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ORIGINAL ARTICLE

Evaluation of yield, yield components and oil production of Dragon's head (*Lallemantia iberica* Fish. et Mey.) in different patterns of intercropping with Dill (*Anethum graveolens*)

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ABSTRACT

In order to evaluate the effects of different intercropping patterns of Dragon's head and Dill on yield, yield components and oil production of Dragon's head, an experiment was conducted at the Research Farm of the Faculty of Agriculture, University of Tabriz, Tabriz, Iran in 2015. The experiment was arranged in RCBD design with seven treatments and three replications. Intercropping patterns included; pure stand of dill variety dukat, pure stand of dill variety super dukat, pure stand of Dragon's head, additive intercropping of optimal density of Dragon's head + 25%, 50% and 75% of optimum density of dill variety dukat, additive intercropping of optimal density of Dragon's head + 25%, 50% and 75% of optimum density of dill variety super dukat. Results showed that sole Dragon's head produced the highest grain yield and Capsule numbers and Harvest index. Among the intercropping systems, additive intercropping of optimal density of Dragon's head + 50% of optimum density of dill variety dukat recorded the highest oil yield, between patterns intercropping additive intercropping of optimal density of Dragon's head + 25% of optimum density of dill variety dukat recorded highest capsule number , grain yield, harvest index.

Key words: Dill, Dragon's head, intercropping, oil production, yield.

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INTRODUCTION

In recent years, a trend in agricultural production systems has changed towards achieving high productivity and promotes sustainability over time. Farmers are developing different crop production systems to increase productivity and sustainability since ancient times. This includes crop rotation, relay cropping and intercropping of major crops with other crops. Intercropping, the agricultural practice of cultivating two or more crops in the same space at the same time is an old and commonly used cropping practice which aims to match efficiently crop demands to the available growth resources and labor. The most common advantage of intercropping is the production of greater yield on a given piece of land by making more efficient use of the available growth resources using a mixture of crops of different rooting ability, canopy structure, height, and nutrient requirements based on the complementary utilization of growth resources by the crops [1]. Nitrogen fixing legumes generally do not need nitrogen fertilizer, whereas, the non-legumes requires additional mineral nitrogen for optimum growth. Besides its own nitrogen requirement, legumes may contribute additional nitrogen to the soil, which can be used by the other crop in the intercrop or the succeeding crops. Higher nutrient uptake and better water use efficiency have also been suggested [2, 3]. Intercrops often reduce pest incidence and improve forage quality by increasing crude protein yield of forage. These include risk of crop loss due to adverse

environmental conditions, need for balanced diet, and the desire to optimize the use of labor and to optimize the use of land. The advantage is often expressed as a land equivalent ratio (LER). LER greater than one indicates that more sole cropped land than intercropped is required to produce a given amount of product.

Dill (*Anethum graveolens* L.) is an annual herb used as carminative, and antispasmodic in medicine [4, 5] and its essence has an inhibitory effect on stored potatoes sprouting [6]. Catizone *et al*. [7] reported that intercropping between annual dill (*Anethum graveolens* L.), and perennial clary sage (*Salvia sclarea* L.) improved the efficiency of cropping systems. Carrubba *et al*. [8] indicated that the presence of dill exerted residue in the soil had a significant effect on fennel seed yields at following years.

Dragon's head (*Lallemantia iberica* Fish. et Mey.) is an annual herb that belongs to Lamiaceae family and spreads in southwestern Asia and Europe [9]. It grows well in arid zones and requires a light well-drained soil [10]. Dragon's head is a valuable species, i.e. all plant parts (leaves or seeds) can be economically used [11]. However, it is mainly cultivated for its seeds that contain about 30% oil with iodic index between 163 and 203. These seeds are used traditionally as stimulant, diuretic and expectorant as well as in food [12].

Due to the lack of relevant information, the present research was conducted to determine the effects of intercropping patterns of Dill and Dragon's head on yield and yield components and oil production of Dragon's head.

MATERIALS AND METHODS

Site description and experimental design

The field experiment was conducted in 2015 at the Research Farm of the University of Tabriz, Iran (latitude 38°05_N, longitude 46°17_E, altitude 1360 m above sea level). The climate of research area is characterized by mean annual precipitation of 285 mm, mean annual temperature of 10℃, mean annual maximum temperature of 16.6℃ and mean annual minimum temperature of 4.2℃. The experiment was arranged in a Randomized Complete Block Design, with three replications and nine treatments. The treatments were represented by the following; different planting patterns treatment: pure stand of dill variety dukat, pure stand of dill variety super dukat, pure stand of Dragon's head, additive intercropping of optimal density of Dragon's head + 25%, 50% and 75% of optimum density of dill variety dukat, additive intercropping of optimal density of Dragon's head + 25%, 50% and 75% of optimum density of dill variety super dukat. All plots were irrigated immediately after sowing.

Measurement of traits

To specify plant heights, number of capsule, 1000 grains weight and oil yield, ten plants were randomly selected from the middle of the plots and then, they were measured. Also to determine of grain and biological yield an area equal to 1 m^2 was harvested from middle part of each plot considering marginal effect. Harvested plants were dried in 25℃ and under shadow and air flow then grains were separated from their remains by threshing.

Statistical analysis

Statistical analysis of the data was performed with MSTAT-C software. Duncan multiple range test was applied to compare means of each trait at 5% probability.

RESULTS AND DISCUSSION

Statistical analysis of the data indicated that different intercropping patterns had significant effect on capsule number, grain yield, and harvest index and oil yield of Dragon's head (Table 1). Maximum Capsule number (102.01) was obtained in additive intercropping of optimal density of pure stand of Dragon's head. Minimum Capsule number was recorded in the additive intercropping of optimal density of Dragon's head + 75% of optimum density of dill variety super dukat (Figure 1). Production of Higher capsule numbers per plant and lateral stem in sole Dragon's head might be attributed to no inter-specific competition. Similar results are reported by Azim Khan *et al* [13].

Table 1. Analysis of variance of selected parameters of Dragon's head affected by intercropping patterns

SOV	df	Capsule number	Grain yield	Biological yield	Harvest index`	grain weight	Oil yield
Block	2	206.333	371.762	2635.190	15.476	1.002	15.476
Intercropping	6	181.651*	650.984**	1342.095ns	75.984**	0.88ns	58.38**
Error	12	39.722	69.817	571.19	4.865	0.556	10.976
(CV)%		7.02	7.01	7.36	5.99	18.63	8.2

Ns=Non significant; * and ** = Significant at 5% and 1% probability level, respectively.

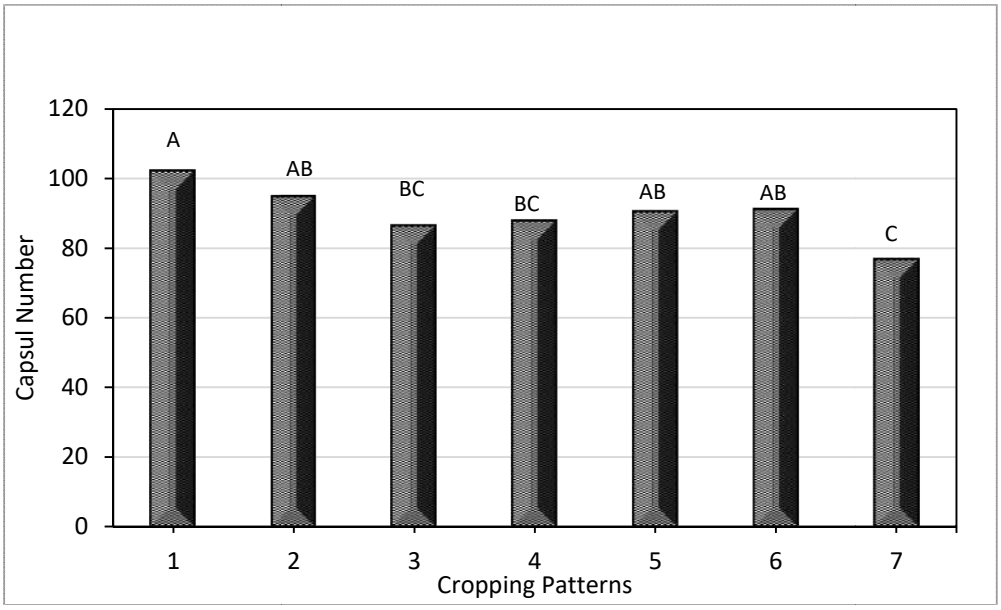

Fig. 1. Mean comparison of Dragon's head capsule number in different patterns of culture. 1- 7: respectively, pure stand of Dragon's head, additive intercropping of optimal density of Dragon's head + 25%, 50% and 75% of optimum density of dill variety dukat, additive intercropping of optimal density of Dragon's head + 25%, 50% and 75% of optimum density of dill variety super dukat.

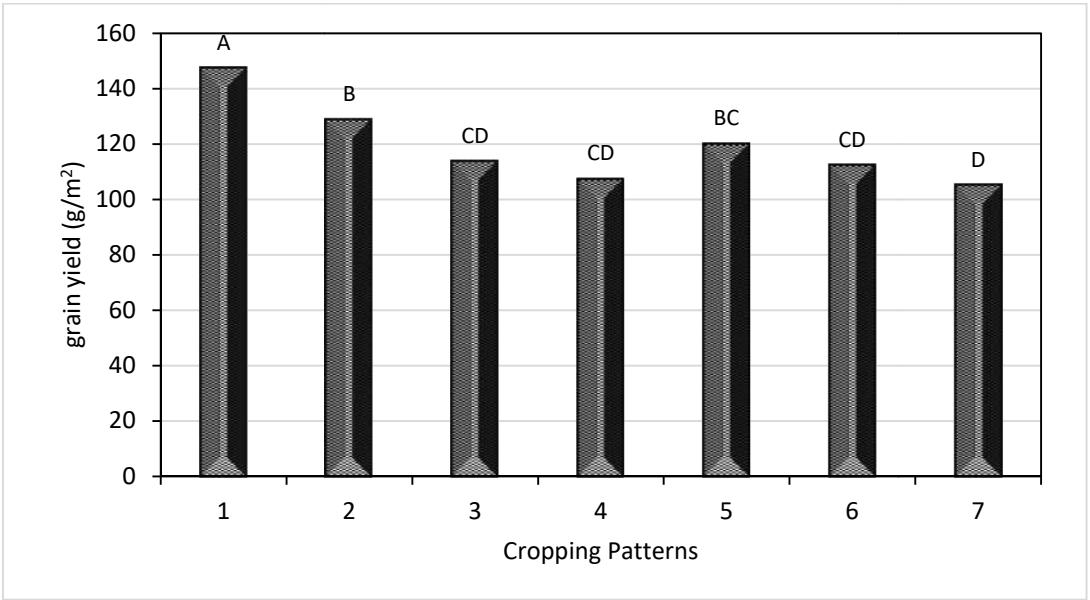

Fig. 2 . Mean comparison of Dragon's head grain yield in different patterns of culture. 1-7: (respectively, pure stand of Dragon's head, additive intercropping of optimal density of Dragon's head + 25%, 50% and 75% of optimum density of dill variety dukat, additive intercropping of optimal density of Dragon's head + 25%, 50% and 75% of optimum density of dill variety super dukat.

Statistical analysis of the data indicated that different intercropping patterns had significant effect on Grain yield of Dragon's head (Table 1). Maximum Grain yield (147.3g.m^{-2}) was obtained in additive intercropping of optimal density of pure stand of Dragon's head. Minimum Grain yield was recorded in the additive intercropping of optimal density of Dragon's head 75% of optimum density of dill variety super dukat (Figure 2).

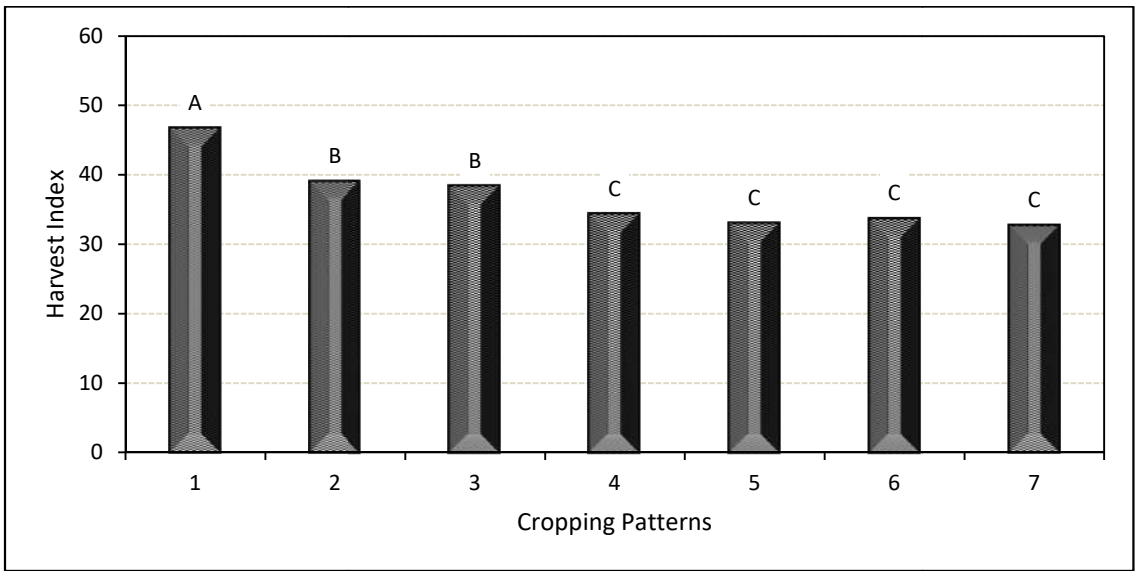

Fig. 3. Mean comparison of Dragon's head harvest index in different patterns of culture. 1-7: respectively, pure stand of Dragon's head, additive intercropping of optimal density of Dragon's head + 25%, 50% and 75% of optimum density of dill variety dukat, additive intercropping of optimal density of Dragon's head + 25%, 50% and 75% of optimum density of dill variety super dukat.

Statistical analysis of the data indicated that different intercropping patterns had significant effect on Harvest index of Dragon's head (Table 1). Maximum harvest index (46.67) was obtained in additive intercropping of optimal density of pure stand of Dragon's head. Minimum Harvest index was recorded in the additive intercropping of optimal density of Dragon's head + 75% of optimum density of dill variety dukat, additive intercropping of optimal density of Dragon's head + 25%, 50% and 75% of optimum density of dill variety super dukat (Figure3).

Jahani *et al*. [14] reported the highest harvest index of lentils in monoculture treatment of this plant. In experiments conducted by Tavasoli *et al*. [15] to investigate intercropping millet (*Panicum miliaceum*) and beans, also the highest harvest index of beans was obtained in the monoculture of beans.

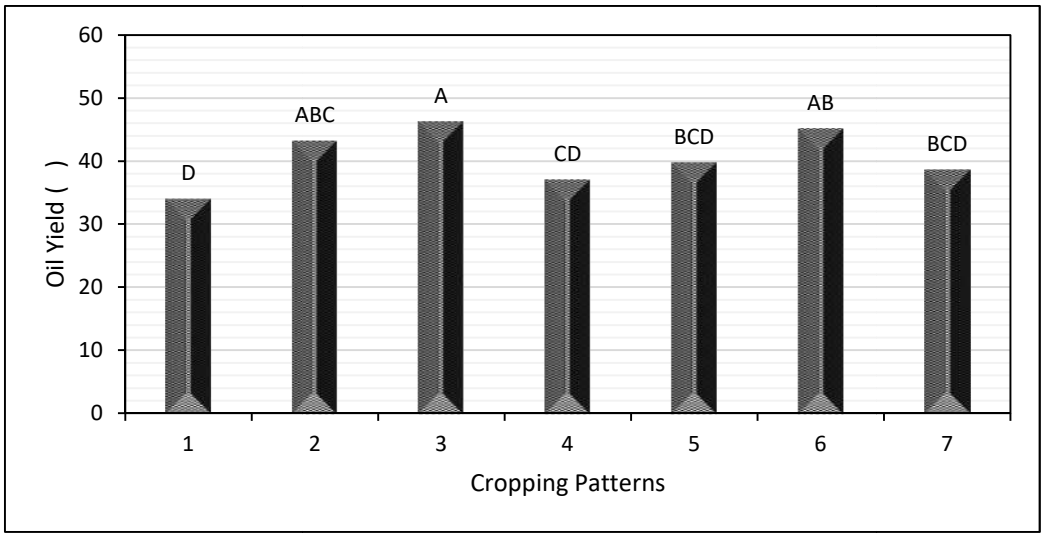

Fig. 4 . Mean comparison of Dragon's head oil yield in different patterns of culture. Effect of different patterns of intercropping on oil yield of Dragon's head ; 1-7: respectively, pure stand of Dragon's head, additive intercropping of optimal density of Dragon's head + 25%, 50% and 75% of optimum density of dill variety dukat, additive intercropping of optimal density of Dragon's head + 25%, 50% and 75% of optimum density of dill variety super dukat.

Statistical analysis of the data indicated that different intercropping patterns significant effect on, Oil yield of Dragon's head (Table 1). Maximum Oil yield (46.26g.m^{-2}) was obtained in additive intercropping of optimal density of 50% optimum density of dill variety dukat. Minimum Oil yield was recorded in the pure stand of Dragon's head (Figure 4). In other research Mirza *et al*. [16] found that the maximum clary sage oil content was obtained at the end of the blossom period.

CONCLUSION

Intercropping Dill with Dragon's head caused significant reductions in Dragon's head yield due to competition. Better grain yield was obtained in plots pure stand of Dragon's head and better grain yield was obtained in plots 50% of optimum density of dill variety dukat.

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