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Influence of Intercropping Corn and *Aloe vera* on some characteristics of *Aloe vera*

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ABSTRACT: Sustainable agriculture is successful management of resources to satisfy changing human needs while conserving natural resources. Intercropping is an important practice to increase the total yield per unit area. This system is used in many parts of the world, especially in regions where the small farmer intensively utilizes a limited land area and is recommended as a method to increase total agriculture production. In tropics, cereal/legume intercropping is commonly practiced because of yield advantages, greater yield stability and lower risks of crop failure, which are often associated with monoculture. Maize is a very common, popular and multi uses cereal crop at present situation. Every year a huge amount of maize grain is required as feed and fodder for poultry and livestock sector and most of them are imported. The field experiment was laid out in randomized complete block design with facrorial design with three replications. Treatments consisted of nitrogen fertilizer (200, 300, 400 kg/ha) and intercropping (pure corn, 50% corn +50 *Aloe vera*, 25% corn +75% *Aloe vera*, pure *Aloe vera*, 75% corn + 25% *Aloe vera*). Analysis of variance showed that the effect of fertilizer and intercropping on all characteristics was significant.

Key word: Nitrogen fertilizer, leaf length, leaf width

INTRODUCTION

Sustainable agriculture is successful management of resources to satisfy changing human needs while conserving natural resources. However, area of cultivable land per unit household is dwindling from time to time due to population pressure. This leads to intensive crop production per unit area of land. Intercropping is one of the intensive cropping systems which ensure sustainable utilization of limited land resources (Tesfa *et al.,* 2001). Maximizing agricultural resource use through intensification of agricultural systems is an important way to achieve greater production and income per unit area per year. Intercropping is an important practice to increase the total yield per unit area. This system is used in many parts of the world, especially in regions where the small farmer intensively utilizes a limited land area (Francis, 1986) and is recommended as a method to increase total agriculture production in Egypt (Metwally, 1999). The extent and importance of intercropping increases as farm size decreases and the smaller the farm size the more complex the combinations. 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 component crops. Moreover, intercropping improves soil fertility through biological nitrogen fixation with the use of legumes, increases soil conservation through greater ground cover than sole cropping, and provides better lodging resistance for crops susceptible to lodging than when grown in monoculture (Tesfa *et al.*, 2001). In tropics, cereal/legume intercropping is commonly practiced because of yield advantages, greater yield stability and lower risks of crop failure, which are often associated with monoculture (Nielsen *et al.*, 2001; Tusbio *et al.*, 2005). In intercropping systems, legumes can provide N for intercropped cereals through N transfer (Rochester *et al.*, 2001). Most studies on intercrops systems reporting legume-cereal intercropping, a productive and sustainable system, its resource facilitation which consist of growing, soil's fertility and yield (Ofori and Stern, 1987; Jensen, 1996). Nitrogen (N_2)-fixing legume is an important resource for intercropped cereal (Shen and Chu, 2004; Betencourt *et al.*, 2012) which benefited to the nitrogen uptake and improved grain yield.

This positive interaction, has been confirmed in cereal-legume intercrops, compared to sole crops, for cowpea-maize, faba bean-wheat and weath-soybean intercropping system (Zhang and Li., 2003; Li *et al.*, 2005; Dahmardeh *et al.*, 2010). The yield increase is not only due to enhanced nitrogen nutrition of the cereal in association, but also to other unknown mechanisms (Connolly *et al.*, 2001). The cereal farming systems occupy an important place in the Algerian food supply, but they remains tributary in both cases; variability of soil and climate or at the pattern of farming system; which results instability in production system (Alkama *et al.,* 2009). Maize (*Zea mays* L.) is the third most important cereal crop of the world after wheat and rice. Casual natural hazards such as excessive rainfall prolong drought, wind and hail storm may prove extremely harmful for maize in monocrop situation. To avoid the environmental and market risks, particularly small farmers of the country need to have an advance system of maize production. Development of proper intercrop system is one of the best approaches to improve the profitability of the small scale farming. Corns are mainly intercropped with legumes. One of the most important advantages of this mixture is the capability of stabilizing nitrogen in legumes. Maize is one of the most sensitive plants in front of weeds so that if not controlled, especially at the initial phases of growth leads to the drastic decrease of product. Yet since legumes are coverage products, while preventing water evaporation also have a muggy effect on different types of weeds in product's crop row (Salamon, 1990). Maize is a very common, popular and multi uses cereal crop at present situation. Every year a huge amount of maize grain is required as feed and fodder for poultry and livestock sector and most of them are imported (Alkama *et al.,* 2009). Maize (*Zea mays*) and cowpea (*Vigna unguiculata*) are important components of traditional mixed cropping system in the tropics because of the associated benefits; notable among which are suppression of weeds, maintenance of soil fertility, protection of soil against soil erosion and soil water losses, insurance against crop failure. Intercropping practice helps to increase profit margin of the farmers, and usually suppress growth of weeds. It also controls pests and diseases occurrence and guides against crop failure (Agbato, 2000). Several research works have been reported on intercropping. Webster and Wilson (1996) concluded that in most of the experiments on mixed cropping in the tropics, more than one acre of pure stand was required to produce the yield of one acre of mixed crop and concluded that for the tropical small scale farmer, there was no advantage to gain by replacing the traditional practice of mixed cropping.

Ezello (1999) reported that intercropping maize is one of the most popular mixed cropping combinations under rain-fed agriculture in the tropics. Cultivation of maize in combination with other crops is therefore a widespread practice in Nigeria, most especially in the South-west. It is not uncommon to see crops like legumes, okra, melon, pepper and cassava being intercropped with maize. In intercropping, sowing crops in the normally recommended uniform row distance would afford little or no opportunity for accommodating a companion crop; hence most African farmers grow around 30,000 maize plants per hectare recommended in a monocrop condition (Alofe et *al*, 1988). Increasing productivity of intercropped soybean and maize over the sole crop has been attributed to better use of solar radiation (Keating and Carberry, 1993), nutrients (Willy, 1990) and water (Morris and Garrity, 1993). Under soybean/maize intercropping systems, soybean yield tends to be lower and maize yield tends to be higher (West and Griffith, 1992; Ghaffarzaeh *et al.,* 1994). Soybean/maize intercropping could be a way of irrigation water saving, especially in situations of limited water resources (Tsubo *et al.*, 2005). Intercrops have been known to conserve water, largely due to early high leaf area index and higher leaf area (Ogindo and Walker, 2005). *Aloe vera* is a succulent CAM plant recently domesticated in Mexico. This plant is different from other CAM species because it is a native of the semitropical regions of South Africa (Cowling, 1982). Thus, the behavior of such plants cultivated under a semiarid environment may be different from that of the native species. The stomata of these plants open at night and close during the day, and as a consequence, all exogenous gas exchange occurs at night. The CO_2 is fixed by the enzyme phosphoenol pyruvate carboxilase (PEPCase) producing malic acid that is decarboxylated during the day, generating CO_2 that is refixed photosynthetically (Bastide *et al.*, 1993; Harstsock and Nobel, 1996). Agronomic management information on A. vera is scarce. Harvesting is performed progressively by removing the external leaves when they reach its largest size. Recent data on this plant grown in the semiarid region of North-Central Mexico indicate that fresh leaf yields of 54.7 t ha^{-1} in an 8-month period (one cut every 4 months) of a crop growth under mulch and irrigated conditions (Rodriguez-Garc´ıa et *al.,* 2000). *Aloe vera* (L.) Burm. f., a perennial plant is a tropical or subtropical plant with turgid lace-shaped green leaves. This plant is a member of the Liliaceae plant family, has been widely cultivated in China and used as a traditional medicine to induce wound healing, and as an anti-cancer and anti-viral agent (findings *et al.,* 2007). It is used in pharmaceuticals, folk medicine, healthcare, cosmetic products and food products (Jin *et al.,* 2007).

Today *A. vera* gel has been extensively utilized as function food in preparing food health drinks and beverages (Kaithwas *et al.,* 2011). *Aloe vera* L. is a perennial liliaceous plant with succulent green leaves joined at the stem in a whorled pattern.It is highly appreciated due to its short growth period and high economic value among all the aloe species, and is used in pharmaceuticals, folk medicine, healthcare, cosmetic products and food products (Reynolds and Dweck, 1999).

MATERIAL AND METHODS

A. Location of experiment

The experiment was conducted at the research Station in zahak (In Iran) which is situated between 54° North latitude and 41° East longitude and at an altitude of 480m above mean Sea Level.

B. Composite soil sampling

The soil of the experimental site belonging loam. Composite soil sampling was made in the experimental area before the imposition of treatments and was analyzed for physical and chemical characteristics.

C. Field experiment

The field experiment was laid out in randomized complete block design with facrorial design with three replications.

D. Treatments

Treatments consisted of nitrogen fertilizer (200, 300, 400 kg/ha) and intercropping (pure corn, 50% corn +50 Aloe vera, 25% corn +75% Aloe vera, pure Aloe vera, 75% corn +25% Aloe vera)

E. Data collect

Data collected were subjected to statistical analysis by using a computer program MSTATC. Least Significant Difference test (LSD) at 5 % probability level was applied to compare the differences among treatments\` means.

RESULTS AND DISCUSSION

A. Number of leaf

Analysis of variance showed that the effect of fertilizer on number of leaf was significant (Table 1). The maximum of number of leaf (9.55) of treatments 300 kg/ha was obtained (Table 2). The minimum of number of leaf (8.50) of treatments 200 kg/ha was obtained (Table 2). Analysis of variance showed that the effect of intercropping on number of leaf wasn't significant (Table 1). The maximum of number of leaf (9.07) of treatments 25% corn +75% *Aloe vera* was obtained (Table 2). The minimum of number of leaf (8.78) of treatments 75% corn +25% *Aloe vera* was obtained (Table 2).

B. Leaf weight

Analysis of variance showed that the effect of fertilizer on leaf weight was significant (Table 1). The maximum of leaf weight (23641.2) of treatments 300 kg/ha was obtained (Table 2). The minimum of leaf weight (18534.2) of treatments 200 kg/ha was obtained (Table 2). Analysis of variance showed that the effect of intercropping on leaf weight was significant (Table 1). The maximum of leaf weight (32307.8) of treatments 25% corn +75% *Aloe vera* was obtained (Table 2). The minimum of leaf weight (18977.7) of treatments 75% corn +25% *Aloe vera* was obtained (Table 2).

C. Total weight

Analysis of variance showed that the effect of fertilizer on total weight was significant (Table 1). The maximum of total weight (23799.6) of treatments 300 kg/ha was obtained (Table 2).

The minimum of total weight (18618.4) of treatments 200 kg/ha was obtained (Table 2). Analysis of variance showed that the effect of intercropping on total weight was significant (Table 1).

Table 1: Anova analysis of the affected by intercropping and nitrogen fertilizer.

S.O.V	df	Number of leaf	Leaf weight	Total weight	Leaf length	Leaf width
R	2	0.20^{ns}	610553*	4899931*	388.81^{ns}	3.47^{ns}
Fertilizer (A)	2	3.54**	84548173**	87349526**	912.41*	31.44**
Intercropping (B)	3	0.15^{ns}	741554520**	730707393**	753.78*	27.44**
A*B	6	0.49^{ns}	25300239**	23723421**	399.71^{ns}	5.84^{ns}
Error	22	0.29	1443170	1410938	250.63	3.89
CV	-	6.02	5.81	5.71	4.46	4.93
*, **, ns: significant at p<0.05 and p<0.01 and non-significant, respectively.						

The maximum of total weight (32382.3) of treatments 25% corn +75% *Aloe vera* was obtained (Table 2). The minimum of total weight (10495.9) of treatments 75% corn +25% *Aloe vera* was obtained (Table 2).

D. Leaf length

Analysis of variance showed that the effect of fertilizer on leaf length was significant (Table 1). The maximum of leaf length (364.53) of treatments 300 kg/ha was obtained (Table 2). The minimum of leaf length (348.50) of treatments 200 kg/ha was obtained (Table 2). Analysis of variance showed that the effect of intercropping on leaf length was significant (Table 1). The maximum of leaf length (365.94) of treatments 25% corn +75% *Aloe vera* was obtained (Table 2). The minimum of leaf length (344.28) of treatments 75% corn +25% *Aloe vera* was obtained (Table 2).

E. Leaf width

Analysis of variance showed that the effect of fertilizer on leaf width was significant (Table 1). The maximum of leaf width (364.53) of treatments 300 kg/ha was obtained (Table 2). The minimum of leaf width (348.50) of treatments 200 kg/ha was obtained (Table 2). Analysis of variance showed that the effect of intercropping on leaf width was significant (Table 1). The maximum of leaf width (365.94) of treatments 25% corn +75% Aloe vera was obtained (Table 2). The minimum of leaf width (344.28) of treatments 75% corn +25% Aloe vera was obtained (Table 2).

Table 2: Comparison of different traits affected by intercropping and nitrogen fertilizer.

Treatments	**Number of leaf**	**Leaf weight**	**Total weight**	**Leaf length**	**Leaf width**
Nitrogen fertilizer					
200	8.50b	18534.2c	18618.4c	348.50b	38.67b
300	9.55a	23641.2a	23799.6a	364.53a	41.77a
400	8.80b	19834.3b	19903.7b	350.57b	39.40b
Lsd 5%	0.45	1017	1006	13.40	1.67
intercropping					
Pure Aloe vera	9.04a	18977.7c	19038.2c	351.17ab	39.69bc
25% corn +75% Aloe vera	9.07a	32307.8a	32382.3a	365.94a	42.18a
75% corn +25% Aloe vera	8.78a	10246.3d	10495.9d	344.28b	37.93c
50% corn +50% Aloe vera	8.92a	21148.5b	21179.4b	356.73ab	40.00b
Lsd 5%	52	1174	1161	15.48	1.92
Any two means not sharing a common letter differ significantly from each other at 5% probability					

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