

GHANJEEVAMRUT AND PANCHAGAVYA: A FACTUAL ASSESSMENT OF THE PERFORMANCE OF MAIZE AND SOIL PROPERTIES UNDER NAGALAND CONDITION, INDIA

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Abstract

Application of recommended dose of fertilizer (RDF) in T₂ significantly enhanced growth, yield attributes and yield of maize. Next best treatment was found in T₈ which produced growth and yield at par with treatment T₃. Maximum grain and straw yields were recorded in T₂ followed by T₈. T₈ produced 9.7% less grain yield as compared to T₂. Nutrient content and uptake by maize was found significantly higher in T₂ followed by T₈. Available nutrients in post-harvest soil found significantly higher in T₂ followed by T₈. Soil biological parameters found significantly higher in T₈. Maximum net return and benefit: cost ratio was observed in T₂ and T₈, respectively. Therefore, application of RDF T₂ is recommended for getting better yield of maize in Nagaland condition.

Introduction

Maize (*Zea mays* L.) is one of the most important cereal food crops belonging to the family *Poaceae* with its center of origin in Mexico, where many diverse types of maize are found. Maize is the third-most significant cereal crop in the world and is successfully cultivated at both high and low elevations in Nagaland. The production of maize in the year 2022 was 62010 metric tons from an area of 39784 ha (Statistical Handbook of Nagaland 2022).

Natural farming is an ecological farming approach established by Masanobu Fukuoka a Japanese farmer and a philosopher. Natural farming uses methods that respect life, observes the law of nature and utilizes natural products. Natural farming includes the use of earthworms, micro-organisms and small creatures instead of using appliances. The soil and water become clean, and ecology is recovered, where natural farming is experienced. It aims to have a good impact on environment. It heals the soil diminished by chemicals and machines. Natural farming products have good taste, high quality and improved yield (Korn 2001). The concept of zero budget natural farming in India was put forward by Mr. Subhash Palekar, native of Amravati, Maharashtra. Palekar is also entitled as "Krishi Ka Rishi" by many farmers of Mysore. Palekar develop four wheels Beejamrit (nectar for seeds), Jeevamrit (nectar of microbes), Acchadana (mulching) and Whapasa (soil moisture). He prepared a solution using cow dung, urine, pulse flour, jaggery and fertile soil which was given the name Jivamruta by him. The cows have less milk production, the more beneficial its dung is towards soil regeneration. One acre of land requires 10 kg of dung per month. The average cow gives 11 kg of dung per day, so dung from one cow can be enough to fertilize 30 acres of land per month (Palekar 2016). The ghanjeevamrut formulations are incredibly rich in microorganisms that proliferate in the soil easily and help in boosting the microbial processes and their activity. Panchagavya is a bio promoter, and it contains almost all the major nutrients like N, P, K and micronutrients necessary for plant and growth hormones like Indole Acetic Acid (IAA) and Gibberellic Acid (GA) required for crop growth (Patel *et al.* 2014). The uniqueness of organics is that they provide growth promoting hormones and immunity boosters

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for plants. Empirical findings from controlled ZBNF trials reveal significantly higher yields, improved soil moisture, moderated soil temperatures, and greater earthworm abundance compared to conventional and organic systems (Machnoor *et al.* 2025). The combined application of jeevamrutha as a soil amendment and panchagavya as a foliar spray has been reported to enhance plant growth, nutrient uptake efficiency and crop productivity in several agricultural crops (Jat *et al.* 2026). Keeping all the above facts in view, the present investigation was conducted during the *Kharif* season of 2023 to study the impact of ghanjeevamrut + panchagavya on performance of maize and soil properties.

Materials and Methods

The experimental site is situated at geographical location of 25°43.923' to 25°50.569' North latitude and 93°37.645' to 93°55.202' East longitude in instructional farm of SAS, Nagaland University, Medziphema in the sub humid tropical climatic zone with high humidity, 2000-2500 mm average annual rainfall and 21°C- 32°C mean temperature during summer. Initial soil properties prior to layout were sandy clay loam in texture with pH 5.10, EC 0.08 dS/m, organic carbon 0.91%, soil available N, P, K and S status 238.2, 23.5, 154.0 and 22.4 kg/ha respectively, WHC 35.8%, SMBC 165.97 µg/g soil, DHA 2.70 µg TPF/g/hr, APA 366.0 µg PNP/g/hr. The experiment was laid out in a randomized block design with three replications and eight treatments using RCM-76 variety of maize in *kharif*. The seeds were sown on 20th June 2023 at a depth of 5 cm in each plot. Treatments comprised of T₁: Control, T₂: RDF (120 kg N, 60 kg P₂O₅, 40 kg K₂O/ha), T₃: 75% RDF, T₄: 50% RDF, T₅: 25% RDF, T₆: ghanjeevamrut (250 kg/ha), T₇: panchagavya (50 L/ha at sowing time, 20 and 40 days after sowing (DAS), T₈: ghanjeevamrut + panchagavya. The NPK were supplied through urea, single superphosphate and muriate of potash respectively. Half nitrogen and full dose of phosphorus and potassium were applied as basal application at sowing time. Rest half nitrogen was given in two equal doses viz., at tasseling stage and silking stage. The ghanjeevamrut was applied at sowing time while panchagavya was sprayed in three equal splits viz., at sowing time, 20 DAS and 40 DAS. Weeds were removed by hand weeding as and when required. Nitrogen content in plant samples was analyzed by Kjeldahl method. Phosphorus, potassium and sulphur contents in plant samples were determined in di-acid (HNO₃-HClO₄) digestion by using standard procedure (Jackson 1973). Soil pH, organic carbon, available N, K and S were determined by adopting standard procedure (Singh *et al.* 2019). Available phosphorus content in soil was determined by Bray's and Kurtz No. 1 method using 0.03 N NH₄F + 0.025 N HCl as extracting solution (Bray and Kurtz 1945). Soil Microbial biomass carbon (SMBC) was determined by fumigation extraction method as described by (Vance *et al.* 1987). Dehydrogenase enzyme activity (DHA) was determined by 2, 3, 5-triphenyl tetrazolium chloride technique as illustrated by (Casida 1977). Acid phosphatase activity (PHA) was determined by p-nitrophenyl phosphate method (Tabatabai and Bremner 1969).

Cow milk (2 L), ghee (1 kg), curd (2 L), dung (7 kg), urine (3 L), sugarcane juice (3 L), Toddy (3 L) and ripened banana (12). All the above items were added to a wide mouthed mud pot. The container was kept open in the shade. The content is to be stirred twice a day both in morning and evening. To prepare toddy two liters of tender coconut water must be kept in a sealed airtight plastic bottle for a week.

Cow dung (100 kg), cow urine (100 L), jaggery and pulses flour (1 kg each) and forest soil (one handful) all the ingredients were mixed thoroughly and stored in a heap for 48 hours in a shady place covered with gunny bags. After 48 hours, the mixture was spread on a clean surface, ball-like structure was made and sundried. After drying, the lump/balls were broken into powder form, filled in sacks to store in cool and dry place.

Results and Discussion

Treatment T₂ recorded the highest plant height, which was statistically at par with T₃, T₆, T₇ and T₈ (Table 1). Treatments T₆, T₇ and T₈ attained more plant height as compared to T₄ and T₅. Ghanjeevamrut and panchagavya (T₈) produced at par plant height to RDF might be because natural formulations dissolved nutrients in the soil and allowed plants to absorb moisture and nutrients. Significant increase in plant height might be due to more availability of macro and micronutrients and growth promoting substances in panchagavya and Ghanjeevamrut treated plots. When these natural formulations applied to the crop as foliar spray and through soil application they improved the plant growth. (Upperi *et al.* 2009).

Yield attribute viz cob length and number of grains per cob were influenced by the application of RDF, panchagavya and ghanjeevamrut (T₈) (Table 1). Significant highest cob length was recorded in treatment T₂ (RDF) which was statistically at par with T₃ (75% RDF) and T₈. Treatments T₆, T₇ and T₈ recorded more cob length as compared to T₄ and T₅. Natural formulations (panchagavya and ghanjeevamrut) when used, the amounts of IAA and GA might have stimulated the plant system and increased the synthesis of growth regulators in the tissues, which in turn encouraged yield attributes. These findings are in accordance with Pagar *et al.* (2016). Highest number of grains per cob recorded in T₂ which was statistically at par with T₃ and T₈. Treatments T₆, T₇ and T₈ gave a greater number of grains per cob as compared to T₄ and T₅. Increased photosynthetic activity and assimilate partitioning from source to sink, as well as higher availability of growth-promoting substances like cytokinin, kinetin, essential plant nutrients, and beneficial microorganisms might have present in panchagavya which may be responsible for the increased number of grains (Sreenivasa *et al.* 2010). Among the different treatments the highest grain yield was recorded in T₂. Second highest grain yield was recorded with T₈ which was at par with T₃. Treatment T₈ gave 9.7% less grain yield as compared to T₂. Furthermore, T₈ gave 1.7% more grain yield in comparison to T₃. The T₂ and T₈ increased the grain yield by 73.6% and 56.0% respectively. Highest straw yield was recorded in T₂ which was statistically at par with T₆, T₇ and T₈. Treatments T₆, T₇ and T₈ produced more straw yield as compared to T₄ and T₅. The harvest index of maize was found to be non-significant. This may be due to presence of cow dung in panchagavya and ghanjeevamrut, which act as a medium for the growth of beneficial microbes and cow urine provided nitrogen which is essential for crop yield (Britto and Girija 2006). Available N, P, K, S and SMBC contents and DHA and APA activity were significantly greater in the panchagavya and ghanjeevamrut inoculated plots (T₈) than other treatments except T₂ thereby, highlighting the beneficial role of natural formulations in improving soil health and soil fertility. These soil parameters showed positive correlation with grain yield of maize (Figs 1 and 2) hence increased the grain yield of maize.

Maximum nitrogen uptake was recorded with T₂ followed by T₈ (Table 1). T₈ was found at par with T₃ regarding nitrogen uptake. The T₂ enhanced total nitrogen uptake by 92.4% over control and 13.6% over T₈. The T₈ treatment increased total nitrogen uptake to the extent of 69.1% over control. According to Choudhary *et al.* (2014) cow urine was rich in uric acid, a source of nitrogen which was readily soluble and one of the important compounds in panchagavya and was readily available to the plants, directly influencing the nitrogen content and uptake. The phosphorus uptake was found to be highest recorded in T₂. Treatment T₈ was statistically at par with T₃. Total phosphorus uptake in T₂ was enhanced by 116.2. The T₈ improved total uptake by 87.7%. The potassium uptake was found highest in T₂. Treatment T₈ was statistically at par with T₃. Treatments T₆ and T₈ gave more potassium uptake as compared to T₄ and T₅. Treatments T₂ and T₈ enhanced total potassium uptake by 90.0 and 73.2%, respectively. The sulphur uptake was highest in T₂. Treatments T₂ and T₈ increased total uptake by 114.3 and 90.2%, respectively. Application of ghanjeevamrut and panchagavya might have increased the solubility of sulphur

Table 1. Effect of different treatments on growth, yield attributes, yield and nutrient uptake of maize.

Treatment	Plant ht. at harvest (cm)	Cob length (cm)	No. of grain/cob	Yield (kg/ha)		Harvest index (%)	Total nutrient uptake (kg/ha)			
				Grain	Straw		N	P	K	S
T ₁	227.96	13.77	254.57	1864.67	4048.1	31.58	52.74	17.92	48.34	15.24
T ₂	252.28	16.61	327.12	3238.88	5185.2	38.45	101.48	38.74	91.91	32.67
T ₃	243.90	15.72	292.32	2874.06	4913.3	36.90	84.75	31.64	79.48	27.23
T ₄	237.80	14.62	277.67	2499.00	4560.3	35.52	71.60	26.66	67.32	22.55
T ₅	234.34	14.60	262.67	2194.65	4486.1	32.92	64.65	22.20	59.71	19.19
T ₆	242.35	15.37	282.00	2564.80	4899.9	34.36	77.20	28.80	75.10	25.11
T ₇	240.78	15.08	281.89	2535.00	4808.3	34.59	73.75	26.36	71.05	23.70
T ₈	245.59	15.97	314.89	2924.06	4981.7	36.98	89.35	33.64	83.75	28.99
SEm±	4.06	0.37	13.52	96.81	198.0	1.61	3.33	0.68	5.23	1.21
CD (=0.05)	12.32	1.14	41.03	293.64	600.6	NS	10.11	2.08	15.86	3.67

Table 2. Effect of different treatments on properties of post-harvest soil and economics of maize cultivation.

Treatment	WHC (%)	pH	OC (%)	Available nutrients (kg/ha)				SMBC (µg/g)	DHA (µg TPP/g/hr)	APA (µg PNP/g/hr)	Fixed cost (₹)	Variable cost (₹)	Total cost (₹)	Gross return (₹)	Net return (₹)	B:C ratio
				N	P	K	S									
T ₁	35.15	5.07	0.90	223.2	23.0	142.3	21.6	157.87	2.62	355.73	19080	0	19080	39158.1	20078	1.05
T ₂	37.91	5.20	1.00	265.6	29.1	166.1	26.4	187.65	2.83	380.05	19080	9374.7	28455	68016.4	39562	1.39
T ₃	37.14	5.17	0.98	248.4	26.0	162.0	24.4	187.41	2.80	373.33	19080	7030.9	26111	60355.3	34244	1.31
T ₄	35.87	5.10	0.96	242.2	25.4	150.4	22.3	176.24	2.77	371.35	19080	4687	23767	52479.0	28712	1.21
T ₅	35.35	5.07	0.93	240.0	24.6	150.3	22.3	172.95	2.74	363.71	19080	2344	21424	46087.7	24664	1.15
T ₆	36.81	5.13	0.96	246.2	25.6	157.5	23.1	218.82	3.04	388.38	19080	2964	22044	53860.9	31817	1.44
T ₇	36.79	5.13	0.94	243.2	24.4	155.4	23.3	192.84	2.89	386.77	19080	2852	21932	53235.0	31303	1.43
T ₈	37.57	5.17	0.98	252.6	27.0	162.2	24.4	227.73	3.18	400.00	19080	5817	24897	61405.3	36508	1.47
SEm±	2.0	2.21	0.05	4.45	0.57	2.53	1.87	8.96	0.08	6.32	*	*	*	*	*	*
CD(P=0.05)	NS	NS	NS	13.50	1.75	7.67	NS	27.20	0.27	19.17	*	*	*	*	*	*

* These parameters were not subjected to analysis of variance (ANOVA)

T₁: Control, T₂: RDF (120:60:40 kg N: P₂O₅: K₂O/ha), T₃: 75% RDF, T₄: 50% RDF, T₅: 25% RDF, T₆: Ghanjeevamrut, T₇: Panchagavya, T₈: Ghanjeevamrut + Panchagavya

containing minerals and transformation of unavailable sulphur to sulphate ions which resulted in more absorption of sulphur by plant. Overall, more nutrient uptake by maize might be due to quick build-up of soil micro flora and fauna which has consequently increased the enzymatic activity, which helped in mineralization, solubilization of native nutrients and making them available for plant uptake (Gore and Sreenivasa 2011, Sutar *et al.* 2017, Choudhary *et al.* 2022, Choudhary *et al.* 2023).

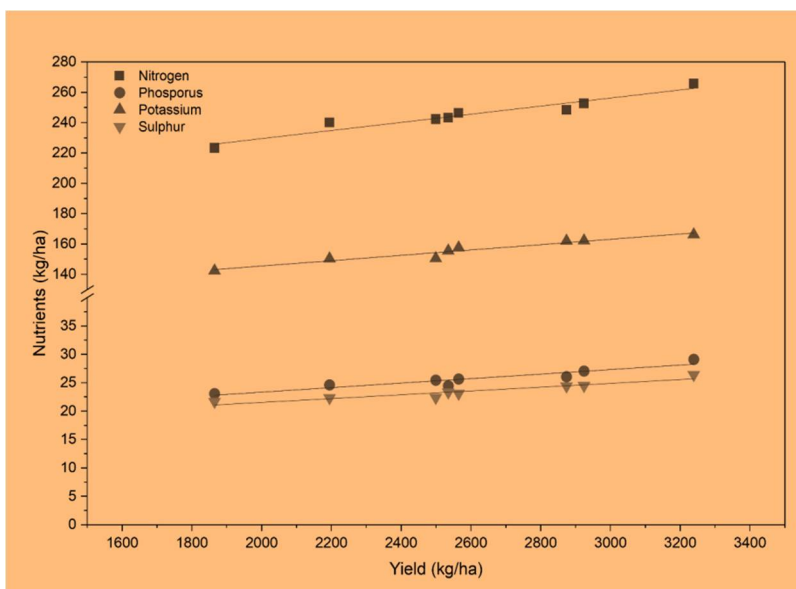


Fig. 1. Relationship between maize grain yield and available nitrogen, phosphorus, potassium and sulphur.

The data on pH, water holding capacity and organic carbon showed no significant variation (Table 2). The highest available nitrogen observed in T₂ which was statistically at par with T₈ and the lowest in T₁. This might be due to rapid mineralization of available pool of nitrogen due to higher microbial activity with application of ghanjeevamrut and panchagavya. The maximum available phosphorus was observed in T₂. Treatments T₆ and T₈ recorded more available phosphorus as compared to T₄ and T₅. These treatments increased the release of organic acid during mineralization which helped in the solubilization of native phosphates, thus increasing available phosphorus pool in the soil. The maximum available potassium observed in T₂ which was statistically at par with T₃ and T₈. Available sulphur content was not affected significantly with application of different treatments. However, remarkable improvement in available sulphur was noticed in T₂, T₃ and T₈. Application of ghanjeevamrut and panchagavya leads to quick build-up of soil microflora and fauna which has consequently increased the enzymatic activity and helped in mineralization, solubilization of native as well as applied nutrients and making them available in the soil. The highest soil microbial biomass carbon, dehydrogenase and acid phosphatase activity were observed in treatment T₈ which was statistically at par with treatment T₆ while lowest was recorded in T₁. Presence of tender coconut water as an ingredient in panchagavya served as microbial inoculums and hence higher microbial population in soil. Furthermore, panchagavya also contains nitrate oxidizers, yeast, ammonium oxidizers, growth hormones (Indole acetic acid and Gibberellic acid), phenols, reducing sugars and glucose. These multiple biochemicals along with growth promoting hormones could have significantly enhanced

enzyme activities in soil (Suresh *et al.* 2011, Patel *et al.* 2014). Natural formulation treated plots showed higher DHA and APA activities. Application of ghanjeevamrut as well as panchagavya enhanced SMBC status which was accompanied by increased DHA activity.

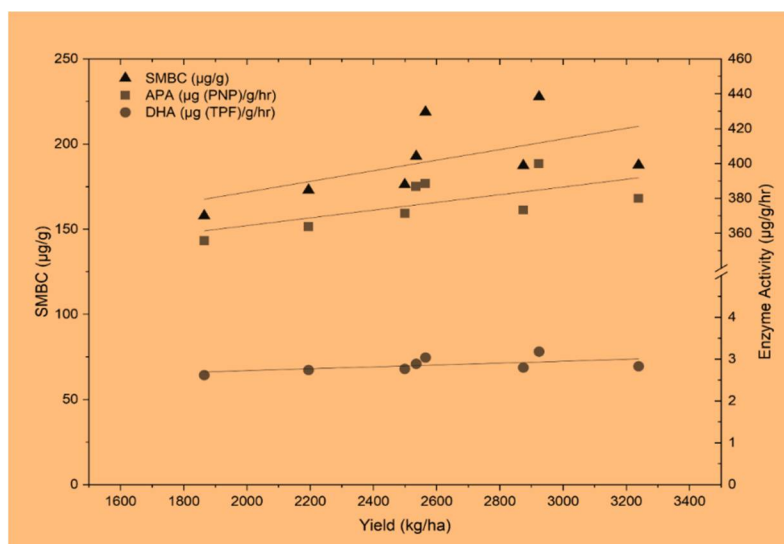


Fig. 2. Relationship between maize grain yield and SMBC, DHA and APA.

Highest total cost was recorded under treatment T_2 , followed by T_3 and T_8 . Maximum net return obtained under treatment T_2 (Table 2). Second highest net return recorded in T_8 . T_8 resulted 7.7% less net return in comparison to T_2 because of less grain yield. However, due to substantially low variable cost, high B: C ratio was recorded in T_8 as compared to T_2 . T_3 produced at par grain yield to T_8 . However, variable cost was high and net return was low in T_3 as compared to T_8 . Therefore, adoption of T_8 treatment may be better option for getting good return from maize cultivation with less investment especially by the resource poor, small and marginal farmers.

From the study, it could be concluded that overall, T_2 (RDF) showed the strongest agronomic performance, highest maize yield and net return among the treatments, hence recommended for resource sufficient farmers. At the same time, combined application of ghanjeevamrut + panchagavya (T_8) gave greater B:C ratio, indicating strong economic performance, and may be a better alternative for marginal and resource poor farmers. Thereby, T_2 (RDF) for resource sufficient farmers and T_8 for resource poor farmers are recommended for obtaining better yield of maize in Nagaland condition.

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