INTERNATIONAL JOURNAL OF SCIENCE AND NATURE

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# YIELD PERFORMANCE OF BLACK ZIRA AND SAFFRON INTERCROPPING SYSTEM IN DIFFERENT PLANT DENSITIES AND REPLACEMENT SERIES

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**ABSTRACT**
This study was conducted to determine the level of competition and yield advantage in safrron and black zira intercropping under different plant densities and rates at Khorsan Agricultural Research Center in 2000. Three planting densities (50, 25 and 12.5 plant per $m^2$ ) and five intercropping ratios (%) of safrron to black zira in a replacement series (0, 33:67, 50:50, 67:33, 100) were studied as factorial arrangement in randomised complete blocks in with a replication of four. The method of bivariate analysis was the good methods of analysis and it make analyse simultaneously two values obtained from one plot related to a specific treatment. Evaluation of land Equivalent Ratio (LER) by bivariate method showed that the yield of all intercropped in treatment, LER was higher than 1. Decreasing density from 16.7 to 4.17 plants per $m^2$ decreased the yield of black zira, But the yield of saffron wasn't significantly changed. Maximum LER obtained with 33:67 saffron to black zira and plant density of 50 plants per $m^2$.

**KEY WORDS** : Bivariate Analysis , black zira, Saffron , Replacement series and LER.

## INTRODUCTION

Using multiple cropping systems and especially intercropping systems provide an efficient utilization of environmental resources, decreases the cost of production, provides higher financial stability for farmers, decreases pest damages, inhibits weeds growth more and more productive than growing pure stands, and improves soil fertility through nitrogen increasing to the system and increase yield and quality (Gharineh and Moosavi, 2010; Nadeem *et al*., 2010).

Intercropping offers farmers the opportunity to engage nature's principle of diversity on their farms by considering the usabiltiy aspects and involving spatial arrangements of plants, planting rates, and maturity dates when planning intercrops (Sullivan and Specialist, 2003). Creating conditions that enhance the abundance of resident populations of natural enemies in agroecosystems is considered critical to the efficiency of biological control of insect pests (Phoofolo *et al*., 2010).

The effects of intraspeciflc competition cannot be isolated from those of inter- specific competition. However to derive benefits from intercropping and diversity, inter specific competition for growth factors should be lower than intra-specific competition in single stands (Jensen *et al*., 2005; Corre-Hellou *et al*., 2009; Mariotti *et al*., 2009; Yunusa, 2009).

The evolution of natural ecosystems is controled by a high level of biodiversity which make a system with positive effect on soil and water quality and on biodiversity conservation, in contrast, intensive agricultural systems involve monocultures associated with high input of chemical fertilisers and pesticides, instead, cropping systems based on carefully designed species mixtures reveal many potential advantages under various conditions (Malezieux *et al*., 2009).

Mixing species in cropping systems may lead to a range of benefits that are expressed on various space and time scales, from a short-term increase in crop yield and quality, to longer-term agroecosystem sustainability, up to societal and ecological benefits. Therefore, the selection of species must be done according to the objective of the intercropping systems so that the different species occupy different niches in ecological time and space (Kadziuliene *et al*., 2009).

Some of the factors as morphological and physiological differences and as well growth behaviors of each components are very important and fundamental for the level of productivity and competition in intercropped mixtures to acquire resource availability (such as water), plant density, proportion of one species to another, and the relative roles of intra- and inter-specific interactions are key factors (Al-Dalain, 2009; Gharineh and Moosavi, 2010). Thus, time of plant emergence, root establishment, plant height, leaf area, and early growth in general are reported to play an important role in competition for resources (Gharineh and Moosavi, 2010). The black zira species is suitable for mix cropping with saffron to increase diversity and particularly biological and economic stability in the long term with respect to the role and importance of saffron as a strategic plant in terms of social and economic in the country and especially in Khorasan province.Therefore, the objectives of this study were to determine the level of competition and yield advantage in saffron and black zira mixed intercropping under different stress levels of plant densities in comparison with mono culture.

**MATERIALS AND METHODS**

The farm experiment was conducted at Agricultural Research Station, located in Mashhad, 6 km south of East latitude 16°.38′ North and longitude E 59°. 36′ with a height of 985 meters of the sea level. Soil texture was silty loam. It was fallow in the last year prior to study. The texture class of the soil was silty loam. The farm land was prepared with a deep plowing in the fall and following the cultural operation with simultaneously with disk and used kg of ammonium phosphate and 50 kg urea per hectare based on soil test results in the next summer.

In order to evaluate the biological effect and interference of black zira and saffron in black zira-safrron intercropping in comparison with mono culture, a factorial experiment was conducted in randomize completely blocks design with four replications based on replacement series. In this experiment treatments were different compositions of black zira (*Bunium persi*cum ) and safrron (*Crocus sativus*). Factors were including the density at three levels: low density (12.5 plants per $m^2$ saffron), medium density (25. 5 plants per $m^2$ saffron), high density (50 plants per $m^2$ saffron) and the planting of five levels: 1 to 2 of saffron to black zira (67: 33), compared to 1 of 1 saffron black zira (50: 50), 2 to 1 ratio of saffron to black zira (33: 67) and two pure cultivations of saffron and black zira. Plant equivalent for each plant unit was considered equal 1.

Replacement series were mixed plots as a line of saffron and a black zira-line, two lines of safrron and a line of black-zira, a line of soffron and two lines of black zira and finally two lines of black zira respectively were considered for planting ratios 50:50, 67:33 and 33: 67. Row spacing was equal to 25 cm for each stripe planting in all treatments in each plot. Every plot stripe, including 8 meters length and area of each plot was 16 $m^2$ ( 8 × 0.25 × 8 m). Spacing between each plant for saffron and black zira in in the shrub row was 8, 16 and 16 cm, respectively, for low density, moderate density and high density. There was used saffron corms about 8 grams and three years old of black zira bulbs with an avrage diameter of 4 cm for uniformity in green and phenology stages. Planting operations were performed combinedly for each plant as late summer after preparing a planting bed. All necessary cares were normally done during the crop maintenance. Crop note measurement was taken for morphological and agronomic characterization, including emergence, flowering date, plant height, stem diameter, number of lateral branches, number of umbrellas, umbrella black zira, number of seeds for saffron at the times of flowering, leaves formation, weight of the dried leaves, leaf length, Kiel Saffron, stigma length, perfume quality properties, color and flavor of saffron stigma were measured in this study.

In order to determine yield and yield components for saffron and black zira in pure culture and inter cropping 50:50 two crops selection was taken from four midline by eliminating one meter from the beginning and end of the midlines. For other plots of mixed cultures of the three midlines plots were selected and removed a meter from the beginning and the end of each plot then they harvested separately. For yield components of 10 plants randomly were selected and yield components and other morphological profile were measured for each crop. Analysis of variance were performed based on two variables (bivariate). Mean comparisons was performed by using the method of Mead and Dear (Dear 1983) and using special computer software drawing oblique axis (Koocheki 1367 and Beheshti 1376). For a better understand of two fundamental parameters of plants in mixed cultures including the Relative Yield (RY), Land Equivalent Ratio (LER) were calculated through required formulas and bivariate methods (Dear 1983, Joliffe 1984).

**RESULTS AND DISCUSSIONS**

The results of analysis of data based onbivariate methods in showed that the effects of source variations on black zira seed yield and dry weight stigma of saffron were significant (Table 2) (P <% 5). When plant density was increased the dry weight stigma of Saffron was decreased significantly in all planting ratios. The maximum dry matter yield of saffron stigma and black zira seed were recorded in weight ratio of planting 67: 33 Saffron black zira, respectively. Comparison of observed data and the expected replacement series method showed that all ratios of observed data by planting ratio was more than expected data and also the relationships between components of mixed cultures were complementary modes thus as result total yield per plot, mixed cultures were more in compare with pure cultivation of black zira and saffron. Land Equivalent Ratio (LER) was greater than one in all the plant densities.

**Table- 1 Analysis of variance two variables for the yield of black zira and saffron in intercropping**

| Source of Variations | Degree of Freedom | Sum of squares for black zira | Total result of multiplying the black zira and saffron | Sum of squares for Saffron | L | F |
|---|---|---|---|---|---|---|
| Replication | 3 | 481.076 | -6.436 | 58.092 | | |
| Plant density (A) | 2 | 2.885 | -2.274 | 175.193 | 212.5096 | 16.2** |
| Planting Ratio (B} | 2 | 173.467 | -246.809 | 573.075 | 521.5222 | 26.2** |
| AB | 4 | 1.276 | -11.879 | 245.700 | 224.3871 | 8.3** |
| Error | 24 | 166.629 | 14.453 | 898.166 | | |

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