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Effect of organic manures and panchagavya on growth and yield of baby corn (*Zea mays* L.)

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Abstract
A field experiment was conducted at the Crop Research Farm (CRF), Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj (UP) during the year 2021 *kharif* season. The experiment comprised of 10 treatments of different combinations of organic manures and panchagavya replicated thrice in a Randomized Block Design. The main objective of the experiment was to evaluate the influence of organic manures and panchagavya on growth and yield of Baby corn. The organic manures include (Vermicompost – 2.5 t/ha), (Neem cake- 500 kg/ha) and (Poultry manures- 2 t/ha) where-as levels of Panchagavya include Panchagavya -3% of 3 spray, FYM – 6 t ha^{-1} and Panchagavya -3% of 3 spray + FYM 3 t/ha. From the present investigation it may be concluded that the profitable production of baby corn can be secured by Vermicompost (2.5 t/ha) + Panchagavya (3 spray) + FYM (3 t/ha).

Keywords: Growth, yield, organic fertilizer and panchagavya

Introduction
Maize is one of the most important cereal crops next to rice and wheat in world agriculture economy both as food for men and feed for animals. It has high yield potential, there is no crop on earth which has so immense potentiality and that is why it is called queen of cereals. Its botanical name is *Zea mays* L. belonging to the family Gramineae, sub family Poaceae and chromosome number is 20 (2n). Christopher Columbus reported that maize was cultivated in Halti, where it was named "mahiz". He carried maize from America to Europe and later it was carried by Portuguese and others Europeans to Africa and Asia, during 16th and 17th centuries. Already, this crop has been developed into a multi dollar business in foreign countries (Thailand, Taiwan, Singapore, Malaysia, USA, Canada and Germany) because of its potential as a value added product for export and a good food substitute. During recent times, its potentiality has been extended to the field of vegetable production (Mugalkhod *et al.* 2011). In India, cultivation of baby corn is a recent development and its industry is still at a juvenile stage. Its cultivation is only now picking up seriously in Meghalaya, Western UP, Haryana, Maharashtra, Karnataka and Andhra Pradesh. In India, maize (*Zea mays* L.) is grown on an area of 9.43 m ha, with production and productivity of 24.35 mt and 2583 kg/ha, respectively (GOI, 2014). Baby corn grown for vegetable purpose is successful in countries like Thailand, Taiwan, Srilanka and Burma. It has been developed into a multi-dollar business because of its potential as a value-added product for export and a good food substitute.

Baby corn maize (*Zea mays* L.) is a highly profitable alternative to farmers due to its short crop duration, being harvested at the juvenile stage. Baby corn cultivation promises to have an important role in the future of crop production due to its fresh and safe product (Chamroy *et al*. 2017) [3]. Baby corn ears 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 (Muthukumar *et al*. 2005) [10]. Immature corn is harvested just before fertilization at 2-3 cm long silk emergence stage. The baby corn has a medium plant type and provides sweet, succulent and delicious green cobs within 65-75 days of sowing. It is a low-calorie vegetable having higher fibre content without cholesterol.

A spatial arrangement of plant governs the shape and size of the leaf area per plant, which in turn influences efficient interception of radiant energy and proliferation and growth of shoots and their activity. Thus, there is need to work out an optimum plant spacing by adjusting inter and intra row spacings in relation to other agronomic factors (Golada *et al.* 2013) [5].

Yield of baby corn varies from 60-80 q/ha young cob is highly perishable owing to its high rate of respiration.

Hence, cob should be stored at 5-7 ºC temperature with 90% Relative Humidity. Low temperature storage also favours to maintain the sugar and conversion of sugar into starch. It has been estimated that if the freshly harvested cob is stored at 0 ºC it maintains 80% sugar up to 4 days while there is 80% loss of sugar if cobs are stored at 30 ºC for only 24 hours. Nitrogen promotes vegetative growth, flowering and fruiting. Its deficiency at any stage of growth adversely affects crop yield. Poplar wood is used in packing cases, hard boards, sports goods, construction works and as pulp wood and poles (Garima and Pant, 2017). Vermicompost is organic manure produced by the activity of earthworms. It is mixture of worm casts which are rich in macro and micronutrients. The casts of earthworm have several enzymes and some growth regulating substances. The average nutrient content of vermicompost is much higher than that of FYM Vermicompost contains 1.60%N, 5.04% P_2O_5 and 0.80% K_2O with small quantities of micronutrients. The C: N ratio of vermicompost is much higher (1:16) than that of FYM (1:30). The activity of earthworms is recognized as beneficial for the improvement of soil physical condition and plant growth (Das *et al.* 2017).

Materials and Methods

The current study was carried out in the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj, during the *Zaid* season of 2021. (U.P.). The experimental field is located approximately 7 kilometers from Prayagraj city, near the Yamuna River, on the left side of the Prayagraj-Rewa Road. Prayagraj is located in the subtropical zone of Uttar Pradesh, with hot summers and pleasant winters. The area's average temperature is 24 °C to 35 °C, with temperatures seldom dropping below 3 °C or 4 °C. The relative humidity levels range from 22% to 93%. In this location, the average annual rainfall is 1050 mm. The soil chemistry analysis revealed a sandy loam texture with a pH of 7.70, low amounts of organic carbon (0.84 percent) and potassium (160 kg/ha), and a low quantity of accessible phosphorus (29 kg/ha). The soil was electrically conductive and had a conductivity of 0.22 dS/m. For each of the nine treatment combinations, three replications were employed. The therapy details and treatment combinations are shown in Tables 1 and 2, respectively. Organic Manures and Panchagavya were maintained according to the treatment combinations. Plant height (cm) at harvest, number of leaves at harvest, dry weight at harvest, number of cobs/plant, weight of cob (g), baby corn yield (t/ha), and green fodder yield (t/ha) were all successfully measured, and an economic analysis of each treatment was completed to determine the best treatment combination for baby corn cultivation.

Table 1: Treatment Details

Organic Manures (O): 3 (Three) levels	**O_1**	**Vermicompost – 2.5 t/ha**
	O_2	Neem cake- 500 kg/ha
	O_3	Poultry manures- 2 t/ha
Panchagavya (P):3 (Three) levels	P_1	Panchagavya -3% of 3 spray
	P_2	Panchagavya – 0% of 3 spray FYM – 6 t/ha
	P_3	Panchagavya -3% of 3 spray + FYM 3ha
	Control	

Table 2: Treatment Combinations

Treatment symbol	Treatment combinations Symbol	Treatment combinations
T_1	O_1P_1	Vermicompost (2.5 t/ha) + Panchagavya (3% of 3 spray)
T_2	O_1P_2	Vermicompost (2.5 t/ha) + Panchagavya – 0% FYM (6 t/ha)
T_3	O_1P_3	Vermicompost (2.5 t/ha) + Panchagavya (3 spray) + FYM (3 t/ha)
T_4	O_2P_1	Neem Cake (500 kg/t) + Panchagavya (3% of 3 spray)
T_5	O_2P_2	Neem Cake (500 kg/t) + Panchagavya – 0% FYM (6t/ha)
T_6	O_2P_3	Neem Cake (500 kg/t) + Panchagavya (3 spray) + FYM (3 t/ha)
T_7	O_3P_1	Poultry Manure (2 t/ha) + Panchagavya (3% spray of 3 spray)
T_8	O_3P_2	Poultry Manure (2 t/ha) + Panchagavya – 0% FYM (6 t/ha)
T_9	O_3P_3	Poultry Manure (2 t/ha) + Panchagavya (3 spray) + FYM (3 t/ha)
T_{10}	Control	

Results and Discussion

Growth parameters at maturity

Plant height (cm) at harvest

Table 3 shows organic manure and Panchagavya on plant height at harvest. The Data indicated that spacing had significant impact on plant height at harvest during the crop growth period. At harvest, there was significant difference between the treatments and maximum plant height (146.74 cm) was observed the applications of Vermicompost (2.5 t/ha) + Panchagavya (3 sprays) + FYM (3 t/ha), whereas the lowest value (123.62 cm) was observed in treatment Control. Similar observation was also reported by (Akongwubel *et al.* 2012) [1]. They observed significant improvement on plant height and leaf area index in corn with ultimate increase in organic manure rates. Organic manure supply essential nutrient elements to promote vigorous growth and physiological activities in the plant system. Increased the rate of poultry manure application significantly get higher plant height, leaf area index and dry matter production. Similar result was also observed by (Igua *et al.* 2009) [7] and (Channal, 2017) [4]. This might be due to adequate supply of nutrients at different growth stages of the crop as well as presence of growth regulators in Panchagavya contributing to higher cob yield (Sridhar *et al.* 2001 and Somasundaram *et al.* 2003) [13, 14].

Table 3: Effect of organic manures and Panchagavya on growth parameters at maturity of baby corn

	Treatment details	Growth Parameters		
		Plant height (cm)	Number of leaves plant^{-1}	Plant dry weight (g/ plant)
1	Vermicompost (2.5 t/ha) + Panchagavya (3% of 3 sprays)	137.69	13.42	98.5ssss1
2	Vermicompost (2.5 t/ha) + FYM (6 t/ha)	140.52	13.41	96.63
3	Vermicompost (2.5 t/ha) + Panchagavya (3 spray) + FYM (3 t/ha)	146.74	15.10	111.02
4	Neem Cake (500 kg/t) + Panchagavya (3% of 3 spray)	130.26	12.93	86.82
5	Neem Cake (500 kg/t) + FYM (6 t/ha)	128.51	13.38	86.86
6	Neem Cake (500 kg/t) + Panchagavya (3 spray) + FYM (3 t/ha)	135.07	14.11	85.94
7	Poultry Manure (2 t/ha) + Panchagavya (3% spray of 3 spray)	131.83	13.24	96.15
8	Poultry Manure (2 t/ha) + FYM (6 t/ha)	129.72	12.67	95.59
9	Poultry Manure (2 t/ha) + Panchagavya (3 spray) + FYM (3 t/ha)	143.07	14.25	97.38
10	Control	123.62	10.03	74.94
F Test		S	S	S
S.Ed. (+)		6.367	1.284	6.533
CD (p= 0.05)		3.031	0.611	3.110

Number of leaves per plant at harvest

Table 3 shows organic manure and Panchagavya on number of leaves per plant at harvest. The Data indicated that spacing had significant impact on number of leaves per plant at harvest. At harvest, there was significant difference between the treatments and maximum number of leaves plant^{-1} (15.10 cm) was observed the applications of Vermicompost (2.5 t/ha) + Panchagavya (3 sprays) + FYM (3 t/ha), whereas the lowest value (10.03 cm) was observed in treatment Control. 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) [6].

Dry weight per plant At Harvest

Table 3 shows organic manure and Panchagavya on dry weight per plant at harvest. The Data indicated that at harvest, there was significant difference between the treatments and maximum dry weight (g/plant) (111.02 cm) was observed the applications of Vermicompost (2.5 t/ha) + Panchagavya (3 sprays) + FYM (3 t/ha), whereas the lowest value (74.94 cm) was observed in treatment Control. 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).

Yield parameters

Number of cobs per plant

Observations regarding the response of different levels of Vermicompost, Panchagavya, FYM, Poultry Manure and Neem Cake on yield and yield attributes of organic baby corn are given in table 4 the results revealed that there was significant difference between the treatments and maximum No. of cobs/plant (2.52) was observed by the application of Vermicompost (2.5 t/ha) + Panchagavya (3 sprays) + FYM (3 t/ha). Whereas the lowest value No. of cobs/plant (1.24) was observed in Control. Higher dry matter is believed to have maintained adequate supply of metabolites for development of reproductive structures. These findings are in close conformity with those of Aravinth *et al.* (2011) [2].

Table 4: Effect of organic manures and Panchagavya on yield parameters at maturity of baby corn

	Treatment details	Yield Parameters			
		Cobs /plant (No.)	Cob weight (g without husk)	Cob yield (t/ha with husk)	Green fodder yield (t/ha)
1	Vermicompost (2.5 t/ha) + Panchagavya (3% of 3 spray)	2.30	7.49	11.85	26.79
2	Vermicompost (2.5 t/ha) + FYM (6 t/ha)	2.25	7.37	11.16	25.69
3	Vermicompost (2.5 t/ha) + Panchagavya (3 spray) + FYM (3 t/ha)	2.52	8.81	13.86	30.62
4	Neem Cake (500 kg/t) + Panchagavya (3% of 3 spray)	2.27	6.94	10.91	27.70
5	Neem Cake (500 kg/t) + FYM (6 t/ha)	1.65	6.98	8.55	22.11
6	Neem Cake (500 kg/t) + Panchagavya (3 spray) + FYM (3 t/ha)	1.81	7.52	8.43	21.69
7	Poultry Manure (2 t/ha) + Panchagavya (3% spray of 3 spray)	1.64	7.74	7.73	24.40
8	Poultry Manure (2 t/ha) + FYM (6 t/ha)	2.20	7.85	9.57	25.46
9	Poultry Manure (2 t/ha) + Panchagavya (3 spray) +FYM (3 t/ha)	1.67	7.88	8.82	29.18
10	Control	1.24	5.44	4.13	18.01
F Test		S	S	S	S
S.Ed. (+)		0.28	0.41	15.72	1.51
CD (p= 0.5)		0.59	0.87	3.02	3.17

Weight of cob (g)

Table 4 shows organic manure and Panchagavya on weight of cob. The data revealed that various treatments of The results revealed that there was significant difference between the treatments and maximum Cob weight (g) without husk (8.81) was observed by the application of Vermicompost (2.5 t/ha) + Panchagavya (3 sprays) + FYM (3 t/ha). Whereas the lowest value Cob weight (g) without husk (5.44) was observed in Control. Greater availability of photosynthates, metabolites and nutrients to develop reproductive structures seems to have resulted in increased productive plants, cob girth, cob length and cob weight with these fertilizer levels. The present findings are within the close vicinity of those reported by Kumar (2009) [9] and Khazaei *et al.* (2010) [8].

Green Fodder Yield (t/ha)

Table 4 shows organic manure and Panchagavya on green fodder yield (t/ha). The results revealed that there was significant difference between the treatments and maximum Green fodder yield (q/ha) (30.62) was observed by the application of Vermicompost (2.5 t/ha) + Panchagavya (3 sprays) + FYM (3 t/ha). Whereas the lowest value Green fodder yield (q/ha) (18.01) was observed in Control. Treatments of organic manure and Panchagavya were significantly at par with each other except for the treatment T_4 (Neem cake 500 kg/t + Panchgavya 3% of 3 spray) and T_9 (Poultry manure 2 t/ha + Panchgavya 3% of 3 spray + FYM 3 t/ha).

Baby corn Yield (t/ha)

Table 4 shows organic manure and Panchagavya on baby corn yield (t/ha). The data revealed that the results revealed that there was significant difference between the treatments and maximum Cob yield (q/ha) with husk (13.86 t/ha) was observed by the application of Vermicompost (2.5 t/ha) + Panchagavya (3 sprays) + FYM (3 t/ha). Whereas the lowest value Cob yield (t/ha) with husk (4.13 t/ha) was observed in Control. Treatments of organic manure and Panchagavya were significantly at par with each other except for the treatment T_1 (Vermicompost 2.5 t/ha + Panchgavya 3% of 3 spray), T_2 (Vermicompost 2.5 t/ha + FYM – 6 t/ha) and T_4 (Neem cake 500 kg/t + Panchgavya 3% of 3 spray). This view is in close conformity with the findings of Sarkar *et al.* (1996) [12], Prodhan *et al*. (2007) [11] and Aravinth *et al.* (2011) [2], who recorded higher yields as sa result of remarkable improvement in different growth and yield attributes when this crop was grown at organic manure and Panchagavya. Such close relationship of yields with different yield attributes were also observed by Pandey *et al*. (2002), Prodhan *et al*. (2007) [11] and Aravinth *et al.* (2011) [2].

Conclusion

On the basis of results obtained in present investigation, it is concluded that the profitable production of baby corn can be secured by Vermicompost (2.5 t/ha) + Panchagavya (3 sprays) + FYM (3 t/ha). These practices may be passed on to the farmers for obtaining higher returns in this agro-climatic zone.

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