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Baby corn (*Zea mays* L.) performance as vegetable-cum-fodder in intercropping with legume fodders under different planting patterns

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Abstract
A field experiment was conducted to study the Baby corn (*Zea mays* L.) performance as vegetable-cum-fodder in intercropping with different fodders at the Agricultural College Farm, Bapatla during *rabi*, 2006-07. Paired row planting of baby corn resulted in significantly higher number of ears plant^{-1}, ear weight and baby corn yield followed by normal row planting of baby corn. Baby corn + cowpea intercropping resulted in higher baby corn ear equivalent yield, total dry matter and green fodder. Quality parameters like crude protein content and crude protein yield was also high in baby corn + cowpea intercropping, while highest crude fibre content was recorded in paired row planting of fodder corn. The highest monetary returns were realized in paired row planting of baby corn followed by baby corn + cowpea intercropping.

Key words: Baby corn, Fodder corn, Intercropping pattern, Economics

India is basically an agrarian country with 56% of its population having agriculture as their main occupation. The annual growth rate of India's human and livestock population is 2.4 and 1.4 % per annum respectively. A steady explosion of both human and livestock population with shortage of cultivated land lead to agricultural intensification, changing land use pattern and closer integration of crop and livestock components. The outcome of the intensification was associated with declining soil fertility and inadequate quality fodder supply to the livestock. Exploring the mitigation options against intensification, efforts were made to cultivate cereals intercropped with forage legumes to fulfill the nutrient demand of the expanding ruminant population (Christiansen *et al*., 2000). A recent development in corn cultivation is harvesting corn for young, fresh, sweet and tender ears for vegetable purpose, which is called as baby corn (Ramachandrappa *et al*., 2004). Baby corn cultivation provides avenues for crop diversification, value addition and revenue generation besides giving good quality green fodder, which adds enormously to the total economic returns (Pandey, 2004). Baby corn being a relatively new introduction in our country, requires development of production technology especially intercropping with legume fodders in realizing higher ear production with good quality fodder. When intercropping is practiced with the objectives of realizing higher yield in food: fodder cropping system, adopting different planting pattern is another agronomic manipulation where two or more crops are accommodated (Pandey *et al*., 1999). Therefore, for increasing the profitability of land and fitting high yielding legumes as fodder crops in food: fodder cropping system, the crop : livestock production should be properly balanced (Mohapatra and Pradhan, 1992). Since, there is not much information quantifying the effect of fodder crops on baby corn both for ears as well as fodder purpose, the present study was undertaken.

The field experiment was conducted during the *rabi* season of 2006-07 at the Agricultural College Farm, Bapatla. The soil of the experimental field was clay loam having pH 7.7, low in organic carbon content (0.32%) and available nitrogen (222 kg/ha), medium in available phosphorus (24 kg/ha) and high in available potassium (618 kg/ha). The experiment was laid out in Randomized Block Design, replicated thrice with eight treatments. The treatment details are T_1: Fodder corn sole, T_2: Baby corn sole, T_3: Fodder corn paired rows, T_4: Baby corn paired rows, T_5: T_4 + Cowpea intercrop, T_6: T_4 + Clusterbean intercrop, T_7: T_4 + Pillipesara intercrop, T_8: T_4 + Fodder corn intercrop. Baby corn (Mridula), Fodder corn (African tall), Cowpea (EC-4216), Clusterbean (Bundel Guar-1) and Pillipesara (Local) were sown on 25-11-2006 as per the treatments. Baby corn and fodder corn sole crops were sown at 45 x 15 cm whereas in paired row planting 30 cm between rows in a pair and 60 cm between two pairs was followed.

For intercrops viz., cowpea, clusterbean, pillipesara and fodder corn 30 x 10 cm was adopted in between two pairs of baby corn. Fertilizer schedule recommended to baby corn *i.*e., 150:75:40 kg N,P_2O_5 and K_2O/ha was adopted in the experiment. Half of the nitrogen fertilizer and full dose of the phosphotic and potassic fertilizers were applied at the time of sowing. Remaining half of the nitrogenous fertilizer was applied as topdressing at 30 DAS. At 20, 40 and 60 DAS, all biometric observations were recorded from tagged plants. Detasseling was done immediately after the emergence of male inflorescence in the plant. The immature green ears were harvested at 2-3 days after silk emergence, weighed and marketed as fresh @ Rs. 7.00/kg. The crop was harvested as green fodder after complete ear picking and sold @ Rs. 0.30/kg. Green fodder yield of corn and intercrops was weighed separately and total green fodder was expressed in t ha^{-1}. The nitrogen percent in whole plant was determined by Modified micro-kjeldahl method (Jackson, 1973) and the percent crude protein was obtained by multiplying nitrogen percent with factor 6.25. The crude fibre content was estimated by the method described by Wright (1939). The data were analyzed statistically, when the original data consists of zero square root $\sqrt{(x+0.5)}$ transformation was used.

The highest number of ears (2.53/plant) was found in baby corn sown in paired rows which was significantly superior to baby corn + fodder corn intercropping (Table 1). Ear weight with and without husk was highest (43.04 g and 8.50 g) in paired rows of baby corn which was significantly superior to the remaining baby corn treatments, except baby corn sown in normal rows. When baby corn was sown in paired rows, there was an efficient utilization of soil, water, nutrients and light, which might had resulted in higher growth parameters. This increased growth could be the possible reason for higher yield attributes. Further, in a cereal legume combination, there could be a synergistic interaction between the cereal and legume due to their differential genetic and morphological make up and differential exploitation of natural resources and their efficient utilization. Higher growth and yield attributes in paired row planting of baby corn were also reported by Choudhary *et al*. (2006) and Panwar and Munda (2006). Further when baby corn was intercropped with fodder corn, intra-specific competition existed between baby corn and fodder corn, may be due to the similarities in their growth, morphology and physiology. This was reflected in lower growth parameters, resulting in significantly the lowest yield attributes in baby corn + fodder corn.

Baby corn ear yield with and without husk was the highest (10848 kg/ha and 1849 kg/ha) in paired rows of baby corn and was comparable with sole baby corn in normal rows, whereas the lowest ear yield was observed in paired rows of baby corn intercropped with fodder corn. The factors for which competition may occur among plants are water, nutrients, light and oxygen (Donald, 1963). He considered that close spacing varieties display their susceptibilities to competitive effects, whereas at wide spacing, they show their different capacity to use a more extensive environment. In paired row sown corn, there was an efficient utilization of all natural resources and was expressed as increased growth and yield attributes. Choudhary *et al*. (2006) and Panwar and Munda (2006) also reported similar results. Some favourable phenomena in corn + legume mixtures might be the reason for the better ear yield of baby corn intercropped with legume fodders. Mohaptra and Pradhan (1992) and Pandey *et al*. (1999) also observed the similar higher corn yield when intercropped with legumes. Baby corn intercropped with fodder corn recorded lower yields due to their competitive effects. Singh and Bajpai (1991) and Paradkar *et al*. (1993) also reported similar reduced yield in cereal + cereal intercropping.

Baby corn ear equivalent yield was the highest (11044 kg/ha) in baby corn + cowpea and was comparable with baby corn sown in paired and normal rows and baby corn intercropped with clusterbean and pillipesara (Table 1). The increase in baby corn ear equivalent yield was 82% in baby corn+ cowpea compared to babycorn+fodder corn intercropping. Significantly the lowest ear equivalent yield (2027 kg/ha) was recorded in fodder corn sole crop. Higher baby corn ear equivalent yield in baby corn + cowpea intercropping might be due to nitrogen fixing behaviour of legume and higher canopy cover resulting in the reduced evapotranspiration and encouraging the baby corn to use the natural resources efficiently. Similar results of higher corn equivalent yield with legume intercropping were reported by Singh and Bajpai (1991) and Pandey *et al*. (1999).

Baby corn intercropped with fodder corn recorded the highest total green and dry fodder yields (68.1 t/ha and 13.2 t/ha) over all other treatments and was comparable with baby corn + cowpea intercropping (Table 2). The lowest green fodder yield (47.3 t/ha) was recorded in sole fodder corn in normal rows.

It is reasonable to suggest that, two species of contrasting habit, with respect to branching, leaf distribution, height, root distribution, mineral uptake or other morphological or physiological characters, will together be able to exploit the total environment more effectively than a monoculture, and will thereby give increased overall yield (Donald, 1963). Hence, baby corn intercropped with cowpea fodder could result in the higher green and dry fodder yields. Similar results of increased fodder yields in fodder corn intercropped with cowpea were also reported by Mohapatra and Pradhan (1992), Patel and Rajgopal (2001) and Kumar *et al.* (2005).

Table 1: Yield attributes, baby corn yield and baby corn ear equivalent yield as influenced by different treatments

Treatment	Number of ears plant^{-1}	Ear weight (g)		Yield (kg/ha)		Baby corn ear equivalent yield (kg/ha)
		With husk	Without husk	With husk	Without husk	
T_1: Fodder corn sole	0.71	0.71	0.71	0.71	0.71	2027
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	
T_2: Baby corn sole	1.72	6.29	2.84	102.16	41.66	10437
	(2.46)	(39.06)	(7.56)	(10437)	(1735)	
T_3: Fodder corn paired rows	0.71	0.71	0.71	0.71	0.71	2070
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	
T_4: Baby corn paired rows	1.74	6.60	3.00	104.16	43.01	10848
	(2.53)	(43.04)	(8.50)	(10848)	(1849)	
T_5: T_4 + Cowpea intercrop	1.68	6.10	2.72	99.47	40.95	11044
	(2.33)	(36.75)	(6.90)	(9894)	(1676)	
T_6: T_4 + Clusterbean intercrop	1.66	5.99	2.70	98.18	40.43	10473
	(2.26)	(35.35)	(6.77)	(9638)	(1634)	
T_7: T_4 + Pillipesara intercrop	1.60	5.71	2.64	97.17	39.53	10142
	(2.06)	(32.05)	(6.48)	(9442)	(1562)	
T_8: T_4 + Fodder corn intercrop	1.47	5.17	2.41	66.16	32.84	6068
	(1.66)	(26.21)	(5.30)	(4376)	(1078)	
SE m ±	0.06	0.16	0.07	1.43	0.63	320.0
CD (P = 0.05)	0.20	0.48	0.21	4.34	1.93	970.7
CV (%)	8.13	5.83	5.46	3.48	3.68	7.0

The data are $\sqrt{(x+0.5)}$ transformed. The figures in parenthesis are the original values.

Table 2: Green and dry fodder yield (t/ha) of baby corn as influenced by different treatments

Treatment	Green fodder yield			Dry fodder yield		
	Corn	**Intercrop	Total	Corn	**Intercrop	Total
T_1: Fodder corn sole	47.3	-	47.3	10.1	-	10.1
*T_2: Baby corn sole	53.7	-	53.7	9.7	-	9.7
T_3: Fodder corn paired rows	48.3	-	48.3	10.3	-	10.3
*T_4: Baby corn paired rows	54.7	-	54.7	9.9	-	9.9
*T_5: T_4 + Cowpea intercrop	50.5	16.1	66.6	8.8	2.7	11.5
*T_6: T_4 + Clusterbean intercrop	49.8	11.7	61.5	8.5	1.9	10.4
*T_7: T_4 + Pillipesara intercrop	48.8	9.8	58.6	8.4	1.6	10.0
*T_8: T_4 + Fodder corn intercrop	28.6	39.5	68.1	5.1	8.1	13.2
SE m ±	2.62	-	3.06	0.45	-	0.62
CD (P = 0.05)	7.96	-	9.28	1.38	-	1.90
CV (%)	9.52	-	9.24	8.86	-	10.15

* Green ear husk was also added to stover and represented as green fodder in baby corn.

** Data was not statistically analyzed

Table 3: Crude protein content, crude protein yield, crude fibre content and economics of baby corn as influenced by different treatments

Treatment	Crude protein content (%)		Crude fibre content (%)		Total crude protein yield (kg/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	Benefit cost ratio
	Corn	*Intercrop	Corn	*Intercrop				
T_1: Fodder corn sole	8.20	-	30.25	-	713	14,190	4,882	0.52
T_2: Baby corn sole	8.12	-	26.92	-	629	89,120	65,222	2.72
T_3: Fodder corn paired rows	8.33	-	31.84	-	756	14,490	5,182	0.55
T_4: Baby corn paired rows	8.25	-	27.60	-	678	92,290	68,392	2.86
T_5: T_4 + Cowpea intercrop	8.73	17.4	25.71	23.94	1001	92,430	67,802	2.75
T_6: T_4 + Clusterbean intercrop	8.62	16.73	25.90	24.21	940	88,200	62,562	2.44
T_7: T_4 + Pillipesara intercrop	8.55	16.18	25.32	20.56	855	85,620	61,342	2.52
T_8: T_4 + Fodder corn intercrop	7.01	7.65	23.76	27.97	732	51,020	26,262	1.06
SE m ±	0.31	-	0.30	-	36.4	2871	1901	0.07
CD (P = 0.05)	0.97	-	0.91	-	110.5	8709	5766	0.23
CV (%)	6.74	-	2.92	-	8.0	7.54	7.28	7.04

*Data not analyzed statistically

The highest crude protein content (8.73%) was recorded in baby corn + cowpea intercropping and was found to be at par with all the treatments except baby corn intercropping with fodder corn, which was found to be significantly lowest (Table 3). Baby corn intercropped with fodder corn was thinner and dwarfer due to competition and subjected to harmful shading. Hence, baby corn registered the lowest crude protein content. Similar results of lower crude protein content in corn intercropped with sorghum were also reported by Singh *et al*. (2005).

The highest gross returns (Rs. 92,430/ha) were recorded by baby corn + cowpea intercropping followed by paired row planting of baby corn (Table 3). Moreover, baby corn grown in paired rows recorded highest net returns (Rs.68,392/ha) and benefit cost ratio (2.86) followed by baby corn + cowpea intercropping. This was due to increase in ear yield in paired row planting of baby corn. The gross returns, net returns and benefit cost ratio obtained from sole fodder corn normal was significantly lowest than all the treatments except fodder corn in paired rows. Similar results of higher monetary returns in paired row planting of baby corn were also reported by Panwar and Munda (2006).

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