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Productivity and Profitability of Sweet corn (*Zea mays* L. *saccharata* Sturt)-Based Intercropping Systems

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***Abstract*:** The experiment was conducted during *Kharif* season of 2017-18 at Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Wadura to evaluate the productivity and profitability of intercropping of sweet corn (*Zea mays* L. *saccharata* Sturt) with *Rajmash* (*Vigna vulgaris* L.) and soybean (*Glycine max* L. Merril). The intercrops were grown in additive series with sweet corn as regular rows of 1:1 and paired rows of 2:1 and 2:2. The experiment was laid out in randomized block design having three replications. The intercropping resulted decrease in yield and yield attributes of sweet corn comparing with sole cropping system. Among intercropping systems, sweet corn + soybean (1:1) was better than other treatments of intercropping in terms of the highest net returns of ₹ 505874/ha and benefit cost ratio of 9.00. The intercropping of sweet corn with soybean in regular rows of 1:1 ratio could achieve higher productivity and profitability among different intercropping systems.

***Keywords*:** Intercropping, Net returns, Productivity, Soybean and Sweet corn

World population is growing exponentially and there was limited scope for horizontal expansion to augment food production, the alternative is to move on with vertical growth by increasing the productivity of the available land area. The cropping system is a design representing combination of crops either in sequence or in combination grown on an area within a year in a given agro-ecological situation. An attractive strategy for increasing productivity of a cropping system per unit available land is to intensify land use by growing several annual crops simultaneously, known as intercropping system. Intercropping may prove to address some of the major problems associated with modern agriculture, thereby helping to deliver sustainable and productive agriculture. The main purpose of intercropping is to produce a greater yield on a given piece of land by making use of resources that would otherwise not be utilized by a single crop efficiently. Normally, the system involves simultaneous cultivation of a cereal and a legume with adoptable row combination on the same piece of land. Inclusion of grain legume in an intercropping system has assumed added significance in recent past particularly in India since it provides the way to sustainable crop production. Corn (*Zea mays* L.) is a multipurpose crop being consumed in the human diet, animal feed and also used in starch industry (Bibi et al 2010). It is a versatile crop, globally grown under a wide range of agro-ecological situations of tropical, sub-tropical and temperate regions over an area of 193.7 million hectare (m ha) with production of 1147.7 million metric tonnes (m Mt) and average productivity of 5.75 t/ha (FAOSTAT 2020). In India as a third most important cereal crop, maize contributed about 8% to the national food basket being grown over an area of 9.2 m ha with grain production of 27.8 million metric tonnes (m Mt) and average productivity of 2.96 t/ha during 2018-19 (Dacent 2020). The speciality corn like sweet corn *(Zea mays* L. *saccharata* Sturt.) has emerged as an alternative food source. The higher content of water soluble polysaccharide in the kernel of sweet corn adds sweetness in addition to texture and quality (Venkatesh et al 2003). Corn provides sufficient inter-row space, which can be profitably utilized for raising an intercrop like beans and soybean. Both, *rajmash* and soybean build up the soil fertility by fixing large amount of atmospheric nitrogen through the root nodules, and contribute organic matter through leaf fall on soil surface at maturity. Intercropping of these legumes helps in soil conservation and improvement of soil fertility and weed control (Belel et al 2014). The intercropping systems are being mostly adopted by small holding farmers with limited resources. Sweet corn is an input intensive and high value crop, therefore study was undertaken to find out the most compatible legume under row regular rows of 1:1 and paired rows of 2:1 and 2:2.

MATERIAL AND METHODS

The trial was conducted under irrigated conditions during *Kharif* season of 2017-18 in the experimental area at SKUAST-Kashmir, Wadura, J&K. The experimental site was located at 34˚17' N latitude and 74˚33' E longitude with an altitude of 1524 meters above mean sea level. The soil was well drained silty- clay loam, non-saline (0.37 dS/m) with neutral in reaction (pH 7.2) and contained 6.8 g/kg organic carbon, 224.5 kg/ha available nitrogen, 19.28 kg/ha available phosphorus and 163.6 kg/ha available potassium. The experiment consisted of ten treatments (Table 1). These treatments were replicated thrice and arranged in a randomized complete block design having each plot size of 4.5 m × 3.0 m. The sweet corn variety 'Mithas', bean 'French Yellow' and soybean 'Shalimar Soybean-1' were used. The different row arrangements of sole as well as intercropping systems of sweet corn and intercrops depicted in Fig. 1. Full dose of phosphorus (60 kg P_2O_5/ha) and potassium (30 kg K_2O/ha) and half dose of nitrogen (60 kg N/ha) were applied as basal dose before the sowing of sweet corn seeds while the remaining half dose of nitrogen (60 kg N/ha) was top dressed at respective critical stages i.e. first at 35 DAS and 65 DAS. In case of sole bean and soybean, 30:60:30 and 30:90:60 kg N, P_2O_5, K_2O per hectare was applied as basal dose through urea, diammonium phosphate (DAP) and murate of potash (MOP) respectively.

RESULTS AND DISCUSSION

Productivity of Sweet Corn and Intercrops (Bean and soybean)

Yield attributes of sweet corn and intercrops: Cropping system had non-significant effect on yield attributes *viz*. number of cobs/m^2, number of rows/cob, number of kernels/row, test weight, cob length and girth (with and without husk) of sweet corn (Tables 1 and 2). Since the number of cobs/plant is the genetic make-up, it could not easily be altered by the agronomic management practices. However, single green cob weight with and without husk varied markedly with significantly highest green cob weight (with and without husk) was recorded with sole sweet corn. The parameter obtained in intercropping system with bean or soybean having row ratio of 1:1 and 2:1 were at par to the sole system. The weight of single green cob decreased significantly with 2:2 row ratios (Table 2). Yield attributing characters of intercrops (bean and soybean) *viz*. number of pods/plant, number of seeds/pod and test weight were reduced due to intercropping (Table 1). Decreasing trend of these attributes with the intercropping systems to the sole cropping system could be attributed to rise in interspecific competition with sweet corn. This might be owing to increase for the competition for light and minerals and more shading in intercropping lead to decrease in photosynthesis. These results confirm the findings of Carruthers et al (2000) and Getachew et al (2006).

Table 1. Yield attributes of sweet corn and intercrops as influenced by cropping system

Treatment	Yield attributes of sweet corn				Yield attributes of intercrops		
	No. of cobs/m^2	No. of rows/cob	No. of kernels/row	Test weight (g)	Number of pods/plant	Number of seeds/pod	Test weight (g)
Sole cropping system							
Sweet corn sole (75 cm)	6.09	14.3	41.7	154.0	-	-	-
Sweet corn paired sole (50/100 cm)	6.06	13.9	44.4	151.1	-	-	-
Bean sole	-	-	-	-	16.6	5.92	299.8
Soybean sole	-	-	-	-	56.3	2.28	269.1
Intercropping system							
Sweet corn + Bean (1:1)	5.57	13.7	41.9	148.9	15.4	4.56	298.5
Sweet corn + Soybean (1:1)	6.04	13.8	42.5	149.3	52.0	2.14	269.1
Sweet corn paired + Bean (2:1)	5.51	13.4	41.5	145.7	16.0	5.60	296.5
Sweet corn paired + Soybean (2:1)	5.52	13.5	42.6	147.8	49.2	2.04	267.8
Sweet corn paired + Bean (2:2)	5.00	13.2	39.8	139.2	15.4	5.21	296.2
Sweet corn paired + Soybean (2:2)	5.42	13.3	41.5	143.0	44.9	1.91	264.8
CD (p=0.05)	NS	NS	NS	NS	-	-	-

Yields of sweet corn and intercrops: There was significantly higher green cob yield with the sole system of sweet corn both in regular and paired rows. Among intercropping system, the green cob yield obtained with sweet corn + soybean (1:1) and sweet corn + bean (1:1) were at par to the sole system. The significantly lowest green cob yield was with intercropping of paired rows of sweet corn + bean (2:2) (Table 3). The pure stand of crops maintained supremacy over the intercropping

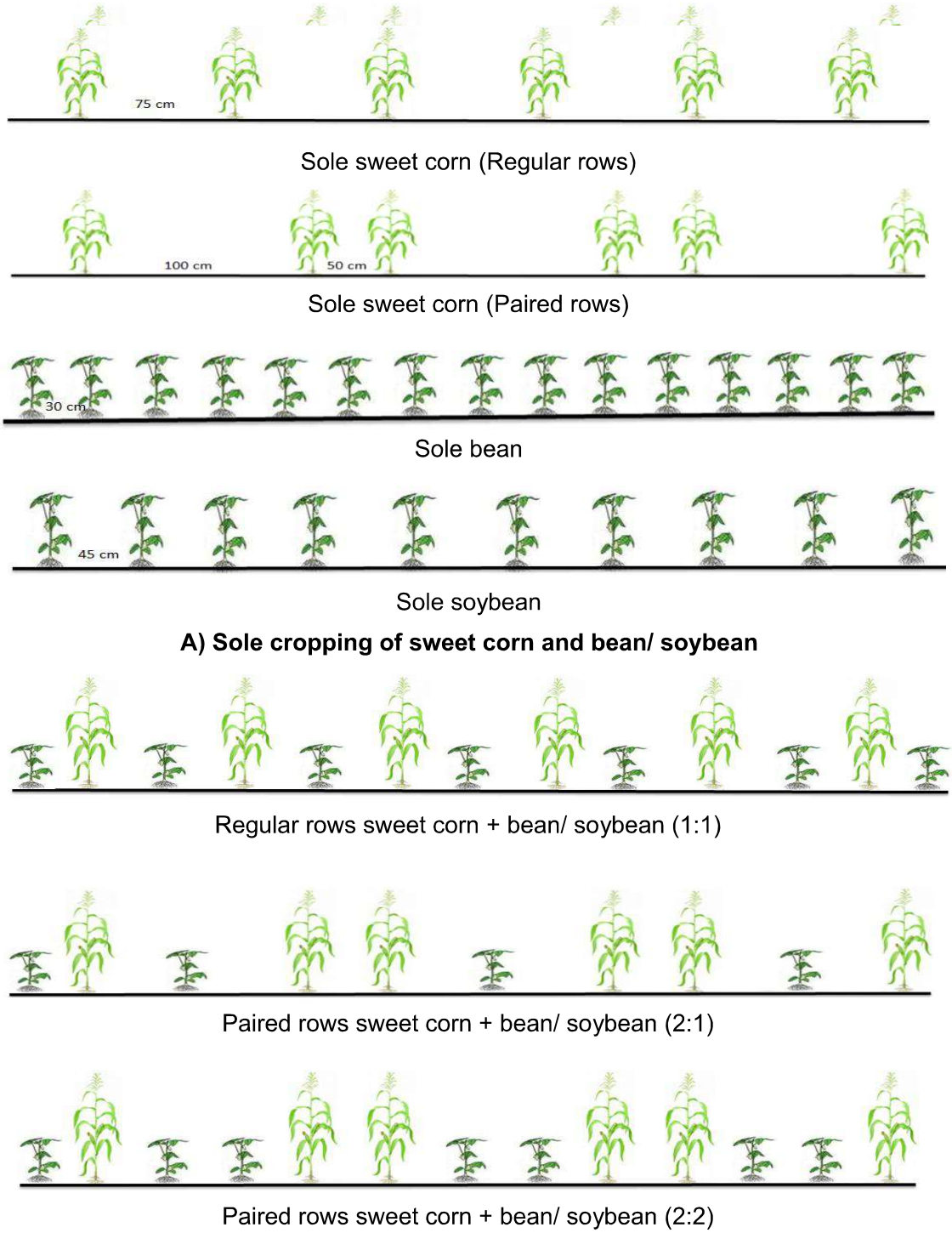

Fig. 1. Different row arrangements of sole as well as intercropping systems of sweet corn and intercrop (bean and soybean)

system with respect to economic yield, which might be attributed to limited disturbance of the habitat and interspecific competition in the sole cropping environment (Aynehband and Behrooz 2011 and Takim 2012). The trend of green fodder yield followed the green cob yield. Yield of intercrops (bean and soybean) were reduced due to intercropping with sweet corn (Table 3). Maximum seed yield of bean and soybean (1.14 and 2.30 t/ha, respectively) were recorded with the sole systems of bean and soybean followed by intercropping systems having 1:1 and 2:2 row ratios. Yield was mostly affected in the short statured under sown leguminous crops. Tall growing sweet corn plants shaded the leguminous crops and the main reason for reduction in yield was probably due to the receipt of lower amount of incoming solar radiation which affected the rate of photosynthesis and thereby translocation of photosynthates from source to sink. Relatively tall growing crop like soybean was less affected with respect to receipt of incoming solar flux. The results were also in consistent with the findings of Patra *et al* (2000). The shading effect of sweet corn plants (taller) on intercrops may also cause to decline in photosynthetic rate of lower plants (bean and soybean) and thereby yield of intercrop reduced in intercropping arrangements. Metwally *et al* (2012) reported that the reduction of light intensity caused by the corn plant reduces the photosynthetic capacity of a second crop in an intercrop pattern.

Table 2. Cob length, cob girth and green cob weight of sweet corn as influenced by cropping system

Treatment	Cob length (cm)		Cob girth (cm)		Weight of single green cob (g)	
	With husk	Without husk	With husk	Without husk	With husk	Without husk
Sole cropping system						
Sweet corn sole (75 cm)	24.3	22.4	6.30	5.70	0.58	0.41
Sweet corn paired sole (50/100 cm)	24.0	22.2	6.27	5.61	0.57	0.40
Intercropping system						
Sweet corn + Bean (1:1)	23.6	21.8	6.22	5.53	0.54	0.37
Sweet corn + Soybean (1:1)	23.8	21.9	6.24	5.56	0.55	0.39
Sweet corn paired + Bean (2:1)	23.5	21.2	6.13	5.51	0.52	0.36
Sweet corn paired + Soybean (2:1)	23.6	21.7	6.20	5.51	0.53	0.37
Sweet corn paired + Bean (2:2)	23.4	20.7	6.01	5.41	0.43	0.33
Sweet corn paired + Soybean (2:2)	23.4	21.1	6.03	5.45	0.51	0.34
CD (p=0.05)	NS	NS	NS	NS	0.08	0.04

Table 3. Yield of sweet corn and intercrops as influenced by cropping system

Treatment	Yield of sweet corn			Yield of intercrops	
	Green cob yield (t/ha)		Green fodder yield (t/ha)	Seed yield (t/ha)	Straw yield (t/ha)
	With husk	Without husk			
Sole cropping system					
Sweet corn sole (75 cm)	32.7	23.1	32.4	-	-
Sweet corn paired sole (50/100 cm)	32.2	22.7	31.7	-	-
Bean sole	-	-	-	1.14	2.79
Soybean sole	-	-	-	2.30	5.91
Intercropping system					
Sweet corn + Bean (1:1)	30.6	22.6	30.7	0.46	1.38
Sweet corn + Soybean (1:1)	31.4	23.0	31.6	1.41	4.02
Sweet corn paired + Bean (2:1)	27.3	20.1	27.5	0.25	0.68
Sweet corn paired + Soybean (2:1)	30.3	20.1	30.0	0.76	2.07
Sweet corn paired + Bean (2:2)	24.2	18.2	22.0	0.42	1.20
Sweet corn paired + Soybean (2:2)	27.2	18.5	23.0	1.28	3.62
CD (p=0.05)	4.4	3.1	4.2	-	-

Table 4. Economics as influenced by cropping systems of sweet corn, bean and soybean

Treatment	Total cost of cultivation (₹/ha)	Gross return (₹/ha)	Net return (₹/ha)	B: C ratio
Sole cropping system				
Sweet corn sole (75 cm)	52475	523344	470869	8.97
Sweet corn paired sole (50/100 cm)	52475	516318	463843	8.84
Bean sole	34375	92582	58207	1.69
Soybean sole	34135	73239	39104	1.15
Intercropping system				
Sweet corn + Bean (1:1)	57225	551109	493884	8.63
Sweet corn + Soybean (1:1)	56225	562099	505874	9.00
Sweet corn paired + Bean (2:1)	56025	476462	420437	7.50
Sweet corn paired + Soybean (2:1)	55025	481401	426376	7.75
Sweet corn paired + Bean (2:2)	57825	444912	387087	6.69
Sweet corn paired + Soybean(2:2)	55825	463995	408170	7.31

Economics: The maximum gross return, net return and B:C ratio was obtained with sweet corn + soybean (1:1) followed by sole systems of sweet corn (Table 4). In agreement with these results, higher net monetary return was also reported by Meena et al (2006) and Sonam et al (2014).

CONCLUSION

Cereal-legume intercropping systems have higher productivity than sole cropping systems. The soybean was more suitable for intercropping with sweet corn compare to bean. Among intercropping system, green cob and green fodder yields showed significantly higher with sweet corn + soybean (1:1) which was closely followed by sweet corn + bean (1:1). Seed yield of intercrops under sole cropping were higher when compared with their intercropping yields. Among different cropping system, intercropping of sweet corn with soybean in regular rows of 1:1 ratio was more biologically and economically viable intercropping system for irrigated silty clay loam soil of Kashmir valley.

REFERENCES

Aynehband A and Behrooz M 2011. Evaluation of cereal legume and cereal pseudo-cereal intercropping systems through forage productivity and competition ability. *American Eurasian Journal of Agricultural and Environmental Science* **10**: 675-683.

Belel MD, Halim RA, Rafii, MY and Saud HM 2014. Intercropping of corn with some selected legumes for improved forage production: A review. *Journal of Agricultural Science* **6**(3): 48-62.

Bibi Z, Khan N, Akram M, Khan Q, Khan, MJ, Batool S and Makhdum K 2010. Integrating cultivars with reduced herbicides rates for weed management in maize. *Pakistan Journal of Botany* **42**(3): 1923-1929.

Carruthers K, Prithiviraj B, Cloutier D, Martin RC and Smith DL 2000. Intercropping corn with soybean, lupine and forages: Yield component responses. *European Journal of Agronomy* **12**: 103-115.

Dacnet 2020. *Agricultural Statistics at a Glance 2020*. Government of India, Ministry of Agriculture and Farmers Welfare, Department of Agriculture, Cooperation and Farmers Welfare, Directorate of Economics and Statistics, New Delhi.

FAOSTAT 2020. http://www.fao.org

Getachew A, Ghizaw A and Sinebo W 2006. Yield performance and land- use efficiency of barley and faba bean mixed cropping in Ethiopian high lands. *European Journal of Agronomy* **25**: 202-207.

Meena OP, Gaur BL and Singh P 2006. Effect of row ratio and fertility levels on productivity, economics and nutrient uptake in maize (*Zea mays*) + soybean (*Glycine max*) intercropping system. *Indian Journal of Agronomy* **51**(3): 178-82.

Metwally AEA, Shafik MM and Tamer AW 2012. Effect of intercropping corn on Egyptian cotton characters. *The Journal of Cotton Sciences* **16**: 210-219.

Patra B C, Mandal B K and Padhi A K 2000. Production potential of winter maize (*Zea mays*)- based intercropping systems. *Indian Journal of Agricultural Sciences* **70**(4): 203-206.

Sonam S, Jha AK and Shrivastava A 2014. Evaluation of different intercropping systems for productivity and economics in maize (*Zea mays* L.). *Annual Agriculture Research* New Series **35**(2): 200-204.

Takim F O 2012. Advantages of maize-cowpea intercropping over sole cropping through competition indices. *Journal of Agriculture and Biodiversity Research* **1**: 53-59.

Venkatesh S, Sanjay R and Shekhar J C 2003. Sweet corn. *Speciality corn technical Series 1*, Directorate of Maize Research, New Delhi. p 1-3.

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