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Effect of minimum tillage on productivity and economics of sweet corn - pulses intercropping system

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Abstract
Field experiment was carried out at Department of Agronomy, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, and Akola (M.S.) during *kharif* 2013 to study the effect of minimum tillage on productivity and economics of sweet corn - pulses intercropping system in FRBD with four replication. The main plot treatment *viz*., S_1- Conventional tillage (one Ploughing and two harrowing), S_2- Minimum tillage (one harrowing) and three sub-plot treatment of intercropping I_1- Sole sweet corn, I_2- Sweet corn+ Green gram (1:2ratio), I_3- Sweet corn + Black gram (1:2ratio).The result revealed that conventional tillage treatment recorded higher number of cob ha^{-1}, biological yield, harvest index, GMR (186507 ₹ ha^{-1}), NMR (148159 ₹ ha^{-1}), and B: C ratio (4.96) than minimum tillage and among intercropping treatments sweet corn + black gram recorded highest GMR (194698 ₹ ha^{-1}), NMR (157467 ₹ ha^{-1}), B: C ratio (5.23) followed by treatment sweet corn + green gram.

Keywords: Economics, intercropping, productivity, sweet corn

Introduction
Maize is known a queen of cereals". It plays important role in the world agricultural economy, both as food for man and feed for animal. Maize is one of the world's leading crop cultivated over an area of about 157.51 million hectare with a production of about 781.36 million metric tons and recorded 4.96 tones average yield per hectare. In India it is grown over an area of 8.6 million hectare with total production of about 19 million tones and average yield per hectare of 2.67 tones (Anonymous 2014) [1]. Sweet corn is one of the most popular types for human consumption among different types of corn grown. Sweet corn has been bread to higher levels of natural sugars, which makes it very popular. Modern sweet corn started growing in 19th century, which a single gene shrunken-2 (sh-2). This gene affects the table quality, synthesis and texture. It is hybridized maize, specially bred to increase sugar content and also known as "Sugar corn". The significance of *in- situ* soil moisture conservation measure is to conserve maximum possible rainwater at the place where it falls, to make efficient use of it. Soil management and agronomic practices are tailored to store and conserve as much rainfall as possible by reducing runoff and increasing the storage capacity of the profile. Dry land occupies an important place in Indian agriculture with 70% cultivated area and 40% of food grain production. Intercropping has various benefits associated with it *viz*. better utilization of soil moisture, nutrients and space and reduce risk of crop, failure due to weed, insect and climate vagaries. Among all, the use of intercrop, improving nutrient use efficiencies is one of the important aspects. Intercropping increases the cropping intensity and recourse utilization through introduction on some variable planting pattern (Pandey *et al.* 2014) [3], which also gives certain insurance against biotic and environmental stresses and gives extra yield advantage by simple expedient of growing crop (Willey 1979) [6]. Keeping these points in view, the current study was undertaken to study the effect of minimum tillage on productivity and economics of sweet corn - pulses intercropping system.

Materials and Methods
A field experiment was conducted during *kharif* 2013 at Department of Agronomy, Dr. Panjab rao Deshmukh Krishi Vidyapeeth, Akola (M.S.).The experimental soil was clay in texture, slightly alkaline in nature (pH 7.78) with normal EC (0.5 dS/m) having moderate organic carbon content (0.48%), low available nitrogen (186.06 kg/ ha.), low available Phosphorus (19.35 Kg/ha.) and high available potassium (321.49 Kg/ha.).

The field experience was laid out in Factorial Randomized Block Design with four replications. The main plot treatment The main plot treatment *viz*., S1- Conventional tillage (one Ploughing and two harrowing), S2- Minimum tillage (one harrowing) and three sub-plot treatment of intercropping I1- Sole sweet corn, I2- Sweet corn+ Green gram (1:2ratio), I3- Sweet corn + Black gram (1:2ratio).Crops were grown in 5.4×3 m plot at a spacing 90 X 10 cm for sweet corn and black and green gram intercrop sown at 30 X 5 cm. Sweet corn var.Sugar-75 was sown on 4th July 2011 with seed rate 18 kg per ha. By dibbling two seed per hill. Intercrops green gram and black gram var. Kopargaon and TAU-1 were sown same day respectively. The quantities of fertilizers to be applied were calculated on gross plot basis as per treatments. The fertilizers were given as per the recommended dose i.e. 120 kg N. The nitrogen was given in 3 split doses, 1/3 at time of sowing, 1/3 at 30 DAS and 1/3 at 50 DAS. The fertilizers used were urea (46% N) for N only. The 1/3 dose of nitrogen at time of sowing and remaining two third nitrogen was top dressed at two times i.e. one third at 30 days after sowing and one third at 50 days after sowing, by placing the fertilizers by the side of each row and covering the same with soil, through hoeing, immediately. All the data pertaining to the present investigation were statistically analyzed with FRBD as given in the Gomez and Gomez (1984) [2]. The statistical analysis of plant characters was done by variance method (Panse and Sukhatme, 1978) [4].

Result and Discussion

Biological yield, harvest index and grain to stover ratio

Data regarding Biological yield, harvest index and grain to stover ratio as influenced by different treatments are shown in table 1.

Effect of tillage

Data on biological yield showed that treatment conventional tillage (S1) produced significantly higher biological yield than minimum tillage (S2).

Effect of intercropping

Data on biological yield revealed that treatment sole sweet corn (I1) recorded significantly maximum biological yield of (218.32 q ha-1). However the lowest biological yield (195.33 q ha-1) recorded by treatment sweet corn + green gram (I2).

Interaction effect

The interaction between tillage and intercropping treatments were found to be non-significant.

Effect of tillage

Harvest index and Grain to Stover ratio was not significantly influenced due to different tillage management techniques.

Effect of intercropping

Harvest index and Grain to stover ratio was not significantly influenced due to different intercropping treatment.

Interaction effect

The interaction between tillage and intercropping treatments were found to be non-significant.

Economics

Data regarding cost of cultivation, gross monetary returns, net monetary returns and benefit: cost ratio as influenced by different treatments are shown in table 2.

Cost of cultivation

Effect of tillage

Data presenting in table 2 in relation to cost of cultivation indicated that the cost of cultivation was significantly more in (S1) conventional tillage (.38357 ha-1) than (S2) minimum tillage (34899. ha-1).

Effect of intercropping

Treatment, sweet corn + blackgram and sweet corn + green gram (I2) (. 37231 ha-1) was significantly more cost of cultivation. The lowest cost of cultivation was recorded by sole sweet corn (I1) (34521. ha-1).

Interaction effect

The interaction between tillage and intercropping treatment was found to be non-significant.

Gross and Net monetary returns

The mean gross and net monetary returns obtained from sweet corn was.178502 ha-1 and.142174 ha-1 respectively.

Effect of tillage

The data on gross monetary returns was significantly influenced due to different tillage. Maximum gross monetary returns of. 186507 ha-1 were observed with the treatment conventional tillage (S1) than minimum tillage (S2) (170496. ha-1). The data on net monetary returns were significantly influenced due to different tillage. Maximum gross monetary returns of. 148151 ha-1 were observed with the treatment conventional tillage (S1) than minimum tillage (S2) (136198. ha-1).

Effect of intercropping

The data on gross monetary returns were significantly influenced due to various intercropping practices. The treatment sweet corn + blackgram (I3) recorded highest gross monetary returns (. 194698 ha-1) followed by treatment sweet corn + green gram (I2). The lowest gross monetary returns were recorded by sole sweet corn (I1) (154115. ha-1).

The data on net monetary returns were significantly influenced due to various intercropping practices. The treatment sweet corn + blackgram (I3) recorded highest net monetary returns (. 157467 ha-1) followed by treatment sweet corn + green gram (I2). The lowest net monetary returns were recorded by sole sweet corn (I1) (119594.ha-1). Similar results were observed by Singh (2000).

Interaction effect

The interaction between tillage and intercropping treatments were found to be non-significant.

Benefit: cost ratio

Data presented in table 2 indicated that the average benefit to cost ratio of sweet corn crop was 4.91.

Effect of tillage

The higher benefit: cost ratio of 4.96 was obtained by conventional tillage (S1) treatment, than minimum tillage (S2).

Effect of intercropping

The data in table shows that, treatment sweet corn + blackgram (I3) recorded significantly maximum benefit: cost ratio of 5.23 which was closely followed by treatment sweet corn + green gram (I2) (5.02).The lowest benefit: cost ratio was obtained by the treatment sole sweet corn (I1) (4.47).

Interaction effect

The interaction between tillage and intercropping management treatments were found to be non-significant.

Table 1: Biological yield (q ha^{-1}), harvest index (%) and grain to stover ratio of corn as influenced by different treatments

Treatments	Biological yield	Harvest index%	Grain to stover ratio
Tillage			
S_1- Conventional tillage (one ploughing and two harrowing)	213.03	35.12	0.54
S_2- Minimum tillage (one harrowing)	197.46	34.25	0.52
S.E (m) ±	2.98	1.01	0.01
C.D. at 5%	9.00	NS	NS
Intercropping			
I_1- Sole sweet corn	218.32	35.10	0.54
I_2 - Sweet corn + green gram (1:2 ratio)	195.33	34.33	0.52
I_3- Sweet corn + blackgram (1:2 ratio)	202.10	34.64	0.53
S.E (m) ±	3.65	1.23	0.01
C.D. at 5%	11.02	NS	NS
Interaction effect (S X I)			
S.E (m) ±	5.17	1.74	0.02
C.D. at 5%	NS	NS	NS
General mean	205.25	34.69	0.53

Table 2: Cost of cultivation (₹. ha^{-1}), gross monetary returns (₹. ha^{-1}), Net monetary returns (₹. ha^{-1}) and benefit to cost ratio as influenced by different treatments

Treatments	Cost of cultivation (₹.ha^{-1})	Gross Monetary return (₹.ha^{-1})	Net monetary Return (₹.ha^{-1})	B:C Ratio
Tillage				
S_1- Conventional tillage (one Ploughing and two harrowing)	38356	186507	148151	4.96
S_2- Minimum tillage (one harrowing)	34298	170496	136198	4.85
S.E (m) ±	-	2862	2862	-
C.D. at 5%	-	8628	8628	-
Intercropping				
I_1- Sole sweet corn	34521	154115	119594	4.47
I_2 - Sweet corn + green gram (1:2 ratio)	37231	186692	149461	5.02
I_3- Sweet corn + blackgram (1:2 ratio)	37231	194698	157467	5.23
S.E (m) ±	-	3506	3506	-
C.D. at 5%	-	10568	10568	-
Interaction effect (S X I)				
S.E (m) ±	-	4958	4958	-
C.D. at 5%	-	NS	NS	-
General mean	36328	178502	142174	4.91

Conclusion

On the basis of the results obtained from study, it could be concluded that the conventional tillage recorded higher number of cob ha-1, biological yield, harvest index, GMR (186507 ha-1), NMR (148159 ha-1), and B: C ratio (4.96) than minimum tillage. Among intercropping treatments sweet corn + black gram recorded highest GMR (194698 ha-1), NMR (157467 ha-1), B: C ratio (5.23) followed by treatment sweet corn + green gram (I2).

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