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Research Paper

Performance of baby corn (*Zea mays*) under different fertility levels and planting methods and its residual effect on sorghum (*Sorghum bicolor*)

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ABSTRACT

A field trial was conducted at Varanasi during 2010–11 and 2011–12, to study the effect of fertility levels and planting methods on growth, yield, nutrient uptake and economics of baby corn (*Zea mays* L.) and its residual biomass incorporation effect on sorghum [*Sorghum bicolor* (L.) Moench]. The experiment was carried out in a spilt-plot design with 4 replications. The main plots were allocated with fertility levels F_0 (no fertilizer as control), F_1 (75, 19.64, 37.35, 20 and 5), F_2 (150, 39.28, 74.71, 40 and 10) and F_3 (225, 46.76, 112.06, 60 and 15) kg/ha of N, P, K, S and Zn and sub-plots with combinations of 2 planting methods (flat bed and raised bed) and 2 varieties viz; ('Pro-Agro 4212' and 'Sweet Corn Sugar 75'). Application of 225, 46.76, 112.06, 60 and 15 kg/ha of N, P, K, S and Zn fertility level significantly increased plant growth, yield, yield attributes and nutrient removal over rest of the treatments. Overall, this particular fertility level registered 55.0% more yield (without husk) than control. Among the sub-plot treatments raised bed planting recorded the highest plant height, leaf-area Index, dry-matter production, nutrient removal and registered 12.5% more baby corn yield (without husk) than flat bed, while 'Pro-Agro 4212' also recorded the same and registered 18.8% more baby corn yield (without husk) than Sweet Corn 'Sugar 75'. Further, 225, 46.76, 112.06, 60 and 15 kg/ha fertility levels applied to previous crop increased the sorghum grain yield by (33.3%) over the control.

***Key words* :** Baby corn, Crop residue, Level of fertilizers, Nutrient removal, Planting methods

Baby corn is unfertilized maize ear which is harvested within 2 to 3 days of silk emergence. The plant enters into the reproductive phase within 45–55 days after sowing and being a short-duration crop (60–70 days), it can be grown 3 to 4 times in a year. Its requirement of nutrient is very high (GoI, 2007) and the importance of nutrient (N, P and K) in maize becomes even more relevant when it is grown as baby corn because of its high plant density and very short duration.

Tillage-based planting methods have exhibited a positive effect on maize yield and shown great promise in increasing productivity (Zhang *et al*., 2012) by improving nitrogen-use efficiency and enhancing carbohydrate, sugars, starch and protein content and ultimately yield (Fahong *et al*., 2004). Incorporation of crop residues in conservation tillage system improves tilth and fertility of soil, reduces wind and water erosion, and prevents run-off and leaching losses of nutrients (Shafi *et al*., 2007). India is the third largest producer of sorghum in the world and a good source of feed, fiber, and biofuel (GoI, 2007). Keeping this in view, the experiment was conducted to study the effect of nutrients and planting methods on the performance of baby corn and the residual effect of baby corn biomass on the succeeding sorghum.

MATERIALS AND METHODS

The trial was conducted to study the influence of fertility levels and planting methods on baby corn varieties and the residual effect of its biomass on sorghum yield during the pre *kharif* seasons of 2009–10 and 2010–11 at the agricultural research farm, Banaras Hindu University, Varanasi (25°21'21.6''N and 82°52'37.7''E, and is situated at an altitude of 76 m from mean sea-level) Uttar Pradesh, in the northern Gangetic alluvial plains. During baby corn-growing period temperature ranged from 27 to 41.5°C, while succeeding sorghum underwent comparatively cooler temperature ranging from 9.1 to 33.1°C. The experimental site was fairly uniform in topography and well drained in nature.

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The soil was sandy clay loam, having pH (7.31), electrical conductivity (0.31dS/m at 25°C) and moderate fertility with 0.43% organic carbon, 202.8 kg/ha available N, 18.95 kg/ha available P, 207.1 kg/ha available K, 18.58 kg/ha available S and 0.52 ppm available Zn. The experiment consisting of 4 fertility levels F_0 (no fertilizer as control), F_1 (75, 19.64, 37.35, 20 and 5), F_2 (150, 39.28, 74.71, 40 and 10) and F_3 (225, 46.76, 112.06, 60 and 15) kg/ha of N, P, K, S and Zn and 2 methods of planting (flat bed and raised bed) along with 2 varieties (Pro-Agro 4212 and 'Sugar 75') making 16 treatment combinations, was laid out in a split-plot design with 4 replications by keeping fertility levels in the main plot and planting methods and varieties in the subplots. Nutrients (N, P, K, S and Zn) were applied as per treatment through urea, diammonium phosphate, muriate of potash, elemental sulphur and zinc oxide respectively. Half of the recommended dose of nitrogen and full doses of P, K and Zn were applied basal and rest half of nitrogen was top-dressed through urea at knee-high stage. The full dose of sulphur was incorporated into the soil uniformly in accordance with the treatments through elemental sulphur about 25 days before to sowing of crop.

Seeds were sown on 18 and 14 May in the first year and second year of experimentation, respectively and hand weeding was done at 25 days after sowing to remove the weeds which was followed by light scrapping to provide proper aeration to the plant roots. Uniform application of Furadon @ 5 kg/ha at the tip of the stem was made to control shoot borers (*Chilo partellus* and *Sesamia inferens*) at 25 days during both the years. Other intercultural operations were carried out as per requirement of crop. Baby corn (unfertilized maize ear) was harvested at 2–3 days of silk emergence stage and marketed as fresh corn (without husk) @ ₹100/kg (local market price). After harvesting of the baby corn cob the whole plant biomass cut at ground level was spread over the same plots in small pieces. The seeds of sorghum (Dhanarasi, SRSH-909) were dibbled in the same lay out without any addition of fertilizer to study the residual effect of the first crop.The weeds were removed by hand-weeding at 4-week and 8 week crop stages and all intercultural operations were carried out as per requirement of crop.

Nitrogen content in cob and straw was determined by modified Kjeldahl method (Jackson, 1973), and phosphorus was estimated by Vandomolybdo-phosphoric acid yellow colour method using the Barton's reagent as suggested by Jackson (1973). The potassium content was estimated with the help of flame photometer (Jackson, 1973) and sulphur by Turbidimetric method (Chesnin and Yien, 1951), while zinc was worked out by Atomic Absorption Spectrophotometry method (Lindsay and Norvell, 1978) and was expressed in percentage. Baby corn performance was evaluated in terms of plant height, leaf-area index, dry-matter production, baby corn (with and without husk) and stover yields as well as nutrient removal by the crop.

The cost of baby corn cultivation was calculated on the basis of prevailing rates of inputs, and gross income on the basis of procurement price of baby corn cobs. Since the total biomass left was added to the soil, it was not included in the income. The income was obtained by subtracting the cost of cultivation from the gross return.

Sorghum was evaluated in terms of yield and yield attributes only. System productivity was worked out as per the methodology given by Devasenapathy (2008). The price of inputs and market price of the output (current) of both crops were considered to work out the cost of cultivation and gross returns. The net return per ha was calculated by deducting the cost of cultivation per ha from gross income. Benefit: cost ratio was worked out. The data collected from the experiment at different growth stages and at harvest were to statistically analysed as per by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Growth attributes

Application of nutrients at 225, 46.76, 112.06, 60 and 15 kg/ha of N, P, K, S and Zn had significant effect on plant height, dry-matter production and leaf area index (Table 1) which were found to be 23.34%, 33.47% and 42.94% higher than the control. Rapid division and elongation of cells with increasing fertility level particularly N and greater availability of nitrogen at higher fertilizer doses which improved photosynthesis as well as protein synthesis ultimately led to vigorous plant growth. Sobhana *et al.* (2012) also reported similar effects of higher fertilization on growth of maize grown for baby corn.

Marked improvement in plant height, dry matter production and leaf-area index was observed with raised bed planting system in comparison to flat bed system (Table 1). Advantages of raised bed planting include improved soil structure, reduced compaction of soil and more aeration of rhizosphere (Fahong *et al*., 2004), which finally results in better plant growth. Higher growth attributes observed in Pro-Agro 4212 than 'Sweet Corn Sugar 75' indicated the existence of genotypic variation between hybrid and sweet corn.

Yield

The fertility levels resulted in marked improvement in the yield of baby corn (both with and without husk) and total stover. The fertility level of 225, 46.76, 112.06, 60 and 15 kg/ha of N, P, K, S and Zn registered the highest yield. Overall 225, 46.76, 112.06, 60 and 15 kg/ha of N, P, K, S and Zn recorded 55.0% increase in yield (without husk) over the control. Better utilization all these nutrients resulted in higher leaf area, photosynthetic activity and total dry-matter production which in turn led to higher cob and stover yields. Panwar and Munda (2006) also reported similar results of higher yields of baby corn at higher fertility level.

Baby corn (with and without husk) and total stover yields were higher in raised bed system than in flat bed system (Table 1). Raised bed, a tool of conservation tillage, by virtue of good surface drainage, better placement of fertilizer, more efficient N uptake and better photosynthetic leaf function resulted in better plant growth and dry matter accumulation (Zhang *et al*., 2012) which ultimately improved the yields.

The varieties also had a significant effect on yields. 'Pro-Agro 4212' produced 18.8% more baby corn, (without husk), 17.0% (with husk) and 15.9% more stover than 'Sweet Corn Sugar 75'. The significant differences between baby corn varieties on these traits confirmed their genetic diversity.

'Pro-Agro 4212' was found to interact significantly with 225, 46.76, 112.06, 60 and 15 kg/ha of N, P, K, S and Zn and registered higher baby corn (with and without husk) and stover yields (Table 2) than the other treatments. Increased yield might be owing to inherent genetic potential and higher source-sink relationship which resulted in enhanced supply of photosynthates for formation of more robust (length, girth and weight) baby corn. These results are in conformity with the findings of Sahoo and Mahapatra (2007), who also observed an increase in yield at higher fertility level.

Nutrient removal

In general, the nutrient removal of N, P, K, S and Zn by baby corn and stover was higher during 2011 than 2010 and it varied significantly with respect to different fertility levels. Fertility level of 225, 46.76, 112.06, 60 and 15 kg/ha of N, P, K, S and Zn recorded the highest nutrient removal, which was statistically superior to other treatments (Table 3). This increase was mainly owing to an increase in dry-matter production and yields (both baby corn and stover) through higher application of the respective nutrients. Sobhana *et al.* (2012) also observed higher content and removal of N, P, K, S and Zn with increasing levels of applied nutrient.

Raised bed planting method registered significantly higher total nutrient removal, viz. N, P, K, S and Zn (0.3 kg/ha) by baby corn than flat bed (Table 3). Advantages of raised bed planting methods in terms of enhanced fertilizer-use efficiency, reduced crop lodging and decreased incidence of diseases are already well documented (Fahong *et al*., 2004). All these advantages increased baby corn yield without husk by 8.0%, baby corn with husk by 8.2% and stover yield by 7.3% over flat bed which correspondingly increased the total nutrient removal by plant.

Table 1. Effect of fertility levels, planting methods and varieties on plant height, dry-matter production, leaf-area index (LAI) at harvest, baby corn (with and without husk) and stover yields (pooled data of 2010–11 and 2011–12)

Treatment	Plant height (cm) Mean	Dry-matter (g/plant) Mean	Leaf-area index (LAI) Mean	Baby corn without husk (t/ha) Mean	Baby corn with husk (t/ha) Mean	Stover yield (t/ha) Mean
Fertility level (*kg/ha N, P_2O_5, K_2O, S* and *Zn*)						
Control	173.1	139.6	3.6	0.9	5.0	18.1
75, 45, 45, 20 and 5	201.0	179.5	4.7	1.4	7.8	26.7
150, 90, 90, 40 and 10	217.4	192.1	5.5	1.7	9.2	32.8
225, 135, 135, 60 and 15	225.8	209.8	6.3	2.0	10.2	36.2
SEm±	2.7	2.4	0.2	0.1	0.3	0.9
CD (P=0.05)	8.5	7.6	0.6	0.2	0.9	3.0
Planting methods						
Flat bed	196.4	173.7	4.8	1.4	7.7	27.4
Raised bed	212.2	186.8	5.3	1.6	8.4	29.5
SEm±	2.5	2.2	0.1	0.03	0.2	0.6
CD (P=0.05)	7.1	6.2	0.3	0.1	0.5	1.8
Varieties						
'Pro-Agro 4212'	217.7	193.0	5.5	1.6	8.8	30.9
'Sugar 75'	190.9	167.5	4.6	1.3	7.3	26.0
SEm±	2.5	2.2	0.1	0.03	0.2	0.6
CD (P=0.05)	7.1	6.2	0.3	0.1	0.5	1.8

Singh *et al*. (2010) reported that N and P uptake by the pigeonpea under permanent raised bed was higher than flat bed system.

Total nutrient removal (N, P, K, S and Zn) was increased significantly by ‘Pro-Agro 4212’ and it was 13.6% (N), 15.0% (P), 13.4% (K), 15.9% (S) and 11.5% (Zn) more than ‘Sweet Corn Sugar 75’. It was therefore quite natural that with higher yield ‘Pro-Agro 4212’ would register greater nutrient removal.

Soil nutrient status after harvesting of baby corn

Amongst the fertility levels, 225, 46.7, 112.1, 60 and 15 kg/ha of N, P, K, S and Zn had maximum available N, P, K, S and Zn in soil (Table 4). Increase in the level of N, P, K, S and Zn also ensured availability of these nutrients to the crop plants in adequate amount which remained in soil in substantial quantity after fulfilling the crop requirement that ultimately improved the soil fertility. It was confirmed by the findings of Saha and Mondal (2006).

Raised bed method recorded significantly higher N, P, K, S and Zn content in soil after harvesting of baby corn. The increase in nutrient content in soil after harvesting of baby corn was due the fact that in raised bed method, there was no stagnation of water in the rhizosphere of the plant, decreasing the loss of nutrients through leaching, volatilization and erosion which helped in increasing the availability of nutrient. Limon-Ortega *et al* (2006) also reported from wheat trial that the grain yield was consistently higher under permanent bed when plant residues were left on the soil surface but not so when the residues were removed.

Sorghum yield

Sorghum yield (grain and stover) and yield attributes viz. grains/plant, 1,000-grain weight and grain weight/ear (Table 5) were higher during 2011 than 2010. Higher rainfall in 2011 increased the plant growth and ears/plant in the second year. Residual effect of 225, 46.76, 112.06, 60 and 15 kg/ha of N, P, K, S and Zn increased the sorghum grain yield by 33.3%, grain/plant by 44.2%, 1,000-grain weight by 23.5%, grain weight/ear by 59.3% and sorghum stover yield by 23.9% over the control (Table 5). Higher quantity of residue associated with greater nutrient content at higher fertility level enriched the soil physical and chemical characters which were reflected in higher sorghum yield.

Raised bed system is more suitable for application of crop residue and this practice reduced soil erosion, surface runoff and mineralization of organic matter and organic carbon. However, under raised bed and crop residue a 2-year lag period was required to adjust to the new management conditions as reported by Ghuman and Sur (2001). Baby corn residue applied to raised bed system improved sorghum yield by 7.5% and stover yield by 7.0% over flat

Table 2. Interaction effect of fertility levels, planting methods and varieties on yield of baby corn (with and without husk) and stover (t/ha) (pooled data of 2010–11 and 2011–12)

Treatment	F_0	F_1	F_2	F_3	Mean
Baby corn (without husk)					
‘Pro-Agro 4212’	1.0	1.6	1.8	2.2	1.6
‘Sweet Corn Sugar 75’	0.8	1.3	1.5	1.6	1.3
SEm±				0.1	
CD (P=0.05) different sub treatment vs same mean treatment		0.2			
SEm±		0.1			
CD (P=0.05) different sub treatment for different main treatment		0.3			
Baby corn (with husk)					
‘Pro-Agro 4212’	5.3	8.4	9.9	11.6	8.8
‘Sweet Corn Sugar 75’	4.7	7.2	8.6	8.8	7.3
SEm±				0.4	
CD (P=0.05) different sub treatment vs same mean treatment			1.0		
SEm±			0.4		
CD (P=0.05) different sub treatment for different main treatment			1.6		
Stover yield					
Pro-Agro 4212	19.1	28.5	35.0	40.9	30.9
‘Sweet Corn Sugar 75’	17.0	24.9	30.7	31.5	26.0
SEm±				1.2	
CD (P=0.05) different sub treatment vs same mean treatment			3.5		
SEm±			1.2		
CD (P=0.05) different sub treatment for different main treatment	5.5				

F_0 (control), F_1 (75, 45, 45, 20 and 5), F_2 (150, 90, 90, 40 and 10) and F_3 (225, 135, 135, 60 and 15) kg/ha of N, P_2O_5, K_2O, S and Zn bed. Raised bed planting system with crop residue retention improved soil quality in terms of organic carbon, biotic activity, reduced the erosion and increased infiltration of water into soil.

System productivity

The highest system productivity (Table 6) was recorded with the application of 225, 46.76, 112.06, 60 and 15 kg/ha of N, P, K, S and Zn fertility level which remained statically superior to all other treatments. The increase in system productivity was owing to the increase in yield of baby corn at high fertility level.

Raised bed also registered its superiority to flat bed by 8.7%, while 'Pro-Agro 4212' registered 18.7% higher sys-

Table 3. Effect of fertility levels, planting methods and varieties on total nutrients removal (kg/ha) by baby corn and stover (on dry weight basis) (pooled data of 2010–11 and 2011–12)

Treatment	Total N removal (kg/ha) Mean	Total P removal (kg/ha) Mean	Total K removal (kg/ha) Mean	Total S removal (kg/ha) Mean	Total Zn removal (g/ha) Mean
Fertility level (*kg/ha N, P_2O_5, K_2O, S* and *Zn*)					
Control	56.7	8.5	52.9	3.74	168.5
75, 45, 45, 20 and 5	71.7	11.7	69.2	4.58	216.5
150, 90, 90, 40 and 10	89.5	15.3	88.2	5.67	314
225, 135, 135, 60 and 15	106.5	18.7	102.1	6.75	385
SEm±	2.28	0.3	1.98	0.14	6.5
CD (P=0.05)	7.29	1.16	6.31	0.46	19.5
Planting methods					
Flat bed	77.5	13.0	75.3	4.96	262.5
Raised bed	84.7	14.1	80.9	5.41	279.5
SEm±	1.3	0.2	1.31	0.10	4.5
CD (*P*=0.05)	3.92	0.67	3.75	0.28	12.5
Varieties					
'Pro-Agro 4212'	87.0	14.6	83.7	5.61	287.5
'Sugar 75'	75.2	12.5	72.5	4.76	254.5
SEm±	1.3	0.2	1.31	0.10	4.5
CD (P=0.05)	3.92	0.67	3.75	0.28	12.5

Table 4. Effect of fertility levels, planting methods and varieties on available nutrients in soil after harvesting of baby corn (pooled data of 2010–11 and 2011–12)

Treatment	N (kg/ha)	P (kg/ha)	K (kg/ha)	S (kg/ha)	Zn (ppm)
Fertility level (*kg/ha N, P_2O_5, K_2O, S and Zn*)					
Control	182.6	14.7	191.5	16.4	0.50
75, 45, 45, 20 and 5	203.0	18.6	201.8	18.2	0.51
150, 90, 90, 40 and 10	216.8	22.2	231.5	21.2	0.54
225, 135, 135, 60 and 15	227.0	25.0	242.0	22.4	0.56
SEm±	2.3	0.2	2.3	0.2	0.01
CD (P=0.05)	7.2	0.7	7.5	0.6	0.02
Planting Method					
Flat bed	203.1	19.7	213.2	19.3	0.53
Raised bed	211.6	20.5	220.2	19.8	0.53
SEm±	1.4	0.1	1.4	0.1	0.00
CD (P=0.05)	4.0	0.4	3.9	0.3	0.01
Varieties					
'Pro-Agro 4212'	213.5	20.9	222.0	19.9	0.53
'Sugar 75'	201.2	19.3	211.4	19.2	0.52
SEm±	1.4	0.1	1.4	0.1	0.00
CD (P=0.05)	4.0	0.4	3.9	0.3	0.01

tem productivity than 'Sugar 75'. Higher yield under this treatment led to corresponding higher system productivity.

System economics

Application of 225, 46.76, 112.06, 60 and 15 kg/ha of N, P, K, S and Zn from data (Table 6) that registered an increased the gross and net return by 43.75 and 52.98% over control respectively. Also 225, 46.76, 112.06, 60 and 15 kg/ha of N, P, K, S and Zn recorded the highest benefit: cost ratio but it was at par with 150, 90, 90, 40 and 10 kg/ha of N, P, K, S and Zn. These enhancements in system economics were owing to improved baby corn and sorghum yields at higher fertility levels. These results are in conformity with the findings of Jain and Dhama, (2005) and Limon-Ortega *et al*. (2006), who reported an increase in the sequence economics with increasing fertility levels and residue application.

Similarly, marked effect of planting methods was also

Table 5. Cumulative effect of fertility levels, planting methods and varieties of preceding baby corn on sorghum yields and yield attributing characters of sorghum (pooled data of 2010–11 and 2011–12).

Treatment	Grains/ plant	1,000-grain weight (g)	Grain weight/ ear (g)	Grain yield (t/ha)	Stover yield (t/ha)
Fertility level (kg/ha N, P_2O_5, K_2O, S and Zn)					
Control	858.5	26.4	18.4	0.8	15.3
75, 45, 45, 20 and 5	1,182.3	29.3	27.1	1.0	16.6
150, 90, 90, 40 and 10	1,235.6	32.6	35.4	1.1	18.0
225, 135, 135, 60 and 15	1,539.1	34.5	45.2	1.2	20.1
SEm±	43.9	0.8	1.4	0.03	0.6
CD (P=0.05)	140.5	2.5	4.5	0.08	1.8
Planting methods					
Flat bed	1,178.1	30.2	31.0	1.0	16.8
Raised bed	1,229.6	31.2	32.1	1.1	18.1
SEm±	29.0	0.5	0.8	0.02	0.3
CD (P=0.05)	NS	NS	NS	0.06	1.0
Varieties					
'Pro-Agro 4212'	1,231.8	31.3	32.4	1.1	17.9
'Sweet Corn Sugar 75'	1,175.9	30.1	30.7	1.0	17.1
SEm±	29.0	0.5	0.8	0.02	0.3
CD (P=0.05)	NS	NS	NS	NS	NS

Table 6. Cumulative effect of fertility levels, planting methods and varieties in system productivity and system economics (baby corn + sorghum)

Treatment	Gross returns ($\times 10^3$ ₹/ha)	Net returns ($\times 10^3$ ₹/ha)	Benefit: cost ratio	System productivity (kg/ha/day)
Fertility level (kg/ha of N, P_2O_5, K_2O, S and Zn)				
Control	170.1	98.7	2.4	2.7
75, 45, 45, 20 and 5	235.0	154.0	2.9	4.3
150, 90, 90, 40 and 10	270.9	181.4	3.1	4.9
225, 135, 135, 60 and 15	302.4	205.6	3.2	5.8
SEm±	5.9	5.9	0.1	0.1
CD (P=0.05)	18.9	18.9	0.2	0.4
Planting methods				
Flat Bed	235.0	150.7	2.8	4.2
Raised Bed	254.1	169.2	3.0	4.6
SEm±	3.7	3.7	0.0	0.1
CD (P=0.05)	10.6	10.6	0.1	0.3
Varieties				
'Pro-Agro 4212'	262.1	184.7	3.4	4.8
'Sweet Corn Sugar 75'	227.1	135.1	2.5	3.9
SEm±	3.7	3.7	0.04	0.1
CD (P=0.05)	10.6	10.6	0.1	0.3

observed on gross returns, net returns and benefit: cost ratio of both crops. Raised bed registered 7.5% higher gross returns, 10.9% higher net return and 7.0% higher benefit: cost ratio than flat bed. Raised bed recorded higher baby corn and sorghum yields and this enhanced the returns and benefit: cost ratio. Sayre *et al*. (2005) reported an increase in yields of rice–wheat and wheat–maize cropping system, under permanent raised bed system.

Similarly, marked effect of varieties was also observed on system economics. 'Pro-Agro 4212' and sorghum recorded higher gross return, net return and benefit: cost ratio by 13.35, 26.87 and 26.87% respectively. The increase in returns and benefit: cost ratio was owing to the higher yield of baby corn and sorghum recorded with 'Pro-Agro 4212' than 'Sugar 75'.

The results showed that 225, 46.76, 112.06, 60 and 15 kg/ha of N, P, K, S and Zn, raised bed planting method and 'Pro-Agro 4212' could produce higher baby corn (with and without husk) and stover yields under irrigated condition of Varanasi, Uttar Pradesh. Further baby corn residues at 225, 46.76, 112.06, 60 and 15 kg/ha of N, P, K, S and Zn applied to the previous crop increased the sorghum yield.

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