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Effect of Different Tillage Systems on Yield and Yield Components in Cowpea-Millet Intercropping

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Abstract

This study focuses on intercropping of millet and cowpea in response to different tillage experiment was conducted in a split plot randomized complete block design with three replications at the Research Station in Zabol University. In this study factors were considered consists of three different methods of tillage (no-till, reduced tillage, conventional tillage) as main plot and five different arrangement of intercropping include: (a pure millet, pure cowpea, 50% millet pulse, 50% of cowpea, 75% millet pulse, 25% cowpea, 25% millet pulse, 75% cowpea) as sub plot. The results of the statistical analysis of the data showed that different tillage systems did not show a significant effect on the measured traits, but the ratios of planting had significant effect on all traits. So that for plant cowpea were obtained highest number of pods per plant, thousand grain weight, seed yield, biological yield and harvest index and for Millet plant were achieved highest height and Yield biologically in monoculture. The maximum grain yield cowpeas were obtained in the no-tillage treatments and confirm it is necessary to keep the plant residues in the field. The highest yield was obtained 75% cowpea pulse, 25% Millet intercropping. Therefore in order to achieve greater yield and increase soil fertility recommended to use 75 % treated cowpea intercropping of 25% millet.

Keywords: Harvest Index, Land Equivalent Ratio

1. Introduction

Soil erosion, destruction of forests and pastures, destroying the efficient soil organisms, aquatic life threatened due to indiscriminate use of pesticides and chemical fertilizers, technology transfer approach has undesirable consequences. On the other side, in response to mentioned challenges in recent decades, especially in recent years, a new outlook in conjunction with any correct utilization, convenient sustainable resource bases formed. Such an approach based on principles of environmental protection, understanding complex biological relationships and utilization of appropriate technologies and is consistent with the characteristics of communities[1]. Create a variety of management methods and forms of exploitation of resources or in other words to increase agricultural diversity of best and most effective solutions of achieving sustainability[2,3]. One of these systems is intercropping. The system was in vented in the distant past, due to conventional agricultural problems today are again raised. Intercropping is as a multiple cropping system, in which two or more crops species planted simultaneously in a field during a growing season, including the oldest cropping systems is the world. Intercropping as an example of sustainable agricultural systems following objectives such as: ecological balance, more utilization of resources, increasing the quantity and quality and reduce yield damage to pests, diseases and weeds. Success of intercrops in comparison with a pure cropping can be determined by a series of agronomic operations that interactions between the species will be affected by them. These operations are including ultimate density, planting date, resources availability and intercropping models[47]. Soil conservation is an economic issue because current investments for higher incomes in the future[8]. Tillage is the mechanical manipulation

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of soil with tools and implements for obtaining conditions ideal for seed germination, seedling establishment and growth of crops. Conservation tillage is preparing a seed planting through the use of tools and equipment that can be associated with a reduced frequency of movement of machinery at the farm. Various methods of conservation tillage include minimum tillage or reduce tillage, no-tillage, strip tillage, mulch tillage and ridge tillage that each of these scenarios with many of the benefits arising from the implementation of sustainable agriculture. Maintaining plant residues on the soil surface in conservation tillage and soil grain diameter does not change. Tollner et al. In[9] were showed that increased soil density also inhibited subsurface root proliferation, hence reducing nutrient uptake. Researchers have shown that the bulk density of the soil layers in direct planting techniques compared to conventional tillage systems more have been used In[10–14] these researchers that showed presence of plant residues on the soil surface and the roots in the soil as much as two-thirds compared with no cover lands and no plant residues, one factor is the increase in soil bulk density[15]. The results of the impact and management of plant residues in wheat tillage systems on soil properties indicate that significant differences in total soil organic carbon levels were increased. Most of the carbon in no-till systems and then conventional tillage system had the lowest carbon. The amount of total nitrogen in soil can also follow the above process[16]. Bloom et al. In[17] were investigated the effect of nitrogen fertilizer and corn crop residue management on soil organic matter soils Minnesota. Research results in soil with low fertility after 13 years of maize residue management indicated that Removal the total remains of the field, compared to revert remains in soil organic carbon is reduced by about 15 percent. Borzali et al. In[18] showed that the tillage system with crop residue and no tillage system increased grain yield and weight of seed compared to be burnt the stubble tillage. Maury In[19] was investigated effect of tillage and residue management for corn grain yield and soil physical properties and reported that no-tillage systems with crop residue on the soil surface compared to conventional tillage increased organic carbon and soil porosity. Identify and use appropriate methods of tillage and increased yield especially in dry areas are necessary. Due to inappropriate methods of the bed preparation this study was conducted to replace an effective method for maintaining stability and performance.

2. Materials and Methods

The experiment was conducted in the field of education - Agricultural Research Institute of Zabol University in the city Zahak position (61° 41_ E, 30° 54_ N). Height of 483 meters above sea level is tested. According to the weather and the coupon classification, the Zahak city is extremely hot arid climate. As well as long-term average rainfall in the region of 63 mm and average annual evaporation is 4500-4000 mm. The results of the chemical analysis of the soil showed that the soil test site with pH = 7.4 of EC = 1.8 dS m. In this study, the effects of different methods of conservation tillage and conventional tillage on yield (millet and cowpea) as the experiment was conducted in a split plot randomized complete block design with three replications. Constant spacing between rows 40 cm and between plants in the row was considered based on mixture. In this study factors were considered consists of three different methods of tillage (no-till, reduced tillage, conventional tillage plow and disk) as main factor and five different arrangement of intercropping include: (a pure millet, pure cowpea, 50% millet + 50% of cowpea, 75% millet + 25% cowpea, 25% millet + 75% cowpea) as sub factor. In this experiment the total land area of 450 square meters a length of 45 meters and a width of 10 were that including 45 plots and each plot was considered 4 rows of length 2 m, the distance between plots is 75 cm and the distance between repetitions 1 meter. During the preparation of the suitable seed bed were given 100 kg of triple super phosphate fertilizer, 150 kg potassium sulfate and 200 kg urea to plots. The plant was planted in March on the lines through the open slot and put the seed in it. Planting was intended to prevent the loss of several factors high density. After 3 to 4 leaf emergence stage the attempting to thinning and harvesting the millet and cowpea in July. Studied traits in cowpea plants would be the height, number of pods, number of seeds per pod per plant, seed weight, economic yield, biological yield and harvest index. The millet studied traits include height and biomass, soil organic carbon, soil nitrogen and soil bulk density and statistical calculations were performed using the software SAS. Software was used to draw regions word, comparison of treatment means was performed using Duncan's multiple range tests at 5% level.

3. Results and Discussion

3.1 Height Cowpea

The effects of different intercropping system on height were significant at the level %1 (Table 1). Maximum height was obtained in pure culture (63.00cm) and the lowest height of intercropping 25% cowpea + 75% millet (39.11cm). Comparison of treatment means showed that there are significant differences between monoculture and different relative intercropping of cowpea. This difference is caused by competition between species that reduces the bean plant. Monoculture cowpea relative to the incremental system and replace mixture had greater plant height[20]. The significant decrease corn plant height in mixtures with legumes may be due to inter specific competition in plants was the use of soil nutrients in the early stages of maize[21]. Raei et al. In[22] and Rezaei Chyanh In[23] reported similar results.

3.2 The Number of Pods in the Cowpea

The results of variance analysis showed that the effect different planting rates on the number of pods were significant at the 1% (Table 1). The highest number of pods was obtained in monoculture cowpea (37.55) and the lowest number of pods of intercropping 25% cowpea + 75% millet (23.77) (Table 2). Hossain et al. In[24] their experiments on intercropping of forage millet and cowpea observed that the increase in the mixture millet, cowpea is reduced the number of pods per plant. He said that reducing the number of pods due to more intense competition millet with cowpea in the mixture, in ratios millet is high. Mobaser In[25] reported that high density is created in the lower number of pods in mung bean. Due to decrease number of pods per plant in the high density can be justified that the number of lateral branches per plant decreased with increasing density and the number of pods formed on the branches was reduced[26].

3.3 The Number of Seeds per Pod

The effects of different planting rates on seed number per pod were significant at the 1% (Table 1). The highest number of seeds per pod of cowpea monoculture (11.55) and the lowest number of seeds per pod of intercropping 25% cowpea + 75% millet (8.77) was obtained. Seeds per pod decreased with increasing density, due to the reduced number of pods per plant. Because of the high density, competition for space, light and nutrients for both plants increased and therefore reduce the production of pods per plant, so that there is a direct relationship between the number of seeds per pod and number of pods per plant[27]. In pure culture due to a decrease in competition between plant and greater use nutrients in plant increased the number of seeds per pod[28]. Ayaz et al. In[29] and Hayat et al. In[30] that showed that increasing density decreased seed number per pod.

3.4 Thousand Grain Weight

The effect different planting rates of cowpea Thousand grain weight were significant at the 1% level (Table 1).Highest thousand grain weights (237.83 g) were obtained in pure culture, and the least amount of cowpea thousand grain weight (210.55 g) in 25% cowpea + 75%millet were achieved (Table 2). Thousand grain weights reduced in high density that presumably due to a severe decline of net assimilation Because the density was too desirable, Leaves shade each other, the amount of leaf of assimilates have been influenced by the shadow less than the amount of carbohydrates consumed in respiration. A result of these leaves instead of exporting materials to grain itself as an opponent sink for consuming carbohydrate made by the upper leaves. Therefore amount assimilate that transferred to grain will be reduced. A result, despite reducing the number of seeds per pod, seed weight also decreases. Also at high density in the root zone for uptake of water and nutrients, there are competing and fewer nutrients will be available each plant. Thus root competition caused reduced thousand grain weights in cowpea. The results correspond with the findings of other investigators [31–33].

3.5 Grain Yield

The effect different planting rates of cowpea Grain yield were significant at the 1% level (Table 1). The highest Grain yield of cowpea monoculture (545.58kg/ ha) and the lowest grain yield of intercropping 25% cowpea + 75% millet (228.20 kg/ha) was obtained (Table 2). A significant difference between treatments in pure culture was mixed with other treatments. The bean seed yield per plant was thoroughly under the influence of planting ratio with the increase bean in the ratio of planting, on seed yield has increased. But this result is not unexpected as monoculture treatment plant ratios were lower in the intercropping treatments. So many resources are available cowpea. In these conditions, each plant has a higher utilization of available resources and sunlight as a result; more resources are allocated to each plant. On the other hand in intercropping treatments, grain yield millet, cowpea ratios have been really impressed and parallel to the increasing density of millet, cowpea grain yield is reduced. Tavassoli et al. In[34] reported similar results in their study of intercropping of millet and kidney beans.

3.6 Biological Yield

The effect different planting rates of cowpea Biological yield were significant at the 1% level (Table 1). The highest yield of cowpea monoculture (2883.78 kg/ha) and the lowest yield of intercropping 25% cowpea + 75% millet (1462.33 kg/ha) were obtained (Table 2). However, it seems that the increase in bean yield biologically monoculture comparison to the other treatment due to be increase in plant on monoculture. Dahmardeh In[20] in study the effect of intercropping of maize and beans on yield stated due to increased competition from corn to beans on light absorption, the yield bean component greatly reduced.

3.7 Harvest Index

The effect different planting rates of cowpea Harvest index were significant at the 1% level (Table 1). The highest Harvest index of cowpea monoculture (20.19) and the lowest harvest index of intercropping 25% cowpea + 75% millet (13.58) were obtained (Table 2). Harvest index in cowpea is also another factor that that could be under the influence of competition with millet. However, an increase ratio of millet leads to was reduced harvest index in cowpea. With increase millet ratio decreased plant vegetative growth and reduced allocation of Attarian and Rashed Mohasel In[35] materials was for making reproductive in cowpea, while reducing yield can decrease the harvest index Cousens et al. In[36] expressed with the tolerance weed in wheat, harvest index was reduced. Attarian and Rashed Mohasel In[35] with effect of winter wheat cultivars with wild oat competition concluded with increased wild oat density Harvest index in will decrease.

3.8 Millet Height

The effect different planting rates of Millet plant height were significant at the 1% level (Table 3). The highest height of millet monoculture (52.33cm) and the lowest height of intercropping 25% millet + 75% cowpea (36.11cm) were obtained (Table 4). With the increased ratios of planting cowpea competition for resources increased and height of millet decreased. Isik et al. In37 7 believed that density increases due to increased competition between plants for water and nutrients reduced inter node length as well as the number of nodes resulting in reduced plant height reduction. The other reason to reduce plant height, of millet compared to beans was competition for light absorption. If other resources are not limiting, plant growth depends on the amount of light absorbed. Reduce the amount of light, resulting in decreased carbon fixation that, ultimately, is reduced the growth. The bean plant intensifies competition for light. In this regard, the determining factor would be plant height, branch location and position of maximum leaf.

3.9 Biological Yield

Effect of different planting density on biological yield of millet was significant at 1% level (Table 3). The highest Biological yield of cowpea monoculture (2515.6 kg/ha) and the lowest Biological yield of intercropping 25% Millet + 75% cowpea (1197.8 kg/ha) were obtained (Table4) Mode competition affected biological yield Millet of beans Intensity of competition was greater (an increase of ratio cowpea). Tavassoli et al. In[34] Evaluation of intercropping of millet and kidney beans also reported similar results.

3.10 Evaluation of Intercropping

By calculating land equivalent ratio (Table 5.), it was found that in all intercropping of treatments, were better use of soil and water resources and land planting in these treatments are more yield. Accordingly, treatment of 75% cowpea + 25% millet (Table 6.) as the most desirable ratio intercropping of for these two plants is presented (LER = 1.69).

4. Conclusion

The highest yield was obtained 75% cowpea + 25% millet intercropping. Therefore in order to achieve greater yield and increase soil fertility recommended to use 75% treated cowpea intercropping of 25% millet.

Table 1. Analysis of variance for quantitative parameters of intercropping for cowpea

		Means of Square						
SOV	df	Height	Number of pod	Seed per pod	Seed weight	Grain yield	Biological yield	Harvest Index
Replication	2	2177.8**	1265.44**	18.77**	6571.15**	120004.5**	840602.02**	213.63**
Tillage system (T)	2	7.69ns	25.19ns	0.86ns	31.64ns	187.76ns	15538.8ns	0.016ns
Error (a)	4	14.98	41.19	1.02	68.96	174.90	7857.94	1.42
Intercropping system (I)	4	878.55**	308.10**	13.22**	1293.02**	166792.9**	315400.5**	73.36**
T*I	8	2.91ns	3.37ns	0.30ns	30.21ns	191.45ns	8770.26ns	0.22ns
Error (b)	24	16.57	9.20	0.50	44.06	3567.25	38684.9	7.83
C.V (%)	-	8.04	10.15	7.03	2.95	16.3	9.31	17.03

*, ** significant at p<0.05 and p<0.01,

Table 2. Means of quantities characteristics of cowpea as influenced by intercropping system and tillage system

Harvest index	Biological yield)kg.ha)	Grain yield (kg.ha)	Seed weight	Seeds per pod	Number of pods	Height	Tillage systems
16/47a	2135/42a	367/57a	225/38a	10/25a	32/00a	50/75a	No-tillage
16/40a	2070/67a	360/01a	225/71a	9/75a	27/83a	49/75a	Minimal tillage
16/41a	2130/25a	365/28a	222/72a	10/16a	29/75a	51/33a	Conventional
1/35	100/5	14/99	9/41	1/149	7/27	4/38	LSD%5
							Intercropping system
20/19a	2883/78a	545/58a	273/83a	11/55a	37/55a	63/00a	100%cowpea
16/90b	2166/11b	382/19b	230/40b	10/44b	30/66b	52/00b	cowpea 75%+ Millet25%
15/03ab	1936/22c	301/92c	219/61c	9/44c	27/44c	48/33b	cowpea50%+ Millet50%
13/58c	1462/33b	228/20d	210/55d	8/77c	23/77d	39/11c	cowpea25%+ Millet75%
2/77	194/8	59/15	6/57	0/700	3/00	4/03	LSD%5

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

Table 3. Analysis of variance for quantitative parameters of intercropping for millet

		Means of square	
s.o.v	df	Height	Biological yield
Replication	2	602.58^{**}	3545272.02^{**}
Tillage system (T)	2	9.75^{ns}	2878.69^{ns}
Error (a)	4	2.58	23332.9
Intercropping system(I)	4	410.32^{**}	2962620.1^{**}
T*I	8	2.6^{ns}	15467.1^{ns}
Error (b)	24	12.95	77073.69
C.V (%)	-	8.13	15.51

*, ** significant at p<0.05 and p<0.01, respectively.

Table 4. Comparison of mean Height and Biological yield in millet influenced by tillage and intercropping systems

Tillage systems	Height	Biological yield
No Tillage	44.50a	1781.50a
Minimum Tillage	43.25a	1779.92a
Conventional	45.00a	1807.50a
LSD 5%	1.82	173.1
Intercropping systems		
Pure millet	52.33a	2515.60a
Cowpea 75%+ 25% millet	36.11c	1197.80d
Cowpea 50%+ 50% millet	42.66b	1497.60c
Cowpea 25%+ 75% millet	45.88b	1947.70b
LSD 5%	3.56	275

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

Table 5. Analysis of Variance Land equivalent ratio influenced by tillage and intercropping systems

		Means of square
s.o.v	df	LER
Replication	2	0.0143
Tillage system (T)	2	$005^{ns}.0$
Error (a)	4	006.0
Intercropping system(I)	3	$832^{**}.0$
T*I	6	$007^{ns}.0$
Error (b)	18	0.009
C.V (%)	-	7.02

*, ** significant at p<0.05 and p<0.01, respectively

Table 6. Comparison of mean Land equivalent ratio influenced by tillage and intercropping systems

	LER
Tillage systems	
No Tillage	1.39 a
Minimum Tillage	1.35 a
Conventional	1.35 a
LSD 5%	0.094
Intercropping systems	
Cowpea 75%+ 25% millet	1.69 a
Cowpea 50%+ 50% millet	1.51 b
Cowpea 25%+ 75% millet	1.25 c
LSD 5%	0.095

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

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