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Growth and yield maximisation of baby corn (*Zea mays* L.) as influenced by integrated nutrient management practices and foliar nutrition

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Abstract
Field experiments were conducted to study the effect of graded levels of inorganic nitrogen in combination with various sources of organic manures and panchagavya foliar spray on hybrid baby corn G-5414 at the Experimental farm, Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalainagar, Tamil Nadu. The treatments were tested in RBD and replicated thrice. The effect of application of 100% recommended dose of nitrogen as inorganic + Vermicompost @ 5 t ha^{-1} + 3 sprays of 3% panchagavya favourably influenced the yield parameters of baby corn culminating in the highest baby corn yield per hectare, which was higher than that of the control. The economic analysis of various treatments imposed revealed that application of 100% recommended dose of nitrogen as inorganic + Vermicompost @ 5 t ha^{-1} + 3 sprays of 3% panchagavya recorded the highest gross and net return of Rs.147400 and Rs.98287 which ultimately resulted in registering the highest net rupee invested as 3.00.

Keywords: Integrated nutrient management, growth and yield maximization, baby corn

Introduction
Baby corn (also known as young corn, mini corn or candle corn) is the ear of maize (*Zea mays* L.) plant harvested young especially when the silks have either not emerged or just emerged and no fertilization has taken place. The Baby corn hybrid G-5414, is a high yielding male sterile with uniform sized creamy ears and they are in light yellow colour with regular row arrangement, 10 to 12 cm long and a diameter of 1.0 to 1.5 cm arrangement are preferred in the market. It is a highly nutritive value crop, for every 100 gram of edible portion; it contains 88.10 per cent moisture, 8.20 g carbohydrates, 1.90 g protein, 0.20g fat, 28.00 mg calcium, 86.00 mg phosphorus, 0.10 mg iron, 0.50 mg thiamine, 0.08 g riboflavin and 11.00 mg of ascorbic acid. The entire miniature ear of baby corn is edible. Baby corn can be eaten raw or cooked. It is used in variety of traditional and continental dishes besides being canned. Due to its high succulence, palatability and digestibility, it is considered to be an ideal fodder crop and it can be used at any stage of its growth. Its green fodder is especially suited for milch cattle as it has lactogenic properties. Baby corn cultivation provides tremendous avenue for diversification, value addition and revenue generation. In the light of recently liberalized policy of government to boost export trade and food industry development, baby corn production on maize belts of India stands better promise for export trade, high income generation and for creation of employment in agriculture sector through canning and dairy industries. For better utilization of resources and to produce crops with less expenditure, INM is the best approach. The combined use of organic and inorganic sources of plant nutrient not only pushes the production and profitability of baby corn, but also it helps in maintaining the permanent fertility status of the soil.

Materials and Methods
Field experiments were conducted in the Experimental farm, Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalainagar with Baby corn Hybrid G-5414. The treatments comprised of an absolute control T_1 with no application of organics and inorganics.

- T_2 – 100% RDN + 3 sprays of 3% panchagavya
- T_3 – 75% RDN + poultry manure @ 5t ha^{-1} + 4 sprays of 4% panchagavya
- T_4 – 100% RDN +poultry manure @ 5t ha^{-1} + 3 sprays of 3% panchagavya
- T_5 – 75% RDN + FYM @ 10 t ha^{-1} + 4 sprays of 4% panchagavya
- T_6 – 100% RDN + FYM @ 10 t ha^{-1} + 3 sprays of 3% panchagavya
- T_7 – 75% RDN + EFYM @ 750 kg ha^{-1} + 4 sprays of 4% panchagavya
- T_8 – 100% RDN + EFYM @ 750 kg ha^{-1} + 3 sprays of 3% panchagavya
- T_9 – 75% RDN + EPC @ 750 kg ha^{-1} + 4 sprays of 4% panchagavya
- T_{10} – 100% RDN + EPC @ 750 kg ha^{-1} + 3sprays of 3% panchagavya
- T_{11} – 75% RDN + vermicompost @ 5 t ha^{-1} + 4 sprays of 4% panchagavya
- T_{12} – 100% RDN + vermicompost @ 5 t ha^{-1} + 3 sprays of 3% panchagavya

Table 1: Important nutrients present in various organic sources

Organic sources	Nutrients		
	Nitrogen (N) in %	**Phosphorus (P_2O_5) in %**	**Potassium (K_2O) in %**
Farmyard Manure (FYM)	0.69	0.62	0.51
Enriched FYM	1.20	3.03	0.52
EPC	2.1	3.0	0.5
Poultry manure	2.48	1.80	1.40
Vermicompost	1.86	1.30	0.55
Panchagavya	4.46	0.33	0.89

*EPC: Enriched Press mud compost

Table 2: Effect of IPNSS on Growth attributes and growth of baby corn G-5414

Treatments	Growth attributes						
	Plant height (cm)		**LAI**		**DMP (Kg ha^{-1})**		**Stem girth (cm)**
	30DAS	**At harvest**	**30DAS**	**At harvest**	**30DAS**	**At harvest**	
T_1	53.68	138.98	1.76	4.66	2322	4500	4.81
T_2	70.87	169.09	2.58	6.41	3020	5925	5.90
T_3	65.66	158.74	2.30	5.75	2774	5449	5.51
T_4	76.13	179.14	2.84	7.09	3277	6442	6.15
T_5	56.17	143.96	1.90	4.95	2437	4740	5.01
T_6	73.65	174.23	2.71	6.77	3152	6167	6.03
T_7	58.64	148.87	2.04	5.23	2551	4978	5.11
T_8	80.06	187.61	3.11	7.47	3460	6789	6.39
T_9	63.14	153.83	2.17	5.50	2663	5214	5.43
T_{10}	78.48	184.11	3.00	7.35	3405	6727	6.35
T_{11}	68.30	163.66	2.45	6.03	2892	5687	5.81
T_{12}	83.20	192.73	3.27	7.72	3582	7034	6.48

Table 3: Effect of IPNSS on Yield attributes and yield of baby corn G-5414

Treatments	Cob length (cm)	Cob diameter (cm)	No of cobs per plant	Cob yield (Kg ha^{-1})	Stover yield (Kg ha^{-1})
T_1	13.57	2.62	1.13	2640	12.17
T_2	19.82	4.77	2.27	5071	18.41
T_3	19.05	4.45	2.13	4448	16.43
T_4	20.68	5.04	2.51	5693	19.13
T_5	15.99	3.32	1.33	3582	13.28
T_6	20.27	4.89	2.40	5402	18.86
T_7	18.49	3.92	1.45	3868	14.37
T_8	21.20	5.19	2.64	6493	20.20
T_9	18.63	4.35	1.95	4163	15.52
T_{10}	21.05	5.17	2.63	6341	20.06
T_{11}	19.44	4.63	2.15	4751	18.12
T_{12}	22.43	5.32	2.81	6845	21.00
SEd	0.173	0.043	0.014	135.00	125.36
CD (P=0.05)	0.36	0.09	0.03	280	260

Results and Discussion

The beneficial influence of organic and inorganic fertilizer on the growth attributes *viz*., plant height, leaf area index, DMP and stem girth of baby corn was observed to be significant when compared to other treatments. The combined application of organic sources along with inorganic fertilizer assumes higher crop and soil productivity on baby corn.

The enhanced plant height, LAI, DMP and stem girth were favorably influenced by the integrated application of 100% RDN + vermicompost @ 5 t ha^{-1} + 3 sprays of 3% panchagavya (T_{12}). This treatment projected the maximum values for plant height which could be the possibility to supply mineral N, which was dominant at early stage of crop growth and its rapid nutrient availability and supply to the crop. The nitrogen from fertilizer helped in the promotion of growth during the early stages and while organic sources of nutrients improved crop growth during later stages. The favourable effect of vermicompost on growth might be attributed to presence of relatively readily available plant nutrients, growth enhancing substances and number of beneficial organisms like nitrogen fixing, phosphate Solubilising, cellulose decomposing and other beneficial microbes as well as antibiotics, vitamins and hormones etc. (Nehra *et al*., 2001). Moreover, vermicompost has narrow C: N ratio less than 20:1 which enhances release of nutrients availability to root. Nitrogen is an essential constituent of proteins, enzymes and chlorophyll and has been observed to influence the leaf growth and its expansion, resulting in increased leaf area index. Availability of adequate phosphorus in plant results in proper leaf expansion, increase in leaf surface area and number of leaves and results in better efficiency of chlorophyll during photosynthesis and this overall improvement gets translocated into better growth of the plant and hence by assimilation of source to sink (Gunjal *et al.*,2017).

Foliar application of panchagaya along with other organic manures enhanced the production of more number of leaves this may be due to the fact that the chemolithic autotrophic nitrifiers in panchagavya contributed to vegetative growth directly and indirectly by increasing the ammonium uptake, thus enhancing the total N supply (Papen *et al*., 2002) leading to increased number of leaves, maximum leaf area and leaf area index. Moreover, panchagavya also contained microbial metabolites in appreciable amount that helped in maintaining the opening of stomata for longer period both in optimum and adverse condition during the crop growth which led to increased production of more leaves, leaf area and leaf area index providing stronger source for sink (Xu *et al.*, 2001). Improved nutrition may enable greater leaf area production that results in greater interception of light thereby increasing dry matter production (source to sink) (Kumawat *et al.*, 2009). The less response of baby corn to other organic manures could be attributed to slow mineralization of organically bound nutrient and low population of beneficial microbes. The integrated effect of organic and inorganic fertilizers increased the plant height, leaf length, which ultimately favoured to higher DMP. These results are in accordance with the finding of (Thavaprakash *et al.*, 2005).

The results of the experiments revealed that the application of 100% recommended dose of nitrogen as inorganic + Vermicompost @ 5 t ha^{-1} + 3 sparys of 3% panchagavya favourably influenced the yield parameters *Viz.*, cob length, cob diameter, number of cobs per plant in baby corn, cob yield, stover yield. The above treatment also projected an increased cob yield over the control.

The results of the experiment revealed that organic manures with inorganic fertilizer distinctly influenced the yield attributes of baby corn than control. Application of 100% recommended dose of nitrogen as inorganic + Vermicompost @ 5 t ha^{-1} + 3 sparys of 3% panchagavya exhibited an accelerated effect on yield attributes which is mainly due to addition of mineral nitrogen along with the vermicompost influenced the stalk thickness of the plants more positively than just a standalone application of vermicompost. This effect could be attributed to the fact that the addition of mineral fertilizer accelerated mineralization processes in the soil and, therefore, was able to release enough and easily available nutrients of vermicompost. (Maria Kmetova and Peter Kovacik, 2014) [3]. Enhanced N, P and K uptake in this treatment could be attributed to increased dehydrogenase activity and higher nutrients supplied by vermicompost along with inorganic NPK. This in turn increased their availability in the form of NH_4-N, NO_3-N, orthophosphates and potassium and their uptake by crop. Similar finding was reported by Arancon *et al.* (2006) [1].

The slowly mineralisable nitrogen from integrated sources ensures adequate availability at greater level of absorption and translocation to the plant parts during growing period thereby increased quantities of N in cob and stover. Similarly, the organic sources of N made P and K in available forms for longer period in soil which improved P and K uptake of N P K by maize with enhanced levels of nutrient supply. Higher values for the uptake of N P K by maize with enhanced levels of nutrient supply were also evidenced by earlier researchers (Massey and Gaur, 2006, Singh and Yadav, 2007, Sunitha and Mahesheswara Reddey, 2012) [4, 6, 7].

The improvement in soil both direct effect of nutrient present in the organic, inorganic and direct effect of microbial activity and mineralization of native nutrients. The present result in agreement with the report of Swarup (1991). Highest cob yield and Stover yield also was recorded in the treatment (T_{12}) might be the abundant supply of nutrients which might have increased the protoplasmic constituents and accelerate the process of cell division and elongation. This in turn resulted in increased yield. Yield increases in (T_{12}) was due to the hormonal substances present in *panchagavya* especially cytokinin which plays a vital role in vegetative plant parts with nutrient partitioning while in reproductive parts, high levels of nutrient mobilization. Increase in yield was also be due to fact that cow dung in *panchagavya* act as a medium for the growth of beneficial microbes and cow urine provides nitrogen which is essential for crop growth (De Britto and Girija, 2006; Patil *et al.*, 2012) [2, 5] .

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