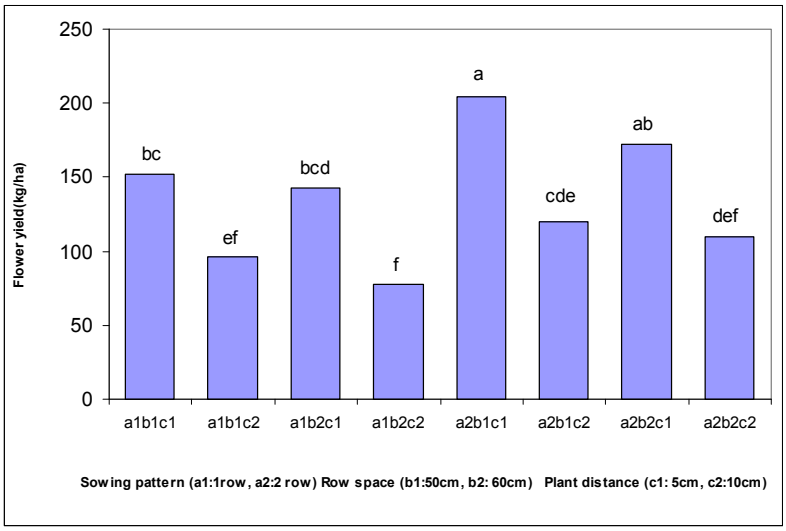

Figure 6: flower yield variation in different density.

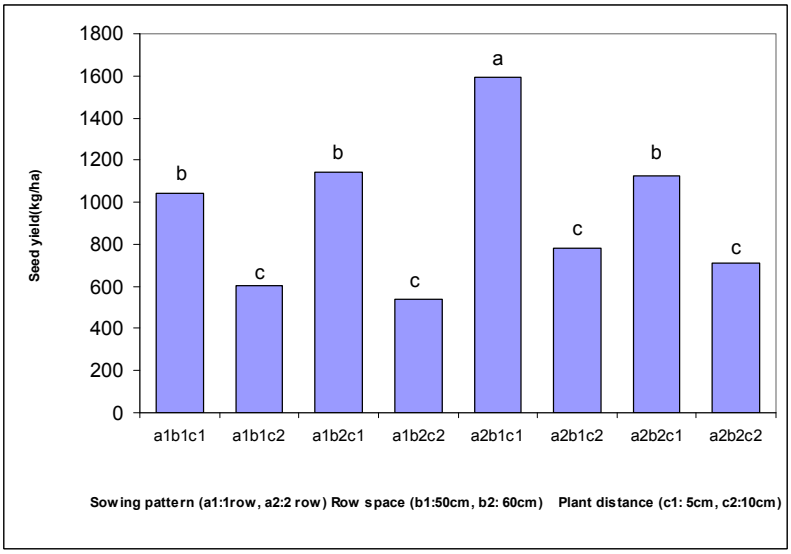

Figure 7: seed yield variation in different density.

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