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Effect of intercropping Sorghum (*Sorghum bicolor* L) and Persian clover on some characteristics of Sorghum

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ABSTRACT: 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. Cereal/legume intercropping system may be increase soil fertility via raising its organic content and available nitrogen fixed by legume. Sorghum (*Sorghum bicolor* L.) is the fifth most important cereal in the world followed by wheat, rice, maize and barley. Persian clover is among the most important forage crops native from the temperate regions cultivated in these regions to produce seeds; Persian clover can establish a symbiotic relation with the soil rhizobium. The field experiment was laid out in randomized complete block design with factorial design with four replications. Analysis of variance showed that the effect of intercropping and row space on fresh forage yield was significant.

Key words: Intercropping, sorghum, persian clover

INTRODUCTION

Stable agriculture is ascribed to the authentic management of agricultural resources, which in addition to fulfilling the ever-changing needs of humans, maintains the health of environment and capacity of water and soil resources (Reijntjes *et al,* 1992). 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).Increasing interest in sustainability and environmental concerns has shifted attention back to intercropping as a means of better utilization of resources while preserving the environment (Anders *et al.,* 1996). Advantages of intercropping are numerous and well-documented (Chatterjee and Mandal, 1992; Egbe *et al.*2009; Egbe, 2010).An alternative procedure to mitigate the effect of these constrains and to increase the acreage and production of such secondary crops is intercropped them particularly in the newly reclaimed soils. Cereal/legume intercropping system may be increase soil fertility viaraising its organic content and available nitrogen fixed by legume(Singh *et al,* 1986), saves water and inputs requirements, reduces costly inputs and insures agricultural sustainability. It is an old and wide spread practice in the low input system based on the manipulation of plant interaction to maximize their growth and productivity in addition to yearly yield stability allowing more consistent yields (Willey, 1979). Thereby, Ofori and Stern (1987) suggested that cereal/legume intercrop is among the most frequently used and most productive compared to monocropping, and is recognized as suitable cropping system in the developing countries especially under poor resources. They also concluded that the temporate cereal/legume intercrops is acknowledged for present and future agricultural potential. Banik *et al* (2000) reported that under the fragile and whimsical nature weather and degraded soil configuration offer little opportunities for stable agricultural production, monocropping cannot ensure stability of production. Researchers put emphasis on the relation between biodiversity and sustainability in as much as a marginal increase in diversity will enhance the complexity and productivity of ecosystem (Burel and Baudry, 1995; McLaughlin and Mineau, 1995). Effective utilization of resources and improving crop productivity makes intercropping to play an important role in agriculture (Yang *et al.,* 1999). Inter and intra-specific competition determines the degree of resource complementarily; however, the availability of environmental resources and the relative frequency of the species and the density of components inevitably influence competition.

Yield advantage occurs when inter- specific competition is less than intra-specific competition in other mean the components of intercrop compete only partly for the same growth resources (Vandermeer, 1992; Willey, 1985). Intercropping cereal and legumes is a practice in which the N fixed by the latter enhances the qualitative and quantitative traits of the former to finally reaching food security and sustainability (Swaminathan, 1998).Intercropping is a way to improve production in range management. Always natural biomes are consisting of different species that have special correlations. Therefore for repair and range expanse it needs to pattern nature and used two or more intercropping. Legumes, in addition to secure beast nutrition which used as grazing and lay harvesting, had strong roots that penetrated soil and helped to amendment and increase soil mass and microorganisms, also having symbiosis relationship with rhizobium bacteria in intercropping could produce much part on nitrogen that grasses used (West and Wdine, 1985). Having adventure roots, grasses need nitrogen for growth fast. If legumes produce good nodule in intercropping, much parts of nitrogen that grasses need was available (Ibrahim and Kabesh 1971). Moynihan *et al* (1996) used different species of *Medicago sativa* for annual seeding with bere. The bushes of *Medicago sativa* decrease weed competition and soil cover and also reduce soil erosion, they results that averagely decrease 65% of weed biomass in contrast with pure cropping. Salc and Alberscht (1996) states that intercropping of *Medicago sativa* with luliom had moreley yield than single cropping and more yield was seen in early variety of luliom in intercropping albeit of lower crude proteins. Intercropping is being advocated as a new and improved approach to farming. However, it has been avoided because of the complications of planting and harvesting. This planting system usually benefits because of increasing in light interception, root contact with more soil, microbial activity and also as a deterrent to pests and weeds of other crop. Furthermore, the most common reason for the adoption of intercropping systems is yield advantage, which is explained by the greater resource depletion by intercrops than monocultures, and N_2 fixation, particularly when cereal and legume crops; i.e. barley/faba bean (Agegnehu *et al.,* 2006), wheat/chickpea (Banik *et al.,* 2006) and corn/cowpea (Geren *et al.,* 2008) are grown together. The efficiency of such cropping systems is expressed as land equivalent ratio (LER) in which the application of different levels of nitrogen fertilizers affects its increasing, decreasing and unchanging trend (Ghanbari and Lee,2003).Benefits of intercropping may be briefed as: better use of resources, improvement of soil fertility by legume components of the system, soil preservation through covering the bare land between the rows, reduction of biotic and abiotic risks by increasing diversity, suppression of weeds infestation, etc (Emam, 2003).Sorghum(*Sorghum bicolor* L.) is the fifth most important cereal in the world followed by wheat, rice, maize and barley (El Naim *et al.,* 2012). Sorghum is used not only for human food, but also for fodder and feed for animals, building material, or for brooms (Doggett, 1988). Utilizing forage sorghum is being practiced recently in many parts in Iran although corn has almost always been the option for most dairies but marked downward trend in water resources forces agronomists for a proper substitute, therefore in order to improve nutritive value and high efficiency to utilize resources, intercropping with legumes is introduced in a complementary system in that such systems are being recognized to increase productivity and resource use efficiency in a high input agriculture (Burel and Baudry, 1995).Ecologically, sorghum plants could grow in wide ranges of environmental conditions. Sunyoto and Kamal (2009) reported that sorghum could grow well under agro climate conditions of Lampung-Indonesia although their yield was affected by planting dates and sorghum genotypes. In general, sorghum that is cultivated in the dry season produces higher yield compared to that cultivated in wet (rainy) season. The study reported by Netondo *et al.* (2004) indicated that sorghum plants are relatively highly tolerant to drought. Thus, it could be used for optimizing biomass production in upland agriculture frequently subjected to water shortage. Sorghum (*Sorghum bicolor* L.) is an important one that possesses a wide range of ecological adaptability because of its xerophytic characteristics. It is widely grown by the subsistence growers for feed and fodder in rain fed as well as in irrigated regions of Pakistan. Its fodder is fed to almost every class of livestock and can be used as hay or silage. However, sorghum fodder is poor in quality due to low protein content and presence of hydrocyanic acid (Hingra *et al.,* 1995). It is, therefore, imperative to improve the quality and quantity of sorghum fodder. Mixed cropping especially with forage legumes can improve both the forage yield and quality, as legumes are a good source of protein (Moreira, 1989).

Persian clover is among the most important forage crops native from the temperate regions cultivated in these regions to produce seeds; Persian clover can establish a symbiotic relation with the soil Rhizobium (Thompson and Stout, 1997).Persian clover with Italian grasses may also improve forage nutritive value. Kunelius and Narasimhalu (1983) reported that a ryegrass-Persian clover mixture had higher nitrogen content and in vitro digestibility than rye grass alone. The addition of Persian clover (*Trifolium resupinatum* L.) to barley-ryegrass mixtures in British Columbia reduced fertilizer needs, improved midseason for age yield, and improved forage nutritive value (Thompson and Stout, 1997).

MATERIAL AND METHODS

A. Location of experiment

The experiment was conducted at the Research Station in goharkuhkhash (In Iran) which is situated between 28° North latitude and 68° East longitude.

B. Composite soil sampling

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 factorial design with four replications.

D. Treatments

Treatments included intercropping (pure Sorghum, 50% Sorghum + 50% Persian clover, 100% Sorghum + 100% Persian clover, pure Persian clover) and Row spacing cultivation (70cm, 100cm).

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. Fresh forage yield in cut one

Analysis of variance showed that the effect of intercropping on fresh forage yield in cut one was significant (Table 1). The maximum of Fresh forage yield in cut one (77.56) of treatments 50% Sorghum + 50% Persian clover was obtained (Table 2).The minimum of fresh forage yield in cut one (56.119) of treatments 100% Sorghum + 100% Persian clover was obtained (Table 2).Analysis of variance showed that the effect of row space on Fresh forage yield in cut one was significant (Table 1). The maximum of Fresh forage yield in cut one (70.312)of treatments 70 cm was obtained (Table 2).

The minimum of fresh forage yield in cut one (61.048) of treatments 100 cm was obtained (Table 2).

Table 1: Anova analysis of the sorghum affected by intercropping and row space.

S.O.V	df	Fresh forage yield in cut one	Fresh forage yield in cut two	Fresh forage yield in cut three
R	3	$54.952^{n.s}$	$79.649^{n.s}$	$13.184^{n.s}$
A	2	951.741^{**}	1668.073^{**}	1474.288^{**}
B	1	514.985^{*}	258.726^{*}	286.281^{*}
A * B	2	$44.003^{n.s}$	$97.118^{n.s}$	245.047^{*}
CV	--	14.97848	8.304201	12.05885

*, **, ns: significant at p<0.05 and p<0.01 and non-significant, respectively.

Table 2: Comparison of Fresh forage yield in cut one affected by intercropping and row space.

Treatment	Fresh forage yield in cut one (ton/ha)
intercropping	
50% Sorghum + 50% Persian clover	77.56 a
100% Sorghum + 100% Persian clover	56.119 b
pure Sorghum	63.36b
row space	
70cm	70.312 a
100cm	61.048 b

Any two means not sharing a common letter differ significantly from each other at 5% probability

B. Fresh forage yield in cut two

Analysis of variance showed that the effect of intercropping on fresh forage yield in cut two was significant (Table 1). The maximum of Fresh forage yield in cut two (102.195) of treatments 50% Sorghum + 50% Persian clover was obtained (Table 3). The minimum of fresh forage yield in cut two (73.658) of treatments 100% Sorghum + 100% Persian clover was obtained (Table 3). Analysis of variance showed that the effect of row space on Fresh forage yield in cut two was significant (Table 1). The maximum of Fresh forage yield in cut two (92.489) of treatments 70 cm was obtained (Table 3). The minimum of fresh forage yield in cut two (85.923) of treatments 100 cm was obtained (Table 3).

Table 3: Comparison of Fresh forage yield in cut one affected by intercropping and row space.

Treatment	Fresh forage yield in cut one (ton/ha)
intercropping	
50% Sorghum + 50% Persian clover	102.195 a
100% Sorghum + 100% Persian clover	73.658 c
pure Sorghum	91.765 b
row space	
70cm	92.489 a
100cm	85.923 b

Any two means not sharing a common letter differ significantly from each other at 5% probability

C. Fresh forage yield in cut three

Analysis of variance showed that the effect of intercropping on fresh forage yield in cut three was significant (Table 1). The maximum of Fresh forage yield in cut three (73.771) of treatments 50% Sorghum + 50% Persian clover was obtained (Table 4). The minimum of fresh forage yield in cut three (46.621) of treatments 100% Sorghum + 100% Persian clover was obtained (Table 4). Analysis of variance showed that the effect of row space on Fresh forage yield in cut three was significant (Table 1). The maximum of Fresh forage yield in cut three (63.608) of treatments 70 cm was obtained (Table 4). The minimum of fresh forage yield in cut three (56.7) of treatments 100 cm was obtained (Table 4).

Table 4: Comparison of Fresh forage yield in cut one affected by intercropping and row space.

Treatment	Fresh forage yield in cut one (ton/ha)
intercropping	
50% Sorghum + 50% Persian clover	73.771 a
100% Sorghum + 100% Persian clover	46.621 c
pure Sorghum	60.069 b
row space	
70cm	63.608 a
100cm	56.7 b

Any two means not sharing a common letter differ significantly from each other at 5% probability

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