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Changes in yield and yield components of two sweet basil cultivars in response to different intercropping patterns with corn

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ABSTRACT: An experiments were carried out based on randomized complete blocks design with three replications in 2014 and 2015, to investigate the influence of different intercropping patterns between sweet basil and corn plants on yield and yield components of sweet basil cultivars. The treatments were sweet basil cultivars sole cropping (40 plants m^{-2}) and the additive intercropping of sweet basil cultivars + corn (20 + 8, 30 + 8 and 40 + 8 plants m^{-2}). Results revealed that number of branches and grains per plant, grain and biological yield in both sweet basil mubarake and Italian large leaf cultivars were decreased with increasing this plants density in intercropping with corn. However, in both mubarake and Italian large leaf cultivars grain weight and harvest index were improved in intercropping with corn plants. Number of secondary branches, number of grain and yield of Mubarake cultivar were significantly more than that of Italian large leaf cultivar.

Keywords: corn, grain weight, intercropping patterns, sweet basil, yield

INTRODUCTION

Intercropping is one of the most common practices used in sustainable agricultural systems which have an important role in increasing the productivity and stability of yield in order to improve resource utilization and environmental factors (Alizadeh *et al.* 2010). Intercropping, the simultaneous growing of two or more species in the same field for a significant period of their growth, is known to increase yield compared to sole crops (Bedoussac and Justes, 2010). 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 (Andrew and Kassam, 1976).

Maize (*Zea mays* L.), which is one of the most important cereal crops grown in Africa (Ayeni, 1987), features prominently in inter-cropping systems involving legume and non-legume crops such as soybean, cowpea, cassava, yam, etc. Maize is used for human food, livestock feed and as a source of industrial raw material for the production of oil, alcohol and starch. Sweet basil (*Ocimum basilicum* L.) is considered an important medicinal and aromatic plants. Its importance is mainly due to its several uses in pharmaceutical and food industries, which its leaves contain essential oils used for medicinal purposes (widely used in traditional medicines) (Ntezurubanza *et al.* 1986). Secondary metabolites from *Ocimum* species possess exceptional biological activity and have antioxidant (Kwee and Niemeyer, 2011) and antimicrobial (Annand *et al.* 2011), bactericidal (Haniff *et al.* 2011), repellent (Nerioet *et al.* 2010), anticonvulsant (Freire *et al.* 2006), chemo preventive and radioprotective effects (Gajula *et al.* 2009).

The genus *Ocimum* (family Labiatae) includes at least 60 species and numerous varieties (Sirvastava, 1982). The recurring polymorphism determines a large number of subspecies that produce essential oils with varying chemical composition. Iran has a long medical tradition and traditional learning of plant remedies (Ghorbani, 2005). Besides serving medical and cultural functions, medicinal plants have also an important economic role across the country. The planting area of medicinal plants is about 166,527 ha which contains nearly 1% of total planting area in Iran (Koocheki *et al.* 2004). In this research we investigate the changes in yield and yield components of sweet basil cultivars affected by different intercropping patterns with corn plants.

MATERIALS AND METHODS

In order to study the effects of different intercropping patterns between sweet basil and corn plants on yield and yield component of sweet basil cultivars a experiment using randomized complete blocks design with three replications was conducted during 2014-2015 at the research farm of the faculty of agriculture, university of Tabriz, Iran (38°5N, 46°E). In this study, different intercropping systems were including: sweet basil cultivars sole cropping (40 plants m^{-2}) and the additive intercropping of sweet basil cultivars + corn (20 + 8, 30 + 8 and 40 + 8 plants m^{-2}).

Seeds of both sweet basil cultivars and corn plants were treated with 2 g kg^{-1} benomyl and sown in a sandy loam soil. Each plot consisted of 6 rows of 2.5 m length, spaced 50 cm apart. All plots were irrigated immediately after sowing. Subsequent irrigations were carried out every 7 days. Hand weeding of the experimental area was performed as required.

At maturity, the plants of both cultivars in 1 m^{-2} of each plot were harvested and branch and grain number per plant, mean 1000 grain weight, grain yield, biological yield and harvest index were determined

All the data were analyzed on the basis of experimental design, using SAS 9.3 software. The means of each trait were compared according to Duncan multiple range test at $P \leq 0.05$.

RESULTS

Analysis of variance of the data indicated that effects of different intercropping patterns between corn and sweet basil plants on number of branch, number of grain weight, grain yield, biological yield and harvest index was significant (Table 1).

Table 1: Analysis of variance of the data on number of branch, grain yield and yield component, biological yield and harvest index of sweet basil plants in intercropping to corn.

		Mean square					
S.O.V	**df**	**Number of branches**	**Number of grain**	**grain weight**	**Grain yield**	**Biological yield**	**Harvest index**
Block	2	0.6193	4662.35	0.00071	1017.39	51049.09	9.84
Treatment	7	19.050^{**}	287516.23^{**}	0.1105^{**}	126396.42^{**}	3827356.11^{**}	22.50^{*}
Error	14	0.3784	2852.25	0.0080	1504.75	35942.42	5.77
CV		11.76	8.81	4.88	11.09	9.47	13.57

* , **: Significant at $p \leq 0.05$ and $p \leq 0.01$, respectively

Number of branch in sweet basil plant in both mubarake and Italian large leaf cultivars was decreased with increasing this plants density in intercropping with corn plants. However, there was no significant differences in this trait between S30/8C and S40/8C in both cultivars. Maximum number of branch in mubarake and Italian large leaf cultivars was recorded for plants under sole cropping pattern. Mubarake had more number of branch in comparison to Italian large leaf cultivar under sole cropping pattern (Fig. 1a). Number of grain in mubarake cultivar under different intercropping patterns with corn and also under sole cropping pattern was greater than that of Italian large leaf cultivar. In both cultivars, maximum number of grain was recorded under sole cropping pattern. Increases in sweet basil plants from 20 to 40 in intercropping with corn was caused the number of grain in both cultivars significantly decreased (Fig. 1b).

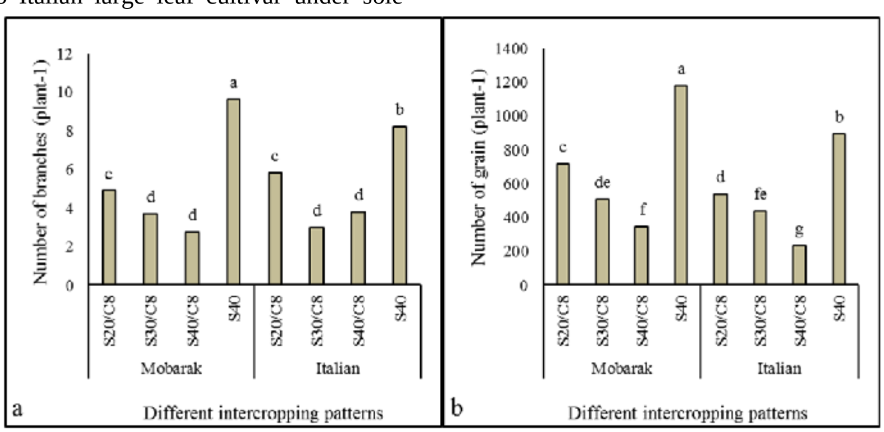

Fig. 1. Changes in number of branches (a) and grains (b) in sweet basil cultivars affected by different intercropping patterns with corn.

In both mubarake and Italian large leaf cultivars, grain weight was improved with increasing sweet basil plants density in intercropping with corn plants. However, difference among S30/C8 and S40/C8 in grain weight was not significant. The lowest grain weight of sweet basil ecotypes was obtained from plants under sole cropping pattern, which this had no significant difference with S20/C8 intercropping pattern (Fig. 2a). There was no significant differences in grain yield among different intercropping patterns between sweet basil and corn plants. The highest grain yield of both mubarake and Italian large leaf cultivars was recorded in plants under sole cropping condition (Fig. 2b).

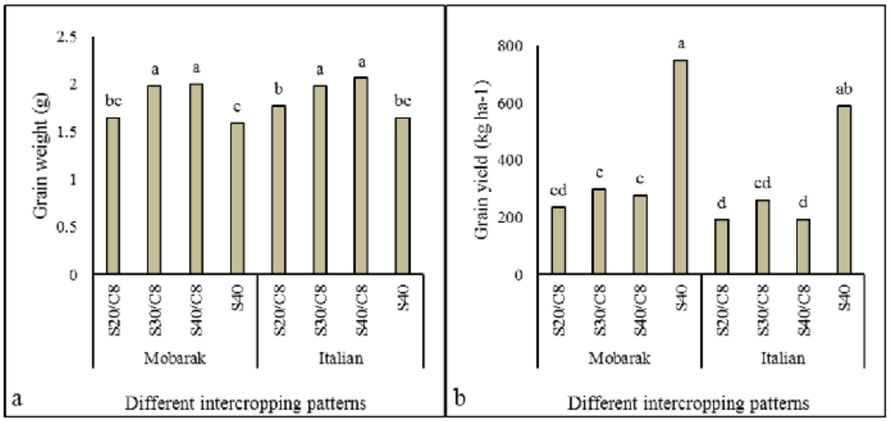

Fig. 2. Changes in grain weight (a) and yield (b) of sweet basil cultivars affected by different intercropping patterns with corn.

Biological yield of mubarake was enhanced with increasing these plants density in intercropping with corn. However, differences among different intercropping patterns with corn in biological yield was not significant. The highest biological yield of both cultivars was showed under sole cropping pattern (Fig. 3a).

Maximum harvest index in mubarake and Italian large leaf cultivars was obtained from S30/C8 intercropping pattern. While, harvest index of mubarake cultivar in S20/C8, S30/C8 and sole cropping patterns was statistically similar. Also, there was no significant difference in harvest index of Italian large leaf cultivar among S20/C8, S40/C8 and sole cropping patterns (Fig. 3b).

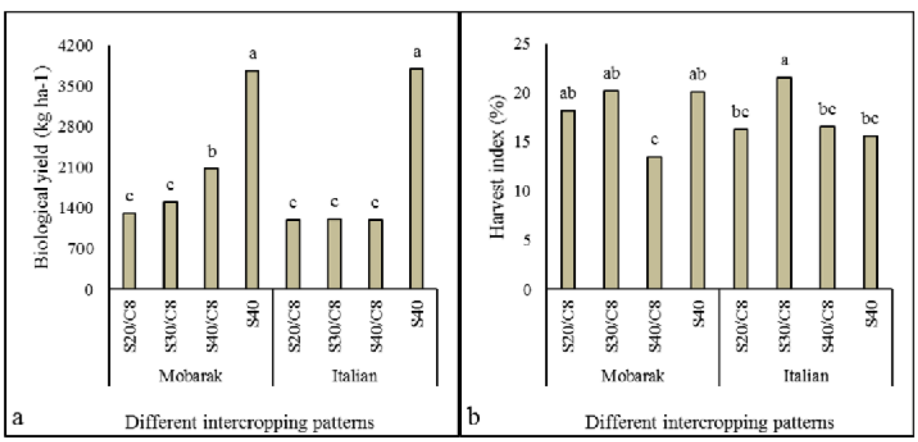

Fig. 3. Changes in biological yield (a) and harvest index (b) of sweet basil cultivars affected by different intercropping patterns with corn.

DISCUSSION

In our research number of secondary branches per plant (Fig. 1a), number of grains per plant (Fig. 1b), grain yield (Fig. 2b) and biological yield (Fig. 3a) of sweet basil cultivars strongly reduced in different intercropping patterns with corn plants. It seems that the lower grain yield in intercropped sweet basil cultivars may be due to shading effect of corn on sweet basil cultivars due to variation in plant architecture.

Subramanian and Rao (1988) in a field experiment consisting intercropping of sorghum with pigeon pea and mung-bean reported that both component crops of sorghum and pigeon pea recorded less grain yield as compared to sole crop yields of sorghum and pigeon pea. Similarly, the significant decrease in branch number, biological yield and herbal yield of basil with increasing basil population in intercrop might also due to increment in competition for soil resources (Morgado and Willey, 2008). Best utilization of nutrients, moisture, space and solar energy can be derived through sole cropping system (Aiyer, 1963). Solar radiation is the major resource determining growth and yield of component crops of intercrops when other growth resources are not limiting. Canopy structure is not only essential to describe radiation interception but also precipitation interception, evapotranspiration and crop productivity. Improved productivity can result from greater interception of solar radiation and higher light use efficiency (Willey, 1990).

One of the disadvantages of intercropping is reduction in yield of component crops due to competition. The extent of competition-induced yield loss in intercropping is likely to depend on the special arrangement of the component crops (Undies *et al.* 2012). In our study, it seems that intraspecific competition is less affected in reducing of sweet basil ecotypes number of branches and grains per plants compared to interspecific competition. Similar results are reported by Asim *et al.* (2006) who observed that number of pods per plant of mung-bean were higher in sole cropping as compared with their corresponding intercropped. Raghuwanshi *et al.* (1993) reported that maximum grain yield of sorghum was obtained from sole crop of sorghum as compared to intercropping with soybean.

Among the most important benefits of intercropping is increasing production per unit area than sole cropping (Banik *et al.* 2006) due to the better use of environmental factors such as water, nutrients and light (Alizadeh *et al.* 2010).

In this study maximum grain weight (Fig. 2a) and harvest index (Fig. 3b) of both mobarake and Italian ecotypes were improved as a result of intercropping patterns with corn. Increasing in grain weight of sweet basil ecotypes in intercropping with corn was associated with decreasing number of grains per plant in those conditions. Reduction in harvest index due to sole cropping pattern was associated with more reduction of grain yield in comparison with biological yield under sole cropping pattern. Jahani *et al.* (2008) reported the highest harvest index of lentils in sole cropping pattern of this plant. In experiments conducted by Tavasoli *et al.* (2010) to investigate intercropping millet and beans, also the highest harvest index of beans was obtained in the sole cropping of beans.

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