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Research Article

Use and Efficacy of N-(N-Butyl) Thiophosphoric Triamide (Nbpt) Urease Inhibitor and Urea Fertilizers on Corn (Zea Mays) and Sugarcane (Saccharum Officinarum)

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Abstract

Urea is the most frequently applied N-fertilizer in agriculture, which accounts for 50% of the total world nitrogen fertilizer consumption; however, due to the rapid hydrolysis of its amide N by reaction with the enzyme urease, a quantitative loss of urea N as NH3 volatilization and NO3- leaching, leads to a definite decrease of urea nitrogen use efficiency. N-(n-butyl) thiophosphoric triamide (NBPT) urease enzyme inhibitor was evaluated for its efficacy in increasing yield in corn and sugarcane when coated to granular urea fertilizers. Both liquid and dry forms of urease inhibitor coatings were used to coat granulated urea fertilizers. Two season corn trials were done in Laguna while sugarcane trials were done in Tarlac and Batangas. The dry season corn yields were increased by 11.99% and 9.55 % for the dry and liquid form of urease inhibitor coating while yields for the wet season showed 25.11% and 29.81% advantage for the dry and liquid form of coating respectively. LKg/ha for sugarcane trials in Tarlac showed 30.01% and 17.48% for dry and liquid coating while the trial in Batangas yielded 17.85 % and 13.43% increase in sugar yield for dry and liquid forms respectively. NBPT nitrogen stabilizer was very effective in delaying the hydrolysis of urea which made sure a steady and sufficient supply of nitrogen throughout the growth of corn and sugarcane thus improving the yield compared to those plots fertilized with uncoated urea.

Keywords: NBPT, Urease Inhibitor, Urea Fertilizer, Corn, Sugarcane

1. Introduction

Urea-based fertilizers make up almost half the world's nitrogen (N) market. Continued growth is expected owing to urea's high-analysis safety and its ability to be applied as a dry or urea containing solution. Studies have shown that urea containing fertilizers can lose up to 30 percent or more of their N if not incorporated within 72 hours by tillage or rainfall. Volatilization occurs when urea hydrolyzes. It reacts with soil moisture and breaks down. The enzyme urease, which is produced by soil microbes, facilitates the reaction. When urea is applied to the soil, it is transformed before any of the N becomes available to the plants. The following are the three main reactions of urea in soil.

Urea hydrolysis: $(NH_2)2CO + 2H_2O$ —urease→ $(NH_4)2CO_3$
Urea water ammonium carbonate.

$(NH_4)2CO_3 + 2H+ \longrightarrow 2NH_4+ + CO_2 \uparrow + H_2O$
Ammonium carbon dioxide.

$NH_4+ + OH- \leftrightarrow NH_3\uparrow + H_2O$
Ammonia.

(NBPT) inhibits the urease enzyme, making volatilization virtually impossible for up to 14 days.

2. Methodology

Field trials were initiated in 2013 and ended in 2015. Nitrogen source was granular urea (with and without NBPT urease inhibitor dry and liquid formulation).

• **Corn Trials:** The two-season study was conducted at the central experiment station of UPLB. Soils were taken during site selection and succeeding chemical analysis was done at the Analytical Services Laboratory (ASL), SAED, ASC, UPLB to determine the fertilizer recommendation of the experimental

site which was found to be 150-60-90 kg N-P_2O_5 -K_2O/ha. The corn variety used was Pioneer 4097. Various growth and yield parameters were measured and analyzed throughout the duration of the experiments.

• **The Micro Plot:** Consisted of sixteen (16) representative hills in the middle of each plot (excluding four (4) hills from both ends of the plot and two (2) rows from both sides) where growth parameters such as plant height, leaf length and diameter will be collected.

• **Plant Height:** Was measured by taking the length of the plant from the soil level to the tip of the longest leaf.

• **Leaf Length was:** Measured by length of the fully expanded leaf or the third leaf from the growing tip of the representative hills.

• **Leaf Diameter was:** Collected by measuring the length of the leaf from both margins of the representative hills.

• **Leaf Area was:** Obtained by getting the product of the leaf length and diameter.

2.1. Yield Parameters Data Collection

• **Cob Length was:** Collected by measuring the length the cob from the base to the tip of sixteen (16) representative plants within the micro plot.

• **Weight of Seeds was:** Taken by weighing the randomly selected 1000 seeds from the sample hills.

• **Grain Yield was:** Taken by weighing the total grain harvested from the plots after threshing and reported as yield at 14% moisture content with a unit of tons per hectare.

2.2. Sugarcane Trials

The trials were laid out in Tarlac and Batangas and fertilizer rates used were 200-90-180 kg N-P2O5 -K2O/ha and 170-90-180 kg N-P2O5 -K2O/ha respectively. Sugarcane variety used for Tarlac was VMC 87-599 and VMC 84-524 for Batangas.

2.3. Statistical Analyses

Normality and homogeneity of the variances were checked using the Shapiro-Wilk and Levene tests before performing ANOVA analyses, respectively. Mean comparison was performed using Turkey's Honest Significance Difference (HSD) Test at 5% level of significance.

3. Results and Discussion

3.1. Effect on Corn

Table 1 shows the effect of AGROTAIN® on the different agronomic parameters of corn during wet season. At 30 DAP, no significant differences were observed. Highest plant height was observed from plants applied with 100% of the conventional recommended rate (T3). For leaf area, the same trend was observed with T3 having the largest leaf area. At 60 DAP, plants under treatment 3 showed significant differences with those from the control (T1). Tallest plants were still observed from T3. Plants treated with full recommended rate in combination with dry coating (T5) were shorter by 3.55 cm compared with T3. Plants treated with full recommended rate with liquid coating (T8) were shorter by 1.9 cm from T3. Plant height of T5 was significantly higher than those plants applied with AGROTAIN® dry stabilizer alone (T6) while plants under T8 were significantly taller than those treated with AGROTAIN® liquid stabilizer alone.

Treatments	ht_30	ht_60	lf_ area_30	lf_ area_60	cob_lth	stvr_wt	1000_wt	grn_yld
T1- Control (no applications)	81.35 a	138.03 b	305.57	463.17 b	117.45 c	8.81 b	273.34 c	5.96 b
T2- 50% Conventional Recommended Rate	90.98 a	169.50 a	395.36	525.90 ab	136.21 abc	13.16 ab	313.19 abc	7.02 ab
T3- 100% Conventional Recommended Rate	95.19 a	191.38 a	438.46	558.65 a	153.88 a	14.65 ab	367.38 a	6.81 ab
T4- 50% Conventional Recommended Rate + AGROTAIN® nitrogen stabilizer dry	94.22 a	177.93 a	417.87	557.71 a	138.70 abc	12.86 ab	341.72 ab	7.71 ab
T5-100% Conventional Recommended Rate + AGROTAIN® nitrogen stabilizer dry	91.45 a	187.83 a	389	545.56 ab	152.19 a	15.25 a	358.52 a	8.52 a
T6 - AGROTAIN® nitrogen stabilizer dry	84.76 a	127.93 b	357.59	465.56 b	123.26 bc	8.66 b	297.47 bc	6.73 ab
T7- 50% Conventional Recommended Rate + AGROTAIN® nitrogen stabilizer liquid	94.86 a	186.78 a	422.64 a	543.36 ab	142.08 ab	14.14 ab	315.66 bc	7.41 ab
T8- 100% Conventional Recommended Rate + AGROTAIN® nitrogen stabilizer liquid	94.95 a	189.48 a	420.59 a	546.51 ab	154.88 a	16.41 a	366.45 a	8.84 a
T9-AGROTAIN® nitrogen stabilizer liquid	83.38 a	136.23 b	384.74 a	490.23 ab	128.53 bc	8.90 b	297.57 c	6.60 ab
coefficient of variation	10.34	6.64	15.88	6.67	6.32	21.24	6.81	14.16

Table 1: Agronomic Parameters of Corn as Affected By Different Levels of Fertilizers in Combination with Dry and Liquid Nitrogen Stabilizers During Wet Season

For leaf area at 60 DAP, T3 recorded the largest leaf area with 558.65 cm2 and was significantly higher than that of the control. Plants under T5 and T8 were both smaller in terms of leaf area as compared with T5. Cob length was highest in T8 with 154.88 cm but it is not significantly higher than that of T3. However, the cob length of T5 was shorter by 1.69 cm from that of T3. For stover weight, plants treated with dry coating (T5) and liquid coating (T8) were higher by 4.09% and 12.01%, respectively from T3. Grain yield obtained from T8 was the highest with 8.84 tons ha-1. Corn applied with only half of the recommended rate (T2) produced higher yield than those applied with full recommended rate of urea. Plants applied with 50% of the recommended rate with dry coating (T4) showed 9.83% advantage over T2 while those applied with 50% recommended rate with liquid coating (T7) 5.56% higher yield than T2. Grain yield of those in T5 and T8 were higher by 25.11% and 29.81%, respectively than that of T3. Both treatments were also significantly higher than that of the control.

Table 2 shows the effect of nitrogen stabilizers on corn during dry season. Plant height at 30 DAP showed no significant differences among the treatments. However, highest value was observed in plants applied with T4. For leaf area at 30 DAP, no significant differences were also observed among treatments but the greatest leaf area which was 468.08 cm2 was observed in T4. At 60 DAP, plant height at T4 is significantly higher than that of the control with 213.85 cm. However, for leaf area at 60 DAP, the greatest value was observed at T3 with 633.16 cm2. Cob length was longest in T8 with 161.55 cm. Grain yield was highest in T5 with 11.49 tons ha-1. It showed 11.99% increase in yield as compared with T3. Corn in T8 also showed 9.55% advantage over T3. Corn applied with half the recommended rate only had a yield of about 8.93 tons ha-1 which was significantly lower than T5. Grain yield during wet season was higher using the dry nitrogen stabilizer. On the other hand, grain yield during the dry season was highest using the liquid nitrogen stabilizer. During wet season, higher leaching loss of nitrate may occur. To address this, nitrogen in the soil must remain in its ammonium form. This can be achieved by using nitrification inhibitors that can limit the activities of Nitrosmonas sp. bacteria, thus inhibiting the conversion of ammonium to nitrate form.

Treatments	ht_30	ht_60	lf_area_30	lf_area_60	cob_lth	stvr_wt	1000_wt	grn_yld
T1- Control (no applications)	87.97a	148.95 b	325.33a	504.92a	124.12 c	10.88 b	328.90 c	6.58 c
T2- 50% Conventional Recommended Rate	97.80a	180.43 ab	410.77a	571.65a	142.88 abc	15.23 ab	368.74 bc	8.93 bc
T3- 100% Conventional Recommended Rate	102.10a	202.30 ab	451.95a	633.16a	160.55 a	17.72 a	387.01 ab	10.26 ab
T4- 50% Conventional Recommended Rate + AGROTAIN® nitrogen stabilizer dry	103.66a	213.85 a	462.08a	573.57a	150.85 ab	16.22 ab	371.22 bc	9.97 ab
T5-100% Conventional Recommended Rate + AGROTAIN® nitrogen stabilizer dry	95.72a	183.75 ab	373.84a	541.40a	154.57 ab	18.49 a	422.94 a	11.49 a
T6 - AGROTAIN® nitrogen stabilizer dry	91.45a	158.85 ab	375.39a	522.63a	134.38 bc	13.22 ab	353.12 bc	7.83 bc
T7- 50% Conventional Recommended Rate + AGROTAIN® nitrogen stabilizer liquid	101.75a	197.70 ab	452.90a	591.40a	148.75 ab	17.16 a	371.62 bc	9.21 abc
T8- 100% Conventional Recommended Rate + AGROTAIN® nitrogen stabilizer liquid	101.85a	187.90 ab	433.68a	594.12a	161.55 a	18.13 a	407.68 ab	11.24 ab
T9-AGROTAIN® nitrogen stabilizer liquid	92.60a	164.65 ab	398.27a	563.72a	135.20 bc	14.11 ab	358.67 cd	7.97 bc
coefficient of variation	10.7	12.62	17.8	9.04	6.81	14.85	5.37	15.55

Table 2: Agronomic Parameters of Corn as Affected By Different Levels of Fertilizers in Combination with Dry and Liquid Nitrogen Stabilizers During Dry Season

3.2. Effect on Sugarcane

Table 3 summarizes the different agronomic parameters of sugarcane treated with varying levels of nitrogen fertilizers. For sugarcane planted in Tarlac, significant differences in LKg/TC were observed among treatments. Sugarcane applied with full recommended rate with dry coating of nitrogen stabilizer (T7) showed the highest LKg/TC with 2.00. It is significantly higher than those applied with 75% of the recommended rate with dry coating (T6) and 50% of the recommended rate with dry coating (T5) by 6.38% and 10.50%, respectively. Furthermore, T7 showed an advantage of about 4.71% over those applied with full recommended rate (T4). Highest cane yield was also observed in T7 with 68.15. It showed an advantage of about 24.25% over T4. Sugarcane in T7 also showed higher cane yield as compared withT6 and T5 by about 8.50% and 27.15%, respectively. No significant difference was observed between T11 and T4. However, T11 showed 14.13% increase in cane yield. Highest LKg/ha was observed in T7. It is significantly higher by 30% as compared with T4. Sugarcane applied with full recommended rate of fertilizer with liquid stabilizer (T11) also showed significantly higher LKg/ha as compared with T4. No significant difference was observed between T11 and T10. However, T11 showed 12.47% higher LKg/ha compared with T10. In comparison with T9, sugarcane in T11 showed significantly higher LKg/ha by about 35.49%.

Agronomic parameters of sugarcane planted in Batangas are summarized in Table 4. Sugarcane applied with 100% recommended Urea with liquid coating (T11) showed the highest LKg/TC with 1.99 followed by those treated with full recommendation of urea plus dry form of nitrogen stabilizer (T7) with 1.96. Both were higher than that of T4. Highest cane yield/ha was observed in T7 with 103.73. It is significantly higher by 17.46% from T4. Those in T11 were also significantly higher than T4 by 10.79%. Sugarcane in T7 showed the highest LKg/ha with 195.13. Although there was no significant difference was observed between T7 and T11, the former produced higher LKg/ha. In T7, the LKg/ha of sugarcane in Batangas was significantly

higher by 17.86% than that of T4. The same comparison was done for T11 and T4 and results showed that sugarcane in T11 had significantly higher LKg/ha than in T4 [1-5].

Treatments	ht_60	ht_120	ht_180	stk_ dia_180	stk_ lth_10MaP	stk_ dia_10MAP	no_mill	stk_wt	LKg/TC	cane yld/ha	LKg/ ha
T1-CONTROL (no application)	36.18a	119.95 a	167.6 c	2.55 a	152.78 a	2.82 ab	3.74 b	1.03 d	1.68 e	38.52 d	65.09 d
T2-50 % recommended rate of conventional fertilizers (UREA)	38.18a	125.38 a	187.3 bc	2.60 a	171.09 a	2.79 ab	4.04 ab	1.14 bcd	1.79 d	46.01 cd	82.40 cd
T3-75 % recommended rate of conventional fertilizers (UREA)	40.03a	125.33 a	182.0 bc	2.61 a	175.78 a	2.84 ab	4.07 ab	1.19 abcd	1.89 bc	48.64 bcd	91.77 bcd
T4-100 % recommended rate of conventional fertilizers (UREA)	39.00a	128.08 a	238.6 a	2.69 a	176.94 a	2.94 a	4.24 ab	1.29 abc	1.91 b	54.85 abc	104.84 bc
T5-50 % recommended rate of Urea coated with dry form of AGROTAIN® nitrogen stabilizer	38.78a	127.70 a	217.7 ab	2.68 a	172.92 a	2.94 a	4.47 ab	1.21 abcd	1.81 cd	53.60 abcd	97.16 bc
T6-75 % recommended rate of Urea coated with dry form of AGROTAIN® nitrogen stabilizer	40.08a	129.98 a	227.2 ab	2.68 a	178.69 a	2.96 a	4.83 a	1.30 ab	1.88 bc	62.81 ab	118.35 ab
T7-100 % recommended rate of Urea coated with dry form of AGROTAIN® nitrogen stabilizer	43.25a	128.05 a	237.0 a	2.69 a	180.16 a	2.98 a	4.87 a	1.40 a	2.00 a	68.15 a	136.30 a
T8-dry form of AGROTAIN® nitrogen stabilizer alone	36.30a	117.50 a	182.0 bc	2.55 a	154.87 a	2.73 b	3.77 b	1.04 cd	1.68 e	39.18 d	66.15 d
T9-50 % recommended rate of Urea coated with liquid form of AGROTAIN® nitrogen stabilizer	39.68 a	131.58 a	219.6 ab	2.58 ab	175.42 ab	2.90 a	4.45 ab	1.16 a	1.79 c	51.03 ab	90.91 bc
T10-75 % recommended rate of Urea coated with liquid form of AGROTAIN® nitrogen stabilizer	41.71 a	131.95 a	220.8 a	2.66 ab	178.19 ab	2.91 a	4.76 a	1.22 a	1.89 b	58.03 a	109.51 ab
T11-100 % recommended rate of Urea coated with liquid form of AGROTAIN® nitrogen stabilizer	41.73 a	133.97 a	225.7 a	2.76 a	179.91 a	2.96 a	4.75 a	1.32 a	1.96 a	62.70 a	123.17 a
T12- liquid form of AGROTAIN® nitrogen stabilizer alone	37.2 a	120.84 a	184.3 ab	2.42 b	152.78 b	2.75 a	3.75 b	1.03 a	1.69 d	38.49 b	65.31 c
coefficient of variation	9.81	7.75	5.11	3.48	7.09	2.93	8.86	9.03	1.77	12.58	13.11

Table 3: Agronomic Parameters of Sugarcane Planted in Tarlac as Affected by Different Levels of Fertilizers in Combination with Dry and Liquid Nitrogen Stabilizers

Treatments	ht_60	ht_120	ht_180	stk_ dia_180	stk_ lth_10MaP	stk_ dia_10MAP	no_mill	stk_wt	LKg/TC	cane yld/ha	LKg/ ha
T1-CONTROL (no application)	40.95 b	157.14 a	204.27 b	2.42 bc	178.34 bc	2.51 b	3.61 b	1.65 cd	1.69 c	59.27 d	100.02 e
T2-50 % recommended rate of conventional fertilizers (UREA)	43.21 ab	164.24 a	213.51 b	2.60 ab	200.31 abc	2.88 a	4.35 a	1.82 cd	1.83 b	79.16 c	144.58 d
T3-75 % recommended rate of conventional fertilizers (UREA)	45.31 ab	167.78 a	218.11 ab	2.62 ab	205.94 ab	2.93 a	4.36 a	1.91 bc	1.93 a	83.35 c	160.43 cd

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T4-100 % recommended rate of conventional fertilizers (UREA)	44.15 ab	169.44 a	220.27 ab	2.85 a	207.32 ab	3.02 a	4.62 a	1.91 bc	1.95 a	88.31 bc	172.03 bc
T5-50 % recommended rate of Urea coated with dry form of AGROTAIN® nitrogen stabilizer	42.90 ab	179.21 a	210.97 b	2.65 ab	206.05 ab	2.78 ab	4.50 a	1.82 cd	1.82 b	81.97 c	149.27 cd
T6-75 % recommended rate of Urea coated with dry form of AGROTAIN® nitrogen stabilizer	50.33 ab	182.35 a	249.00 a	2.66 ab	210.13 a	2.83 ab	4.54 a	2.17 ab	1.93 a	98.51 ab	189.77 ab
T7-100 % recommended rate of Urea coated with dry form of AGROTAIN® nitrogen stabilizer	51.03 a	179.69 a	245.54 a	2.86 a	213.44 a	3.10 a	4.35 a	2.38 a	1.96 a	103.73 a	202.75 a
T8-dry form of AGROTAIN® nitrogen stabilizer alone	40.85 b	168.42 a	200.73 b	2.17 c	175.67 c	2.52 b	3.69 b	1.63 d	1.73 c	60.07 d	103.85 e
T9-50 % recommended rate of Urea coated with liquid form of AGROTAIN® nitrogen stabilizer	44.91 ab	180.23 a	234.30 a	2.68 abc	206.00 ab	2.98 a	4.58 a	1.82 b	1.83 b	83.29 bc	151.65 cd
T10-75 % recommended rate of Urea coated with liquid form of AGROTAIN® nitrogen stabilizer	51.34 a	183.37 a	238.38 a	2.69 abc	208.83 ab	3.00 a	4.50 a	2.14 a	1.93 a	96.15 ab	185.15 ab
T11-100 % recommended rate of Urea coated with liquid form of AGROTAIN® nitrogen stabilizer	51.79 a	180.71 a	234.93 a	2.93 a	210.88 a	3.05 a	4.46 a	2.19 a	1.99 a	97.84 a	195.13 a
T12- liquid form of AGROTAIN® nitrogen stabilizer alone	42.11 ab	164.14 a	203.43 b	2.49 bc	184.15 ab	2.53 b	3.54 b	1.64 b	1.78 c	58.14 d	103.51 e
coefficient of variation	8.98	7.63	5.99	5.25	6.35	4.94	6.02	5.95	1.61	6.53	6.89

Table 4: Agronomic Parameters of Sugarcane Planted in Batangas as Affected by Different Levels of Fertilizers in Combination with Dry and Liquid Nitrogen Stabilizersbilizers

Treatments	Mean1	Mean2	Mean3	Mean4
T1-CONTROL (no application)	6.58 c	5.96 b	65.09 d	100.02 e
T2-50 % recommended rate of conventional fertilizers (UREA)	8.93 bc	7.02 ab	82.40 cd	144.59 d
T3-75 % recommended rate of conventional fertilizers (UREA)	-	-	91.77 bcd	160.43 bcd
T4-100 % recommended rate of conventional fertilizers (UREA)	10.26 ab	6.81 ab	104.84 ab	172.03 abc
T5-50 % recommended rate of Urea coated with dry form of AGROTAIN® nitrogen stabilizer	9.97 ab	7.71 ab	97.16 bc	149.27 cd
T6-75 % recommended rate of Urea coated with dry form of AGROTAIN® nitrogen stabilizer	-	-	118.35 ab	189.77 ab
T7-100 % recommended rate of Urea coated with dry form of AGROTAIN® nitrogen stabilizer	11.49 a	8.52 a	136.30 a	202.75 a
T8-dry form of AGROTAIN® nitrogen stabilizer alone	7.83 bc	6.73 ab	66.15 d	103.85 e
T9-50 % recommended rate of Urea coated with liquid form of AGROTAIN® nitrogen stabilizer	9.21 abc	7.41 ab	90.91 bcd	151.65 cd
T10-75 % recommended rate of Urea coated with liquid form of AGROTAIN® nitrogen stabilizer	-	-	109.51 ab	185.15 ab
T11-100 % recommended rate of Urea coated with liquid form of AGROTAIN® nitrogen stabilizer	11.24 a	8.84 a	123.17 a	195.13 a

T12- liquid form of AGROTAIN® nitrogen stabilizer alone	7.97 bc	6.60 ab	65.31 d	103.51 e
Coefficient of Variation	18.08	14.16	13.11	7.06

Table 5: Agronomic Parameters of Sugarcane Planted in Los Baños as Affected by Different Levels of Fertilizers in Combination with Dry and Liquid Nitrogen Stabilizers

Corn trial (Pioneer 4097) dry season in Los Baños
Corn trial (Pioneer 4097) wet season in Los Baños
Sugarcane trial (VMC 87-599) in Tarlac
Sugarcane trial (VMC 84-524) in Batangas

4. Summary and Conclusions

Urea is the most commonly used nitrogen fertilizer in agriculture, representing 50% of global nitrogen fertilizer consumption. However, its efficiency is compromised due to the rapid hydrolysis of its amide nitrogen by the enzyme urease, resulting in significant losses of urea nitrogen through NH3 volatilization and NO3- leaching. This reduces the overall nitrogen use efficiency of urea. The urease enzyme inhibitor N-(n-butyl) thiophosphoric triamide (NBPT) was tested for its potential to enhance crop yields when applied as a coating on granular urea fertilizers. Both liquid and dry urease inhibitor coatings were applied to granulated urea, with corn trials conducted in Laguna and sugarcane trials in Tarlac and Batangas.

Results showed that the use of AGROTAIN® nitrogen stabilizers demonstrated varying effects on corn agronomic parameters across wet and dry seasons. During the wet season, plants treated with the full recommended urea rate (T3) exhibited the tallest height and largest leaf area, although no significant differences were observed at 30 DAP. At 60 DAP, T3 showed the highest plant height and leaf area, which were significantly higher than the control. However, plants treated with AGROTAIN® dry (T5) and liquid (T8) stabilizers showed reduced plant heights compared to T3, with T8 yielding the highest grain production (8.84 tons ha^{-1}). Moreover, T5 and T8 resulted in 25.11% and 29.81% higher yields than T3, respectively. Corn treated with half the recommended urea rate (T2), particularly with AGROTAIN® coatings (T4 and T7), showed yield improvements over the full recommended rate.

In the dry season, while plant height at 30 DAP was highest with T4, the largest leaf area at 60 DAP was observed in T3. Cob length was greatest in T8, but grain yield was highest in T5 (11.49 tons ha^{-1}), showing an 11.99% increase over T3. The results suggest that grain yield during the wet season benefited from dry nitrogen stabilizers, while liquid stabilizers provided higher yields in the dry season. This difference may be due to reduced nitrate leaching in the wet season, which can be mitigated by using nitrification inhibitors to keep nitrogen in its ammonium form, thus improving nitrogen use efficiency. As for the sugarcane, in Tarlac, sugarcane treated with the full recommended urea rate combined with dry nitrogen stabilizer coating (T7) exhibited the highest leaf-to-plant ratio (LKg/TC), cane yield, and LKg/ha. Specifically, T7's agronomic parameters were consistently higher than the other treatments, including those with reduced nitrogen rates, showing a 6.38% and 10.50% increase in LKg/TC over the 75% and 50% recommended rate treatments, respectively, and a 24.25% higher cane yield compared to the full recommended rate (T4). Additionally, T7's LKg/ha was 30% higher than that of T4. Treatment T11, which used the full recommended rate with liquid nitrogen stabilizer, showed a 14.13% increase in cane yield over T4 and performed similarly to T7 in terms of LKg/ha.

In Batangas, the highest LKg/TC was observed in sugarcane treated with T11, followed closely by T7. Cane yield was highest in T7, with a 17.46% increase over T4, and although there was no significant difference between T7 and T11 for LKg/ha, T7 produced higher yields. The LKg/ha for sugarcane treated with T7 was 17.86% higher than that of T4, while T11 also showed a significant increase over T4. Both dry and liquid nitrogen stabilizer coatings on the full recommended urea rate (T7 and T11) led to significant improvements in sugarcane yield and other agronomic parameters in both regions. T7's agronomic parameters, with the dry stabilizer, were consistently higher than the other treatments, particularly in cane yield and LKg/ha, while T11 with the liquid stabilizer also showed notable advantages, particularly in Batangas. These findings suggest that nitrogen stabilizers, both in dry and liquid forms, can enhance nitrogen use efficiency and improve sugarcane productivity.

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