Original Research Article

EVALUATION OF LIQUID NANO UREA FERTILIZER FOR ENHANCING YIELD, YIELD ATTRIBUTES AND ECONOMIC PERFORMANCE IN SUGARCANE PLANT-RATOON CYCLE

ABSTRACT

A field experiment on "evaluation of liquid nano urea fertilizer for enhancing yield, yield attributes and economic performance in sugarcane plant-ratoon cycle" was carried out during *rabi* of 2021-22 (plant crop) and 2022-23 (ratoon crop) at Navsari (Gujarat). The experiment was laid out in randomized block design including treatment comprising of nitrogen levels for soil application with foliar spray of nano urea and urea in both plant-ratoon system of sugarcane. The results recorded in respect to the both individual plant crop and ratoon crop season as well as in pooled analysis of both seasons of sugarcane, yield attributes such as No. of millable cane, No. of internodes/cane, cane girth and single cane weight as well as yield parameters *viz.*, millable cane yield and green top yield were found to be significant highest with the application of 75% RDN + 2 spray of liquid nano urea at 90 and 180 DAP (T_3) which was at par with T_2 and T_4. During both plant crop and ratoon crop season, an application 75% RDN + 2 spray of liquid nano urea at 90 and 180 DAP (T_3) recorded higher net returns (285956 and 295835 ₹/ha, respectively) and benefit: cost ratio (2.49 and 3.77, respectively). It concluded that for achieving higher yield and net monetary returns in sugarcane plant-ratoon cultivation should be fertilized with 100 % of recommended P_2O_5 and K_2O + 75 % RDN + two sprays of either liquid nano urea @ 4 ml/L or 2 % urea at 90 and 180 DAP of plant crop and DAR of ratoon crop. This application effectively replaces the 25% of recommended dose of nitrogen while matching the performance of the 100% RDN treatment.

Keywords: Economics, IFFCO nano urea, Plant-ratoon sugarcane, Sugarcane, Yield attributes, Yield

1 Introduction:

Nanotechnology offers a promising approach to addressing challenges associated with the excessive use of fertilizers in agriculture. By utilizing nano-sized materials, nano-fertilizers enable more efficient nutrient delivery to plants, minimizing waste and reducing environmental impact. These fertilizers enhance nutrient uptake by crops, allowing for more effective use of applied fertilizers and reducing the need for large quantities (Jakhar *et al.*, 2022). This precision can mitigate issues like soil degradation and nutrient imbalances by providing the right nutrients at the right time. Additionally, nano-materials can be engineered for gradual nutrient release, promoting sustained availability and minimizing runoff into water bodies, which can help protect water quality and aquatic ecosystems. Nano-fertilizers may also support soil microbial ecosystems, fostering a more balanced soil environment (Thul *et al*., 2013). The use of nanotechnology in agriculture is still in the developmental stage, but it shows great potential in overcoming challenges faced by traditional methods. Nano-fertilizers offer advantages such as smaller application requirements, slow-release mechanisms and reduced costs and lower soil salt accumulation compared to conventional fertilizers. For example, nano nitrogen, an alternative to traditional urea, provides precision and targeted application, reducing losses and increasing nutrient uptake efficiency (Shukla *et al*., 2019). The Indian Farmers Fertiliser Cooperative (IFFCO) has developed a patented nano-fertilizer called nano-urea, which contains nanometer-scale particles with enhanced surface area and nutrient delivery properties (Upadhyay *et al*., 2023). This innovation has demonstrated effectiveness in laboratory and small-scale studies, positioning nano-urea as a promising agricultural solution. Nano-urea, particularly in liquid form, offers a transformative shift in fertilizer technology, leveraging nanoscale properties for improved nutrient absorption and efficiency. It provides an environment-friendly nitrogen source with high efficiency, promoting crop growth, yield and quality (Yogendra *et al*., 2020). The controlled release mechanism of nano-urea ensures sustained nutrient availability, reducing losses through leaching and volatilization. This technology benefits the environment by minimizing nitrogen runoff and proves economically viable for farmers due to its lower application rates and enhanced efficacy. In conclusion, the application of nanotechnology in agriculture, particularly through the use of nano-fertilizers, holds significant promise for enhancing agricultural productivity while minimizing environmental impact. However, thorough research on the environmental and health implications of nano-materials is crucial to ensure their safe and sustainable use. Balancing increased agricultural productivity with environmental conservation through responsible nanotechnology application can play a pivotal role in shaping the future of sustainable agriculture. Sugarcane (*Saccharum officinarum* L.) is a tall, perennial grass cultivated primarily for its high sugar content. Originating from New Guinea, it's a crucial crop in tropical and subtropical regions, essential for sugar, molasses and ethanol production. India is the largest producer, with Gujarat significantly increasing its cultivation and productivity in recent years. Sugarcane's growth demands careful management of water, nutrients, particularly nitrogen and pest control. Nitrogen is vital for photosynthesis, growth and sugar content, but must be balanced to avoid excessive vegetative growth Boschiero *et al*. (2020). The innovative use of nano urea, especially in foliar applications, has shown promise in enhancing nutrient uptake and yield, providing an efficient and sustainable approach to fertilization Upadhyay *et al*. (2023). However, more research is needed on the combined use of conventional and nano urea, particularly in South Gujarat.

2 Materials and Methods

Field experiment was carried out for consecutive years during *rabi* of 2021-22 as plant crop and 2022-23 as ratoon crop at College Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari, Gujarat. Geographically, the Navsari Agricultural University campus is positioned at 20˚ 57’ North latitude and 72˚ 54’ East longitude. Navsari's climate is tropical monsoon, featuring a warm and humid monsoon season, a moderately cold winter and a fairly hot and humid summer. The mild climate is due to its coastal location. The experiment used a randomized block design to study nitrogen levels in soil application with foliar sprays of nano urea or urea in a sugarcane plant-ratoon system.

Table 1: Experimental soil properties:

Texture	Clayey
EC	0.46 dS/m, normal
pH	7.78, slightly alkaline
Available N	228.5 kg/ha, low
Available P_2O_5	37.62 kg/ha, medium
Available K_2O	350.5 kg/ha, high
Organic carbon	0.37 %, low

Each spray of IFFCO nano urea @ 4 ml/L of water. Combinations of these all treatments were applied in plant crop as well as at same interval in ratoon crop to study and their effect on growth behavior and yield were assessed and analyzed during both plant crop and ratoon crop.

Table 2: Details of treatments

T_1	:	Absolute control
T_2	:	100 % RDN
T_3	:	75% RDN + 2 spray of liquid nano urea (at 90 and 180 DAP)
T_4	:	75% RDN + 2 spray of 2 % urea (at 90 and 180DAP)
T_5	:	50% RDN + 4 spray of liquid nano urea (at 90, 120, 150 and 180 DAP)
T_6	:	50% RDN + 4 spray of 2 % Urea (at 90, 120, 150 and 180 DAP)

T_7	**:**	25 % RDN + 6 spray of liquid nano urea (at 60, 90, 120, 150, 165 and 180 DAP)
T_8	**:**	25 % RDN + 6 spray of 2 % urea (at 60, 90, 120,150, 165 and 180 DAP)

Amount of N was added through each treatments:

Treatments		Soil application		Foliar spray
		N in **plant crop** (2021-22)	N in **ratoon crop** (2022-23)	Nano urea (L/ha) or 2% urea (kg/ha)
T_1	**:**	0	0.00	0.0
T_2	**:**	250.00	300.00	0.0
T_3	**:**	187.50	225.00	2.8 L/ha
T_4	**:**	187.50	225.00	14 kg/ha
T_5	**:**	125.00	150.00	6.0 L/ha
T_6	**:**	125.00	150.00	30 kg/ha
T_7	**:**	62.50	75.00	8.8 L/ha
T_8	**:**	62.50	75.00	44 kg/ha

Note:
200 L/ha water required for foliar spray at 60 and 90 DAP of plant crop and DAR of ratoon crop,
300 L/ha water required for foliar spray at 120 DAP of plant crop and DAR of ratoon crop,
500 L/ha water required for foliar spray at 150, 165, 180 DAP of plant crop and DAR of ratoon crop,

The recommended doses of N-P_2O_5-K_2O at 250-125-125 kg/ha for plant crop and 300-62.5-125 kg/ha for ratoon crop were computed based on the treatment specifications for each plot area. Phosphorus was applied through single superphosphate and potash was supplied *via* muriate of potash, were manually applied as basal dressing in furrows. Nitrogen was administered in the form of urea, divided into four splits in plant crop: 15% N at planting, 30% N at 60 days after planting, 20% N at 90 days after planting and 35% N before the final earthing-up at 150 days after planting. For the ratoon crop three splits of nitrogen application (25% as basal, 50% at 90 DAR and 25 % at 150 days after ratooning (DAR) of ratoon, according to the treatment allocations for each plot area. During the crop period, agronomic practices are applied in a timely manner and in accordance with requirements. A random sample technique was applied throughout the experiment to record observations. The count for the number of millable canes was conducted at harvest from net plot was calculated to report as the number of millable canes per net plot at harvest of both plant and ratoon crop. The millable cane population was then converted on a hectare basis. The number of internodes was counted for five previously selected plants from net plot at harvest of plant crop as well as ratoon crop and the average was calculated to report as the number of internodes per plant. Top, middle and bottom cane girth were measured full radius by sewing threads at harvest. The cane girth at three spots measured by averaged of five cane from plant as well as ratoon crop from net plot and recorded as the girth of the cane in cm. The weight of five randomly selected plant and ratoon crops from net plots was recorded individually and presented as average weight per cane at harvest in kilogram during plant and ratoon season. The fresh weight of green top for sugarcane was recorded from both plant and ratoon crops and converted to tonnes per hectare (t/ha). Each net plot was harvested separately, with the canes de-trashed and millable canes prepared by cutting the top portion. The weight of these millable canes was recorded in kilograms at harvest for both plant and ratoon crops, then converted to t/ha using a conversion factor. Pooled analysis in sugarcane plant-ratoon crop experiments enhances reliability and generalizability, determining consistent treatment effects across years. This robust approach ensures effective decision-making for crop management and improvement strategies. The gross realization in terms of rupees per hectare was calculated on the basis of plant and ratoon crop yields of each treatment and the prices of the produce prevailing in the market. The cost of cultivation for each treatment was worked out by taking into consideration the cost of all the operations right from the preparatory tillage till harvesting and the cost of all inputs involved. Net realizations of each treatment were calculated by deducting the total cost of cultivation from the gross realization. The Benefit Cost Ratio (BCR) was calculated on the basis of formula given below and recorded in rupees per hectare accordingly.

$$\text{Benefit cost ratio (BCR)} = \frac{\text{Gross income (₹/ha)}}{\text{Total expenditure (₹/ha)}}$$

3 RESULTS AND DISCUSSION

3.1 Effect on Yield Attributes and Yield

Data presented in Table 3 and 4 indicated that the application of conventional urea along with foliar spray of nano urea and urea observed into significant result in the case of yield attributes such as No. of millable canes, No. of internodes/plant, cane girth (cm) and single cane weight (kg) at harvest of the plant and ratoon crop as well as in pooled analysis. Significantly higher No. of millable cane (’000)/ha, No. of internodes/plant, cane girth (cm) and single cane weight (kg) at harvest of plant and ratoon crop as well as in pooled analysis was recorded with the application of 75% RDN + 2 spray of liquid nano urea at 90 and 180 DAP (T_3) but it was remained at par with application of treatment T_2 (100% RDN) and T_4 (75% RDN + 2 spray of 2 % urea at 90 and 180 DAP) as compare to the other treatments and absolute control. Furthermore, treatments T_5, T_6, T_7 and T_8 did not impart any significant result as compared to absolute control.

A summary of the data presented in Table 4 showed that different treatments had a significant effect on millable cane yield and green top yield in plant crop and ratoon crop. Data clearly showed that significantly higher millable cane yield (130.45, 108.88 and 119.66 t/ha during the years 2021-22, 2022-23 and pooled result, respectively) of sugarcane was recorded with application of 75% RDN + 2 spray of liquid nano urea at 90 and 180 DAP. However treatment T_3 was remained statistically at par with T_2 and T_4 in terms of millable cane yield. Same trends were observed in plant-ratoon cycle. Whereas significantly lower millable can yield was found with treatment T_1 (absolute control). However, millable cane significantly increased 67.25%, 62.62% and 52.53% during plant crop season, 96.78%, 93.19% and 78.89% during ratoon crop season as well as 79.51, 75.31 and 63.47% in pooled analysis with the treatments T_3, T_2 and T_4, respectively as compare to absolute control. Furthermore, treatments T_5, T_6, T_7 and T_8 increased the millable cane yield as compared to absolute control but it was not statistically significant. The response of different treatments in cane yield (t/ha) of sugarcane was in order $T_3 > T_2 > T_4 > T_5 > T_6 > T_7 > T_8 > T_1$. The findings for green top yield closely mirrored those of millable cane yield. Significantly maximum green top yield was obtained under treatment T_3 and it was statistically at par with T_2 and T_4 during both plant crop and ratoon crop as well as with the pooled analysis. While the lowest green top yield in treatment T_1 (absolute control). However, treatments T_5, T_6, T_7 and T_8 did not significant increased the green top yield as compared to absolute control. Furthermore, as per the results of pooled analysis it was indicated that the yield attributes and yield were recorded significantly higher in plant crop season as compared to ratoon crop tenure with respective all treatments.

The observed increase in sugarcane yield attributes and yield, encompassing both cane yield and green top yield in both plant and ratoon crop seasons, can be attributed to several factors associated with the application of liquid nano urea fertilizer in conjunction with conventional urea. The combined application of these fertilizers optimized nutrient availability throughout the growth stages of sugarcane, ensuring that the plants received adequate nutrients essential for their growth and development. Nano urea, with its nano-sized particles and controlled-release mechanism, facilitated better absorption of nutrients by the plants, leading to improved nitrogen utilization. Moreover, the foliar application of nano urea directly impacted metabolic processes within the sugarcane plants, notably enhancing photosynthesis and carbohydrate metabolism. This resulted in the accumulation and translocation of elevated levels of photosynthates to both vegetative and reproductive components of the plant. Consequently, there was a significant increase in total dry matter production, including enhanced chlorophyll production and prolonged leaf greening, which ultimately led to increased dry matter yield.

Furthermore, nano urea's supplementary growth-promoting affects, such as increased activity of chloroplasts, rubisco and antioxidant enzyme systems, contributed to the enhanced growth and development of sugarcane plants. These effects were particularly evident in the increased number of tillers per meter of row length which is crucial for sugarcane yield as it determines the number of shoots produced. Additionally, nano urea formulations often contain additives that improve nutrient solubility and dispersion, further enhancing their effectiveness. The controlled-release properties of nano urea ensured a sustained supply of nitrogen, supporting continuous tiller development and overall plant growth throughout the crop cycle. Moreover, the increase in sugarcane yield can also be attributed to the improved nutrient uptake facilitated by nano urea through its easy and direct penetration through leaf stomata via gas exchange. This facilitated the mobilization of synthesized carbohydrates into amino acids and proteins, stimulating rapid cell division and elongation, ultimately enhancing plant growth and yield attributes. Specifically, the application of nano urea led to significant increases in plant height, number of tillers, single cane weight, number of millable canes and cane girth. These morphological improvements were underpinned by enhanced nutrient availability, resulting in improved nutrient use efficiency as measured by agronomic nutrient efficiency, partial factor productivity and nitrogen apparent recovery efficiency which was might be due to the combined application of nano urea with decreasing rates of recommended nitrogen (RDN) consistently outperformed the sole application of 100% RDN as a soil application, highlighting the superior effectiveness of this approach. Overall, the synergistic effects of conventional urea and liquid nano urea fertilizers, coupled with their targeted application at critical growth stages, significantly enhanced the growth, yield attributes and nutrient uptake of sugarcane. These outcomes align with the research findings of Alimohammadi *et al.* (2020) and Kumar *et al.* (2023b).

Thus, the combined application of conventional and nano urea fertilizers, particularly treatment T_3, significantly increased sugarcane yield by optimizing nutrient availability, enhancing photosynthesis and promoting growth. This underscores the potential of nano urea in improving crop productivity through enhanced nutrient utilization and growth-promoting effects. The results are in close agreement with those of Salama and Badry (2020), Ninama *et al.* (2023) and Jadhav *et al.* (2022) in maize, Sahu *et al.* (2022), Bhargavi and Sundari (2023), Dhyalan *et al.* (2023) and Gajbhiye *et al.* (2024) in rice, Navya *et al.* (2022) and Pandav *et al.* (2022) in mustard and Rawate *et al.* (2022) in wheat.

3.2 Effect on Economics

Considering the cost of cultivation, selling price and cane yield, economics of the different treatments was computed separately for plant as well as ratoon sugarcane and on sequence basis (plant + ratoon) as well (Table 5a, 5b and 5c). During both plant crop and ratoon crop season, an application 75% RDN + 2 spray of liquid nano urea at 90 and 180 DAP (T_3) recorded higher net returns (285956 and 295835 ₹/ha, respectively) and benefit: cost ratio (2.49 and 3.77, respectively) while, lowest net returns (131579 and 136763 ₹/ha, respectively) and benefit: cost ratio (1.86 and 2.96, respectively) observed in absolute control (T_1).

However, in plant-ratoon cycle an application of 75% RDN + 2 spray of liquid nano urea at 90 and 180 DAP (T_3) recorded higher net returns (565072 ₹/ha) and benefit: cost ratio (2.95) while, lowest net returns (268342 ₹/ha) and benefit: cost ratio (2.21) observed in absolute control (T_1). Similar results observed with the findings of Mishra *et al.* (2020), Yogendra *et al.* (2020), Ajithkumar *et al.* (2021), Chinnappa *et al.* (2023), Dutta *et al.* (2023), Nitesh *et al.* (2023), Srivastava *et al.* (2023) and Upadhyay *et al.* (2023).

4 CONCLUSION

It concluded that for achieving higher yield and monetary returns in sugarcane plant-ratoon cultivation should be fertilized with 100 % of recommended P_2O_5 and K_2O + 75 % RDN combined with two sprays of either liquid nano urea @ 4 ml/L or 2 % urea at 90 and 180 days after planting (DAP) of plant crop as well as 90 and 180 days after ratooning (DAR) of ratoon crop. This application effectively replaces the 25% of recommended dose of nitrogen while matching the performance of the 100% RDN treatment.

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Table 3: Yield attributes as influenced by different treatments in plant (2021-22) and ratoon (2022-23) sugarcane

Treatments		Number of millable cane ('000)/ha			Number of internodes/cane			Cane girth (cm)		
		Plant	Ratoon	Pooled	Plant	Ratoon	Pooled	Plant	Ratoon	Pooled
T_1		71.95	53.92	62.93	19.14	18.82	18.98	7.27	7.03	7.15
T_2		102.28	86.31	94.29	24.01	23.25	23.63	9.00	8.67	8.83
T_3		106.15	89.58	97.87	24.38	23.48	23.93	9.10	8.70	8.90
T_4		100.37	81.94	91.16	23.41	23.08	23.25	8.83	8.60	8.72
T_5		91.53	77.40	84.46	21.17	20.36	20.76	7.93	7.57	7.75
T_6		90.03	75.60	82.82	21.05	20.31	20.68	7.90	7.53	7.72
T_7		86.05	72.99	79.52	20.10	19.42	19.76	7.43	7.27	7.35
T_8		82.70	69.44	76.07	19.39	19.07	19.23	7.42	7.13	7.28
SEm±		4.58	3.57	2.90	1.04	1.02	0.73	0.37	0.37	0.26
CD (P=0.05)		13.89	10.84	8.41	3.17	3.09	2.11	1.13	1.12	0.76
CV %		8.68	8.16	8.50	8.38	8.42	8.40	7.99	8.17	8.07
Y	SEm±	-	-	1.45	-	-	0.36	-	-	0.13
	CD (P=0.05)	-	-	4.21	-	-	NS	-	-	NS
Y X T	SEm±	-	-	4.11	-	-	1.03	-	-	0.37
	CD (P=0.05)	-	-	NS	-	-	NS	-	-	NS

Table 4: Single cane weight and yield as influenced by different treatments in plant (2021-22) and ratoon (2022-23) sugarcane

Treatments		Single cane weight (kg)			Millable cane yield (t/ha)				Green top yield (t/ha)			
		Plant	Ratoon	Pooled	Plant	Ratoon	Pooled	Plant-Ratoon cycle	Plant	Ratoon	Pooled	Plant-Ratoon cycle
T_1		1.100	1.034	1.068	77.99	55.33	66.66	133.32	13.72	11.79	12.76	25.51
T_2		1.288	1.245	1.266	126.83	106.89	116.86	233.73	23.61	21.46	22.54	45.07
T_3		1.311	1.278	1.295	130.45	108.88	119.66	239.33	23.93	21.71	22.82	45.64
T_4		1.272	1.227	1.249	118.96	98.98	108.97	217.94	21.17	19.99	20.58	41.17
T_5		1.163	1.108	1.135	104.86	86.58	95.72	191.44	20.28	18.87	19.58	39.15
T_6		1.160	1.103	1.131	100.97	83.29	92.13	184.25	19.86	18.60	19.23	38.46
T_7		1.135	1.077	1.106	97.59	79.28	88.43	176.87	18.43	16.32	17.38	34.75
T_8		1.134	1.076	1.105	92.59	75.19	83.89	167.78	17.64	15.86	16.75	33.50
	SEm±	0.049	0.055	0.037	6.07	6.47	4.43	11.34	1.16	0.88	0.73	2.05
	CD (P=0.05)	0.148	0.166	0.106	18.40	19.61	12.84	34.41	3.53	2.68	2.12	6.21
	CV %	7.06	8.28	7.67	9.89	12.90	11.25	10.18	10.17	8.48	9.45	9.36
Y	SEm±	-	-	0.018	-	-	2.22	-	-	-	0.37	-
	CD (P=0.05)	-	-	NS	-	-	6.42	-	-	-	1.06	-
Y X T	SEm±	-	-	0.052	-	-	6.27	-	-	-	1.03	-
	CD (P=0.05)	-	-	NS	-	-	NS	-	-	-	NS	-

Table 5a: Economics of plant sugarcane as influenced by different treatments

Treatments	Cane yield (kg/ha)	Green top yield (t/ha)	Gross realization (₹/ha)	Treatment Cost (₹/ha)	Common Cost (₹/ha)	Harvesting cost (₹/ha)	Total Cost of cultivation (₹/ha)	Net realization (₹/ha)	BCR
T_1	77.99	13.72	283881	0	117205	35097	152302	131579	1.86
T_2	126.83	23.61	464896	15400	117205	57076	189681	275215	2.45
T_3	130.45	23.93	477250	15389	117205	58700	191294	285956	2.49
T_4	118.96	21.17	433611	14127	117205	53533	184865	248746	2.35
T_5	104.86	20.28	386254	15647	117205	47186	180039	206215	2.15
T_6	100.97	19.86	372747	12945	117205	45434	175585	197163	2.12
T_7	97.59	18.43	358366	16191	117205	43916	177312	181054	2.02
T_8	92.59	17.64	340372	12227	117205	41663	171096	169276	1.99

Table 5b: Economics of ratoon sugarcane as influenced by different treatments

Treatments	Cane yield (kg/ha)	Green top yield (t/ha)	Gross realization (₹/ha)	Treatment Cost (₹/ha)	Common Cost (₹/ha)	Harvesting cost (₹/ha)	Total Cost of cultivation (₹/ha)	Net realization (₹/ha)	BCR
T_1	55.33	11.79	206531	0	44869	24899	69768	136763	2.96
T_2	106.89	21.46	395707	12881	44869	48101	105851	289857	3.74
T_3	108.88	21.71	402686	12986	44869	48996	106851	295835	3.77
T_4	98.98	19.99	366715	11724	44869	44540	101134	265581	3.63
T_5	86.58	18.87	324236	13362	44869	38962	97193	227043	3.34
T_6	83.29	18.60	313024	10660	44869	37480	93009	220015	3.37
T_7	79.28	16.32	294483	13884	44869	35674	94428	200056	3.12
T_8	75.19	15.86	280253	9921	44869	33836	88626	191627	3.16

Table 5c: Economics of plant-ratoon two year cycle during (2021-22 to 2022-23) in sugarcane as influenced by different treatments

Treatments	Plant-ratoon cycle		Gross realization (₹/ha)	Treatment Cost (₹/ha)	Common Cost (₹/ha)	Harvesting cost (₹/ha)	Total cost of cultivation (₹/ha)	Net realization (₹/ha)	BCR
	Millable cane yield (t/ha)	Green top yield (t/ha)							
T_1	133.32	25.51	490412	0	162075	59995	222070	268342	2.21
T_2	233.73	45.07	860603	28281	162075	105176	295532	565072	2.91
T_3	239.33	45.64	879936	28374	162075	107697	298146	581790	2.95
T_4	217.94	41.17	800326	25851	162075	98073	285999	514327	2.80
T_5	191.44	39.15	710490	29010	162075	86148	277232	433258	2.56
T_6	184.25	38.46	685771	23605	162075	82914	268594	417177	2.55
T_7	176.87	34.75	652849	30075	162075	79590	271740	381110	2.40
T_8	167.78	33.50	620625	22148	162075	75499	259722	360903	2.39

Sale price of sugarcane millable cane = 3200 ₹/t of cane yield

Sale price of sugarcane green top = 2.5 ₹/kg

Harvesting cost = 450₹/t of cane yield