Time of bean sowing time related to marigold in different intercropping systems could be increase their yields

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Abstract: In order to study effect of sowing date and planting pattern on yield of marigold and bean in intercropping systems a field experiment was conducted at the Agricultural Research Station of Islamic Azad University of Tabriz, Iran, during 2011. The studied treatments were sowing date of bean related to marigold (10 days earlier, simultaneously and 10 days after than marigold), marigold varieties (kampar and porpar), planting patterns of marigold-bean (3:3 as strip intercropping, 1:1 as row intercropping and sole-cropping of both crops). 100 seeds weight of bean ranged from 37 g in earlier sowing of bean than marigold, porpar variety as row intercropping up to 46.4 g in bean sole-cropping. Yield reduction values in treatments of bean earlier cropped related to marigold cv. kampar as strip intercropping and bean delayed intercropped to marigold cv. porpar as row intercropping were 56% and 44%, respectively, compared to the control. In both varieties with delayed cropping of bean related to marigold essential oil yield increased, significantly. Bean-marigold intercropping led to significant reduction in weeds biomass. When bean intercropped simultaneously or 10 days after marigold varieties, LER were >1. Simultaneous or delayed intercropping of bean with marigold by farmers could be recommended.
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Key words: LER, Essential oil yield, Variety, Yield reduction.

1. Introduction

Intercropping is an agricultural practice of cultivating two or more crops in the same farm and at the same cropping season (Andrews and Kassam, 1976). When two or more crops are grown together, each must have adequate space to maximize cooperation and minimize competition between the crops. To accomplish this, spatial arrangement, plant density, maturity dates of the crops and plant architecture must be considered (Silva et al., 2009).

Marigold is a herbaceous plant. It belongs to the genus of *Calendula*, in the family of Asteraceae. It has nearly 20 annual and/or perennial species. The most commonly cultivated and used member of the genus is the marigold (*Calendula officinalis* L.) (Omidbeigi, 2009). Its extract has in some way refreshing and comforting effects (Bolderston et al., 2006). On a global basis, weeds are considered to be responsible for about 10% reduction of crop yield (Froud-Williams, 2002). Marigold is a poor competitive plant with weeds and its ability to compete with weed in Iran relies heavily on the application of herbicides (Omidbeigi, 2009). Weeds declines many of crops yields and it lead to higher cost in agricultural productions (Wanjari et al., 2001). There is need to develop the best cropping pattern to increase crop production. It has been shown that intercropping helps in increasing farm income (Kalra and Gangwar, 1980), while Mandal et al. (1985) reported that intercropping of wheat, mustard and chickpea decreased number of fruiting branches per plant, number of pods per plant and 1000 seed weight. The aim of the research was to study effect of sowing date and planting pattern on yield of marigold and bean (*Phaseolus vulgaris*) in intercropping.

Materials and Methods

The field experiment was conducted on a sandy loam soil at the Agricultural Research Station of Islamic Azad University of Tabriz, Iran, during 2011 growing season. The experimental field had been in a potato-barley rotation cycle for the last two years. The experimental area was ploughed in the fall and manured with 10 t ha^{-1}. Field were cultivated, disked, furrowed and then plotted in spring before sowing the seeds. Fertilizers used, in spring and before sowing, were 150, 100 and 15 kg ha^{-1} of ammonium phosphate, potassium sulfate and urea, respectively. The studied treatments were sowing date of bean related to marigold (D_1=10 days earlier, D_2=simultaneously and D_3=10 days after than marigold), marigold varieties (V_1=kampar and V_2=porpar), planting patterns of marigold-bean (I_1=3:3 as strip intercropping, I_2=1:1 as row intercropping and I_3=sole-cropping of both crops).

All data were statistically analyzed based on randomized complete block design, using MSTAT-C software. The means of the treatments were compared using the least significant difference test at * $P < 0.05$.

Results and Discussion

Effect of studied factors on 100 seed weight (HSW) and grain yield of bean, dry flower yield, biomass and essential oil yield of marigold and weeds biomass were significant at 1%, and land

equivalent ratio (LER) at 5% probability levels (Table 1). HSW of bean ranged from 37 g in earlier sowing of bean than marigold, porpar variety as row intercropping up to 46.4 g in bean sole-cropping. When bean was delayed cropped to marigold cv. kampar as strip intercropping, produced seeds with HSW of same as single cropping (Fig. 1). Sowing date influences stem height, time to ripening, seed size and finally it's yield (Khanal et al., 2004).

Means comparison of bean grain yield indicated that there is a significant difference among treatments, and then sole-cropping of bean lead to produce higher yield (81 g m^{-2}). Yield reduction values in treatments of bean earlier cropped related to marigold cv. kampar as strip intercropping and bean delayed intercropped to marigold cv. porpar as row intercropping were 56% and 44%, respectively, compared to the control (Fig. 2). In an experiment conducted by Onuh et al. (2011) on mung bean/melon/maize intercrop, mung bean mono-cropping resulted in higher leaves number and grain yield.

Mono-cropping of marigold caused to dry flower yield improvement of marigold (109 g m^{-2}). In simultaneously or earlier cropping of bean, marigold flower yield decreased significantly (Fig. 3). In delayed cropping of bean related to marigold, kampar variety as strip or row intercropped systems marigold had greater above-ground biomass than other treatments (Fig. 4). All treatments had statistically same essential oil percentage (2.8%) under experiment conditions. While, essential oil yield of marigold had same trend to its dry flower yield. Essential oil yield values increased from 1.32% in all intercropped treatments of porpar variety up to 3.05% and 2.57% in mono-cropping of porpar and kampar varieties, respectively. In both varieties with delayed cropping of bean related to marigold essential oil yield increased, significantly (Fig. 5), that was not un-expected.

Table 1. Effect of sowing date and planting pattern on yield of marigold and bean in intercropping.

SV		Bean		Marigold			Weeds	Intercropping index
	df	100 seeds weight	grain yield	dry flower yield	biomass	essential oil yield	biomass	LER
Replication	2	84.48*	800.12*	540.23**	54.45	58.58	81.77	31.90
Treatment	14	109.00**	1200.12**	58.11**	129.25**	460.46**	423.12**	127.66**
Error	28	20.19	228.28	11.11	29.22	49.25	33.33	36.35
CV (%)	-	13.00	20.19	18.35	-	25.11	19.00	23.23

*: P<0.05 **: P<0.01

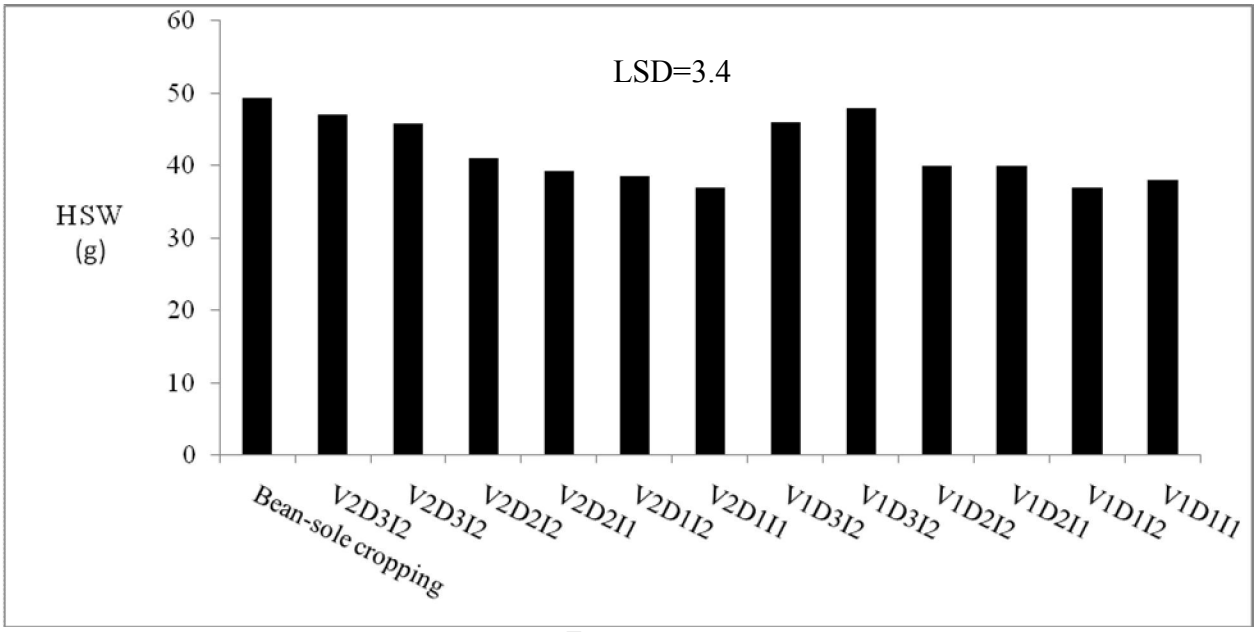

Fig. 1. Effect of sowing date and planting pattern on 100 seeds weight of bean.

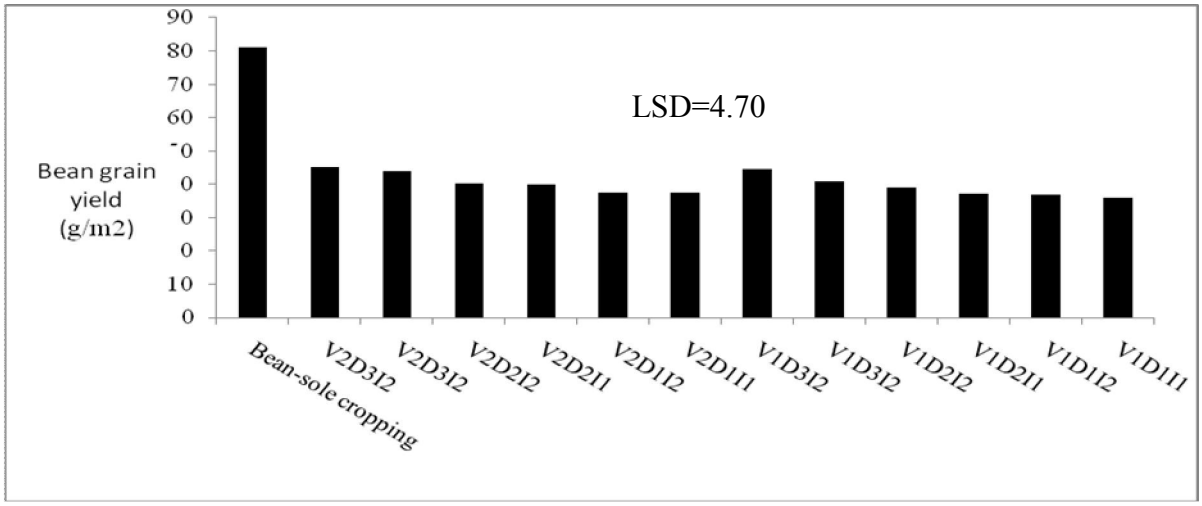

Fig. 2. Effect of sowing date and planting pattern on grain yield of bean.

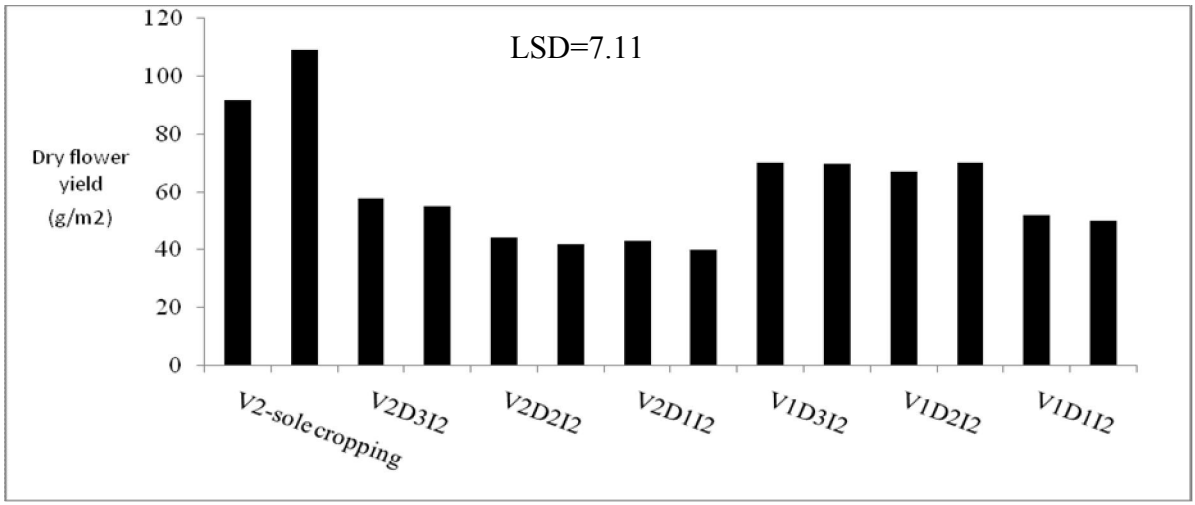

Fig. 3. Effect of sowing date and planting pattern on dry flower yield of marigold.

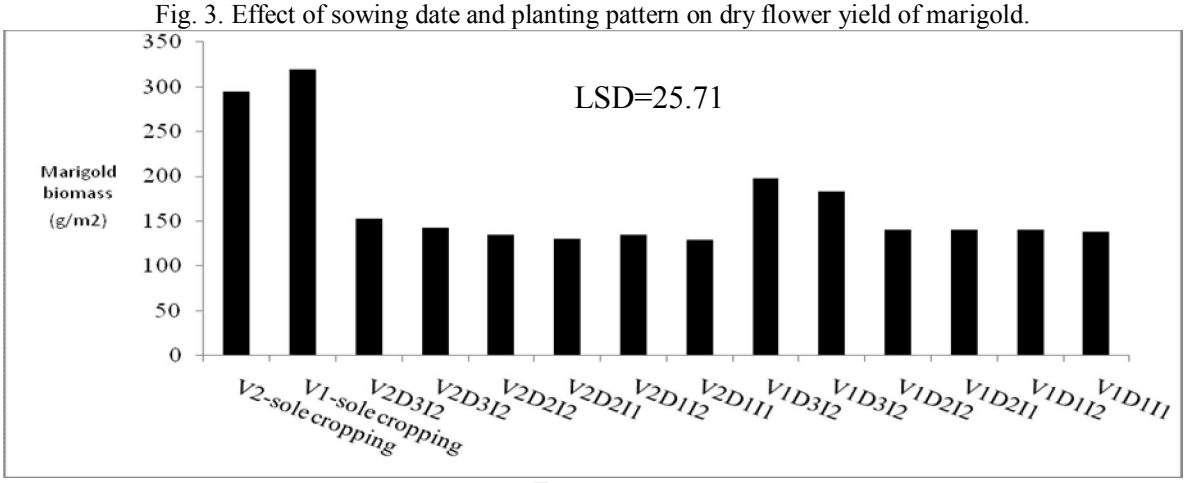

Fig. 4. Effect of sowing date and planting pattern on marigold biomass.

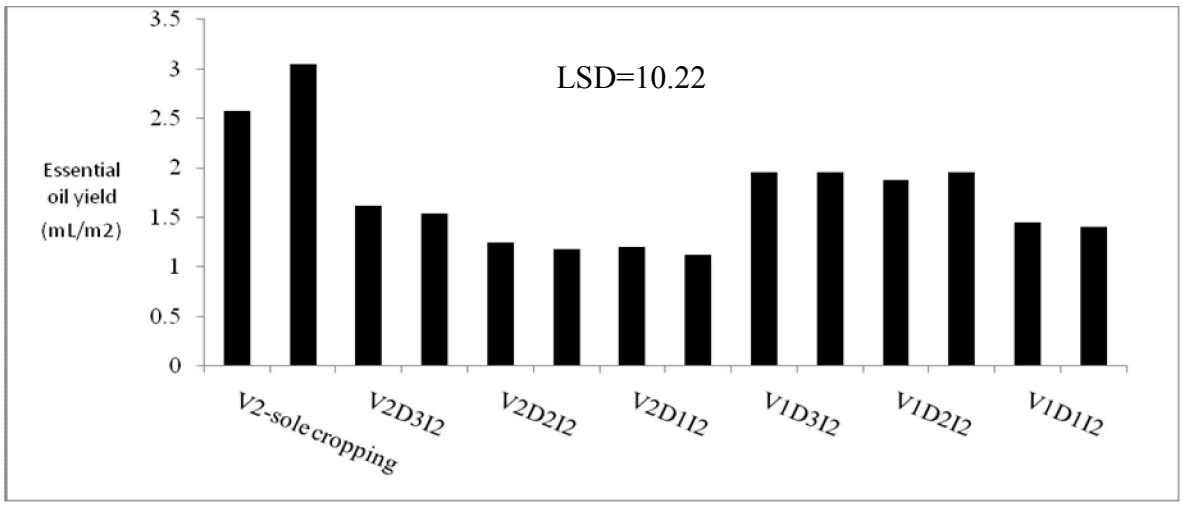

Fig. 5. Effect of sowing date and planting pattern on marigold essential oil yield.

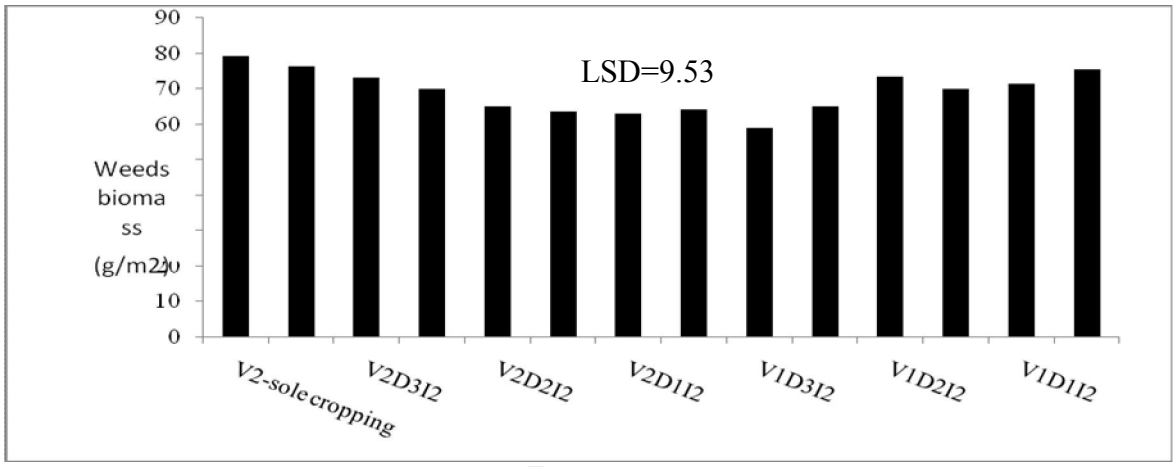

Fig. 6. Effect of sowing date and planting pattern on weeds biomass.

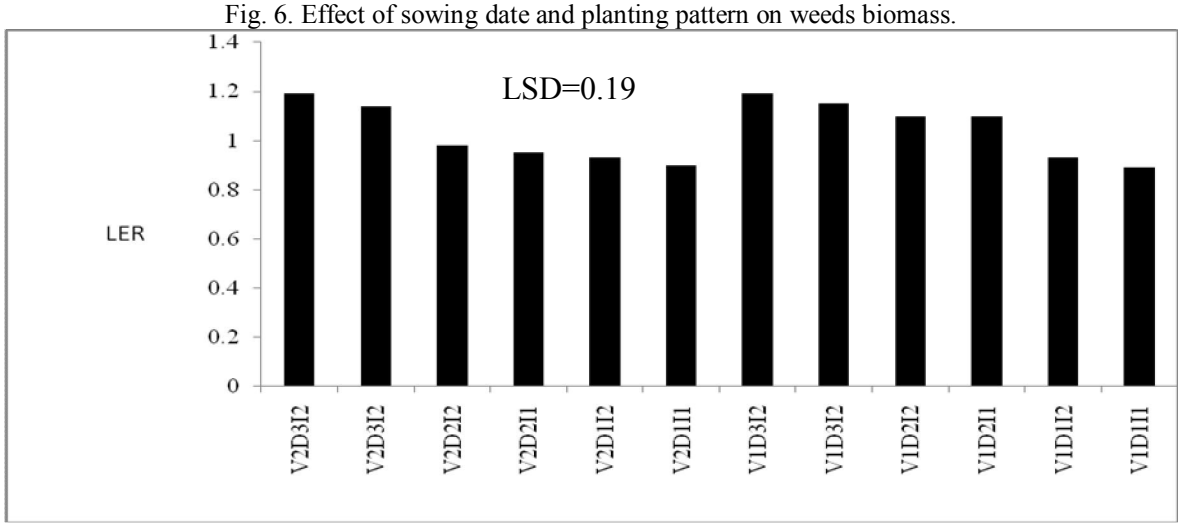

Fig. 7. Effect of sowing date and planting pattern on land equivalent ratio.

Both marigold cultivars indicated same compatibility power against weeds. Bean-marigold intercropping led to significant reduction in weeds biomass. Also, weeds biomass decreased 0.014 g m^{-2} per each day delaying in bean sowing (Fig. 6). Odhiambo and Agria (2001) resulted that weeds population and biomass reduced in all intercropping systems. Lowest weed dry weight was observed on 20 and 40 canola plants m^{-2} and 60 bean plants m^{-2} (5.64 and 6.96 g m^{-2}) respectively; and highest weed dry weight was achieved in sole canola with 20 and 40 plants m^{-2}.

Gharineh and Moosavi, (2010) and Leibman and Dyck (1993) reported that weed dry weight will decrease in intercropping treatments comparing to sole cropping. Morphological and capability of faba bean in competition with other crops showed most reasonable effects on reducing weed dry weights. Intercropping of Triticale and faba bean reduces weed population (Sobkowiz, 2006). When bean intercropped simultaneously or 10 days after marigold varieties, LER were >1. Darbaghshahi et al. (2009) reported that LER in saffron-chamomile intercropping due to higher water and nutrient extrapolation improved.

Conclusion

Based on the results, simultaneous or delayed intercropping of bean with marigold by farmers could be recommended.

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