FINAL REPORT ON

EFFICACY EVALUATION OF N-GUARD (A NITRIFICATION INHIBITOR)-COATED UREA IN CORN)

PROJECT SPONSORED BY

NICO ORGO MANURES, OPPOSITE RAILWAYSTATION,

DAKOR-388225 (GUJARAT), INDIA

SGS India Private Limited

Field Trial- Agricultural Services, SGS House,4B, Adi Shankarcharya Marg, Vikhroli(W), Mumbai 400 083, India Tel.:91 2266408888 Fax: +91 22 66408826/66408827; www.sgs.com

Member of the SGS Group (Societe de Surveiliance)

EFFICACY EVALUATION OF '*N-GUARD*' (A NITRIFICATION-INHIBITOR)-COATED UREA IN CORN

SGS Study Code: 0898/001

Number of Locations in Study: 1- location (India Trials)

This report is an account of a project carried out on behalf/sponsorship of **NICO ORGO MANURES**

4/6/12

Dr. Ranjeet K Poddar
Study Director

4/6/2012

Dr. Joseph Lopez
Team Member

Date: **04-JUNE-2012**

Trials performed by: ***Dr. Ranjeet K Poddar & Team***

Author: ***Dr. Ranjeet K Poddar***

SGS India Pvt Ltd field trial services to the best of possibilities follow the published package of practices recommended by the state agricultural university/ crop based national research centre, for raising the crops and maintaining them. The data on percent disease index and other insect-pest infestations are recorded as per the standard assessment methods.

Every attempt has been made to ensure the accuracy of the data contained herein but SGS India Pvt Ltd cannot be held responsible for decisions made or actions taken as a result of information contained in this report.

Dr. Ranjeet K Poddar
PhD (IARI)
Manager (Field Trials)

CONTENTS

1. TITLE

Efficacy evaluation of *N-Guard* (a nitrification-inhibitor) coated urea in corn

2. OBJECTIVE

2.1 To evaluate the comparative effects of *N-Guard* (nitrification–inhibitor) coated, uncoated, and split dose applied urea based on better nitrogen-use-efficiency

2.2 To standardize the dosages of application of *N-Guard* for the coating of urea

2.3 Assessment of yields as affected by the use of the reduced dose of coated urea in comparison to uncoated urea at full dose

2.4 To observe the effect of application of *N-Guard* in form of coating of urea on incidence of diseases, infestations of insect-pests and plant-parasitic-cyst nematodes (*H. Zeae*)

2.5 To compare the nitrogen–status before application of N-Guard in form of coating, after application and at/near harvest

2.6 To determine the Benefit : Cost ratio.

3. SUMMARY

3.1. The various treatments of uncoated, Agrotain coated and N-Guard coated urea applications without split and with split applications revealed that the best fertilizer (nitrogen) use efficiency resulted by T5 (N-Guard coating @ 7.59 ml/Kg + Full Urea with 3-split applications at Basal, knee high and tasseling stages) with Harvest Index of 37.1% and followed by Harvest index of 36.8 % of T4 (Agrotain coating @ 2.84 ml/Kg + Full Urea with 3-split applications at Basal, knee high and tasseling stages) which was in turn followed with Harvest Index of 36.4% by treatment T6 (N-Guard coating @ 6.6 ml/Kg + Full Urea with 3-split applications at Basal, knee high and tasseling stages).

Treatment T6 was however followed by the Harvest Index of 35.9 % in the treatment T7 (N-Guard coating @ 5.61 ml/Kg + Full Urea with 3-split applications at Basal, knee high and tasseling stages), Harvest Index of 35.3 % in T3 (Uncoated Full Urea with 3-split applications at Basal, knee high and tasseling stages), Harvest Index of 35.2 % in T8 (N-Guard @ 6.6 ml/Kg + 15 % reduced Urea with 3-split applications at Basal, knee high and tasseling stages) and Harvest Index of 35.1 % in treatment T2 (Uncoated Full Urea with 2-split applications at Basal and knee high stages) respectively.

T9 (N-Guard @ 6.6 ml/Kg + 25 % reduced Urea with 3-split applications at Basal, knee high and tasseling stages) and T1 (Uncoated Full Urea without split application) were recorded to be the least effective treatments with 34.6 % Harvest Index for both.

3.2. The progressive results obtained from the increasing dosages of N-Guard from T7-T5 without reaching the plateau phase where the efficacy turns out to be the stagnant and law of minimum return exist, clearly indicate the possibility of increasing dose of N-Guard.
Based on the results of the trial the dose of treatment T5 (N-Guard @ 7.61 ml/Kg Urea) appears to be most promising dose. However this dose is most effective and still under the phase of law of increasing returns indicating further possibility of increasing the dose to 8.75 ml/Kg urea or increasing the cost.

3.3. Based on the yields obtained, the comparative gain in grain yield increase (8.1%) of T8 (N-Guard coating @ 6.6 ml/Kg + 15 % reduced Urea with 3-split applications at Basal, Knee high and Tasseling stages) and T9 (N-Guard coating @ 6.6 ml/Kg + 25 % reduced Urea with 3-split applications at Basal, Knee high and Tasseling stages) (1.5 % Gain in Grain-Yield) can replace the treatment T1 (Uncoated full urea without split application)

3.4. The observations recorded on the percent control of insect-pest(stem borer-*Chilo partellus*), diseases (Maydis Leaf Blight- *Helminthosporium maydis*, Turcicum leaf blight- *Exserohilum trucicum* and Stripe Downy Mildew-Scleropthora rayssiae var. Zeae) and plant parasitic cyst nematodes revealed that T5 (N-Guard coating @ 7.59 ml/Kg + Full Urea with 3-split applications at Basal, knee high and tasseling stages) resulted 49.2 % control of insects-pests and 68.4 % control of the cyst nematodes in corn and followed by the market std check of T4 (Agrotain coating @ 2.84 ml/Kg + Full Urea with 3-split applications at Basal, knee high and tasseling stages) with 46.1 % control of insect – pests and 50.6 % control of nematodes which was in turn followed with 36.8 % control of insect-pest and 47.8 % control of nematodes by T6 (N-Guard coating @ 6.6 ml/Kg + Full Urea with 3-split applications at Basal, knee high and tasseling stages).

As far as diseases control, the treatment maximum disease control of 26.4% resulted by T4 (Agrotain coating @ 2.84 ml/Kg + Full Urea with 3-split applications at Basal, knee high and tasseling stages) which was followed with 25.9 % and 18.9% control of diseases by T5 (N-Guard coating @ 7.59 ml/Kg + Full Urea with 3-split applications at Basal, knee high and tasseling stages) and T6 (N-Guard coating @ 6.6 ml/Kg + Full Urea with 3-split applications at Basal, knee high and tasseling stages) respectively.

Addition of diseases controlling agent of organic base in the N-Guard product formulation will give a competitive edge to the product against the market std check of Agrotain.

3.5. Treatment T5 (N-Guard coating @ 7.59 ml/Kg + Full Urea with 3-split applications at Basal, knee high and tasseling stages) stabilized the urea based N-loss to the extent of 37 % in comparison to uncoated urea T1 ((Uncoated full urea without split application) and followed by T6 (N-Guard coating @ 6.6 ml/Kg + Full Urea with 3-split applications at Basal, knee high and tasseling stages) which stabilized to the extent of 20.1% and followed by T4 (Agrotain coating @ 2.84 ml/Kg + Full Urea with 3-split applications at Basal, knee high and tasseling stages) with 17.7 % N-stabilization.

3.6. Treatment T5 (N-Guard coating @ 7.59 ml/Kg + Full Urea with 3-split applications at Basal, knee high and tasseling stages) also resulted the highest B:C ratio of 0.73:1 which was followed by the treatment of T4 (Agrotain coating @ 2.84 ml/Kg + Full Urea with 3-split applications at Basal, knee high and tasseling stages) with B:C Ratio of 0.66:1 which in turn followed by T6 (N-Guard coating @ 6.6 ml/Kg + Full Urea with 3-split applications at Basal, knee high and tasseling stages) and T3 (Uncoated Full Urea with 3-split applications at Basal, knee high and tasseling stages) with 0.62:1 B:C ratio for both.

3.7. The visual observations on phytotoxic parameters did not show any adverse effect for all the dosages of test product N-Guard in comparison to std check of Agrotain and uncoated urea treatments and found safe to the crop.

4.0 TREATMENT DETAILS

Treatments (T)		Dosage of applications at different stages							
		Basal				Knee-high		Tasseling	
		Nitrification – inhibitor/ N-Stabilizer (ml/ha)	N (Urea)*	P (SSP)	K (MOP)	Nitrification – inhibitor/ N-Stabilizer (ml/ha)	N (Urea)	Nitrification – inhibitor/ N-Stabilizer (ml/ha)	N (Urea)
Full N [Uncoated full N (Urea) + P + K]	T_1	0	120 (260.87)	60 (375)	40 (67.67)	0	0	0	0
Full N [Uncoated ½ N (Urea) + P + K] + [½ N (Urea)]	T_2	0	60 (130.43)	60 (375)	40 (67.67)	0	60 (130.43)	0	0
Full N [Uncoated 1/3 N (Urea) + P + K] + 2 X [Uncoated 1/3 N (Urea)]	T_3	0	40 (86.96)	60 (375)	40 (67.67)	0	40 (86.96)	0	40 (86.96)
Agrotain coating @ 740.87 ml/ha (2.84 ml/Kg Urea) + Full N; [1/3 coated N (Urea) + P + K] + 2 X [1/3 coated N (Urea)]	T_4	246.96	40 (86.96)	60 (375)	40 (67.67)	246.96	40 (86.96)	246.96	40 (86.96)
***N-GUARD* coating @ 1980 ml/ha (7.59 ml/Kg Urea) + Full N; [1/3 coated N (Urea) + P + K] + 2X [1/3 coated N (Urea)]**	T_5	660	40 (86.96)	60 (375)	40 (67.67)	660	40 (86.96)	660	40 (86.96)
***N-GUARD* coating @ 1721.74 ml/ha (6.6 ml/Kg Urea) + Full N; [1/3 coated N (Urea) + P + K] + 2 X [1/3 coated N (Urea)]**	T_6	573.91	40 (86.96)	60 (375)	40 (67.67)	573.91	40 (86.96)	573.91	40 (86.96)
***N-GUARD* @ 1463.48 ml/ha (5.61 ml/Kg Urea) + Full N ; [1/3 coated N (Urea) + P + K] + 2 X [1/3 coated N (Urea)]**	T_7	487.83	40 (86.96)	60 (375)	40 (67.67)	487.83	40 (86.96)	487.83	40 (86.96)
Full dose of *N-GUARD* coating @ 1463.48 ml/ha (6.6 ml/Kg Urea) + 15% reduced N (Urea); [1/3 coated N (Urea) + P + K] + 2 X [1/3 coated N (Urea)]	T_8	487.83	34 (73.91)	60 (375)	40 (67.67)	487.83	34 (73.91)	487.83	34 (73.91)
Full dose of *N-GUARD* coating @ 1291.3 ml/ha (6.6 ml/Kg Urea) + 25% reduced N (Urea) ; [1/3 coated N (Urea) + P + K] + 2 X [1/3 coated N (Urea)]	T_9	430.43	30 (65.22)	60 (375)	40 (67.67)	430.43	30 (65.22)	430.43	30 (65.22)

5. MATERIALS AND METHODS

5.1 Characterisation of Products

Product sample	Active Ingredients	Batch No.	Source & Date Received
Test product – ***N-GUARD***	-----	-----	From sponsor; Nov 2011
Standard check product (N-Stabilizer/Urease inhibitor)- ***AGROTAIN***	-----	-----	Procured and Shipped from USA December, 2011

Storage conditions: Ambient temperature (between + 20ºC to + 25ºC)

5.2 Site Summary

The trial was conducted at one location under natural conditions on SGS-owned field trial station at Dehgam (Ahmedabad). The crops were applied with the treatments as per schedule at 3-critical stages (Basal, Knee high and Just before tasseling). Each treatment replicated 3-times.

5.2.1 Map showing trial location:

5.2.2 Trial Details

Trial Number:	01
Location details	Dahegam, Galudhan Village, 23 km N-W Ahmedabad
Site Type	Agricultural land
Soil Type	Sandy loam
Crop	Corn
Plot Size	10 m 10 m
Agronomic tilling operations	As per recommendation for corn
Irrigation	5-irrigations at 12-15 days intervals + Rain
Fertilizer Application/ ha (N:P:K)	120:60:40
Crop spacing (R-R X P-P)	60 cm x 20 cm
No. of plants per sq m	~ 8.33 plants
Date of sowing	16-Dec-2011
1st weeding and thinning	31-Dec-2012
Basal application	3-Jan-2011 (17-Day After Sowing DAS)
1st earthing-up and 2nd weeding	14-Jan -2012
2nd earthing-up and 3rd weeding	29-Jan-2012
Split Fertilizer application at Knee high stage	30-Jan – 2012 (45 Days After Sowing)
Appearance of symptoms	31-Jan-2012
Soil Sampling for Nematode	6-Feb – 2012
Observations on Insect – pest and diseases	6-Feb– 2012
Soil sampling for N-status	14-Feb - 2012
4th weeding	14-Feb-2012
Split Fertilizer application at Tassel emergence stage	19-Feb– 2012 (65 Days After Sowing)
Soil Sampling for Nematode	26-Feb-2012
Observations on Insect – pest and diseases	26-Feb-2012
Soil sampling for N-status	5-March-2012
Variety	Pioneer Hi-Bred
Other observations	22-Apr-2012 (Ht) and other after shelling and threshing
Date of harvesting	23-Apr-2012

5.3 Applications

5.3.1 Application Details

Trial no	**01**
1st basal application	3-Jan –12
2nd application at knee high stage	30-Jan –12
3rd application at just before tasseling	19-Feb– 12
Treatments applied	As per schedule (treatments with coating/uncoating)
Crop Stress	None

5.3.2 Application Equipment & Methods

Basal dressing	Manual band placement in the line of the germinated seedlings
Granule broadcasting	Manual broadcasting at constant rate of movement (approx 5 Km/hr

5.4 ASSESSMENTS:

5.4.1 Height (cm): Mean height of random 10-plants/plot were calculated by measuring the height of each corn plant from the soil surface to the apex of the plant.

5.4.2 Insect-pest infestation:

5.4.2.1 Stem Borer/ Dead Hearts (No.): The number of affected plants showing dead heart symptoms/shoots was calculated out of total number of plants per plot/replication and percent infestations calculated.

5.4.2.2 Grain-weevil (%): Grains infested out of representative bulk of 100-grains per plots were examined for the infestation of weevils

5.4.3 Diseases:

5.4.3.1 Maydis Leaf blight-MLB (PDI): Percent disease indices (PDIs) were calculated by rating the disease occurrence on the scale of 0-5 on 2-leaves each from upper half and lower half of 10-plants (total 20-leaves) per plot/replication

5.4.3.2 Turcicum Leaf Blights-TLB (PDI): Percent disease indices (PDIs) were calculated by rating the disease occurrence on the scale of 0-5 on 2-leaves each from upper half and lower half of 10-plants (total 20-leaves) per plot/replication

5.4.3.3 Stripe Downy Mildew-DM (PDI): Percent disease indices (PDIs) were calculated by rating the disease occurrence on the scale of 0-5 on 2-leaves each from upper half and lower half of 10-plants (total 20-leaves) per plot/replication

5.4.4 N (Nitrogen) – status (mg/Kg): Soil samples from 0-15 cm depth were collected from 6-spots per plot, mixed well and a representative sample of 300 g/plot drawn and sent to the lab for analysis by std method

5.4.5 Enumeration of corn cyst nematodes (No.): Soil samples collected from rhizosphere (inclusive of some rootlets) from the suspected, partly affected or fully or affected at random 10-plants/plot were mixed well and 250 g-representative sample drawn to send the laboratory for enumeration of *H. zeae* using genome specific primer through PCR technique and manually under microscope though cobb's decanting and gravitational method. The manual method used for counting of cysts/100 g soil and PCR technique used for determining the population of nematodes/100 g soil. The number of nematodes was worked out thorough standard curve drawn out of *H. Zeae* cysts collected from soil of the untreated plot prior to carrying out the estimation process.

5.4.6 Crop Vigour (1-10 Scale) – The maize plants from each plots were critically examined and rated on 1-10 scale in comparison to the selected most vigourous plants (rated 10), representing the best growth, development, greenness and branching.

5.4.7 Crop phytotoxicity: 10- random plants and 20- leaves were examined critically in each plot for assessing the phytotoxic effect of test products on 0-10 scale

5.4.8 Stover Yield (t/ha): The harvested stalks were weighed plot-wise in Kg to obtain the data for Stover yield per 100 sq m plot area and divided by 10 to get the data converted into t/ha

5.4.9 Number of grains per cob/ear: 10-random cobs per plot were shelled separately and threshed after drying and the number of grains were counted to obtain the mean number of grain per cob/ear

5.4.10 Grain-Yield (Q/ha): Total grain-yield weighed plot wise after shelling, drying and threshing in Kg per 100 sq m area. The data multiplied with 10 to obtain the yield in Q/ha

5.4.11 B:C Ratio: The B:C was calculated by following formula:

B:C Ratio = Net Return/Total cost

Where,

Total cost = Costs incurred on agronomic operations + Costs incurred on the fertilizers and treatments

Gross Return = Income from Grain Yield + Income from the stover yield

Net return = Gross Return – Total cost

6. RESULTS TABLES:

TABLE 6.1: EFFECT OF VARIOUS TREATMENTS AGAINST INSECT-PEST AND DISEASES IN MAIZE (CV. PIONEER HI-BRED-30R77) AT VILL-GALUDHAN, TALUQ-DAHEGAM, AHMEDABAD DURING RABI, 2011-12

TR (T)	DOSE		EFFECT ON INSECT-PEST AND DISEASES IN MAIZE										
	NITRIFICATION-INHIBITOR/N-STABILIZER FOR COATING SPLIT UREA (ML/HA)	N : P : K (SPLIT N-UREA) (KG/HA)	INSECT – PEST (% ROC)			DISEASES (PDI)						
			DEAD-HEARTS (STEM- BORER)		POOLED	MLB		TLB		STRIPE DM		POOLED
			AT KNEE HIGH STAGE	AT TASSELING STAGE	(% ROC)	AT KNEE HIGH STAGE	AT TASSELING STAGE	AT KNEE HIGH STAGE	AT TASSELING STAGE	AT KNEE HIGH STAGE	AT TASSELING STAGE	(% ROC)
T3	**UNCOATED**	120:60:40	0.0	0.0	**0.0**	22.7	27.7	21.7	22.3	7.0	10.0	**0.0**
	(0.00)	(40+40+40)	(0.0)	(0.0)		(28.4)	(31.7)	(27.7)	(28.1)	(15.3)	(18.4)	
T4	**AGROTAIN @ 740.87**	120:60:40	42.1	49.9	**46.1**	20.0	21.0	18.0	19.7	1.3	2.0	**26.4**
	(246.96+246.96+246.96)	(40+40+40)	(40.4)	(44.9)		(26.5)	(27.2)	(25.0)	(26.3)	(6.5)	(7.9)	
T5	**N-GUARD @ 1980**	120:60:40	44.0	54.4	**49.2**	20.0	20.7	18.3	18.3	2.0	3.3	**25.9**
	(660+660+660)	(40+40+40)	(41.5)	(47.5)		(26.5)	(27.0)	(25.3)	(25.3)	(8.1)	(10.4)	
T6	**N-GUARD @ 1721.74**	120:60:40	34.0	39.5	**36.8**	20.7	23.0	19.7	20.0	2.3	4.7	**18.9**
	(573.91+573.91+573.91)	(40+40+40)	(35.6)	(38.9)		(27.0)	(28.6)	(26.3)	(26.5)	(8.7)	(12.4)	
T7	**N-GUARD @ 1463.48**	120:60:40	20.1	24.3	**22.3**	21.0	23.3	20.0	20.0	3.3	6.7	**15.3**
	(487.83+487.83+487.83)	(40+40+40)	(26.5)	(29.5)		(27.2)	(28.8)	(26.5)	(26.5)	(10.4)	(14.9)	
T8	**N-GUARD @ 1463.48**	102: :60:40	6.1	16.8	**11.4**	21.3	24.7	20.3	20.7	3.7	7.0	**12.3**
	(487.83+487.83+487.83)	(34+34+34)	(14.2)	(23.8)		(27.4)	(29.7)	(26.7)	(27.0)	(10.9)	(15.3)	
T9	**N-GUARD @ 1291.3**	90:60:40	4.2	12.3	**8.3**	22.3	26.0	20.7	21.3	6.7	7.3	**6.4**
	(430.43+430.43+430.43)	(30+30+30)	(9.6)	(16.8)		(28.1)	(30.6)	(27.0)	(27.4)	(14.9)	(15.6)	
SEM (±)			**(1.97)**	**(3.41)**	-	**(0.15)**	**(0.51)**	**(0.26)**	**(0.14)**	**(0.45)**	**(0.54)**	-
CD (P=0.05)			**(6.31)**	**(4.82)**	-	**(0.48)**	**(1.59)**	**(0.81)**	**(0.45)**	**(1.41)**	**(1.70)**	-
CV (%)			**(12.22)**	**(17.59)**	-	**(0.98)**	**(3.04)**	**(1.70)**	**(0.94)**	**(7.34)**	**(6.97)**	-

VALUES ARE MEANS OF THREE REPLICATIONS % ROC = Percent reduction over control PDI = PERCENT DISEASE INDEX data recorded 7-DAYS AFTER applications of coated/uncoated urea at knee high and tassel emergence stages MLB = MAYDIS LEAF BLIGHT TLB = TURCICUM LEAF BLIGHT STRIPE DM = STRIPE DOWNY MILDEW pooled = DATA POOLED OVER the control of insect-pests and diseases over the application stages VALUES IN THE PARENTHESES REPRESENT ARCSINE ANGULAR TRANSFORMED VALUES among the insect-pests, weevils in grains at shelling were recorded to be nil across the treatments.

TABLE 6.2: EFFECT OF VARIOUS TREATMENTS AGAINST PLANT PARASITIC NEMATODES (*HETERODERA ZEAE*) AND AVAILABLE NITROGEN STATUS IN SOIL IN MAIZE (CV. PIONEER HI-BRED-30R77) AT VILL-GALUDHAN, TALUQ-DAHEGAM, AHMEDABAD DURING RABI, 2011-12

TR (T)	DOSE		EFFECT ON PLANT PARASITIC NEMATODES AND AVAILABLE NITROGEN-STATUS IN SOIL IN MAIZE							
			HETERODERA ZEAE – MAIZE CYST NEMATODE (% ROC)					AVAILABLE NITROGEN-STATUS (MG/KG)		
			PCR TECHNIQUE		MANUAL CYST COUNT		POOLED (%ROC)	AT KNEE HIGH STAGE	AT TASSELING STAGE	POOLED (% IOC)
	NITRIFICATION-INHIBITOR/N-STABILIZER FOR COATING SPLIT UREA (ML/HA)	N : P : K (SPLIT N-UREA) (KG/HA)	AT KNEE HIGH STAGE	AT TASSELING STAGE	AT KNEE HIGH STAGE	AT TASSELING STAGE				
T3	**UNCOATED (0.00)**	120:60:40 (40+40+40)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	**0.0**	311.6	240.7	**0.0**
T4	**AGROTAIN @ 740.87** (246.96+246.96+246.96)	120:60:40 (40+40+40)	70.9 (57.4)	75.16 (60.1)	24.4 (29.4)	32.1 (34.2)	**50.6**	371.7	299.4	**21.5**
T5	**N-GUARD @ 1980** (660+660+660)	120:60:40 (40+40+40)	82.3 (65.1)	84.8 (67.0)	62.2 (52.0)	44.3 (41.7)	**68.4**	482.7	393.6	**58.7**
T6	**N-GUARD @ 1721.74** (573.91+573.91+573.91)	120:60:40 (40+40+40)	63.1 (52.6)	71.5 (57.7)	24.43 (29.4)	32.1 (34.2)	**47.8**	372.0	319.1	**25.1**
T7	**N-GUARD @ 1463.48** (487.83+487.83+487.83)	120:60:40 (40+40+40)	53.5 (47.0)	62.9 (52.4)	5.5 (8.0)	20.6 (22.5)	**35.6**	319.7	309.1	**13.9**
T8	**N-GUARD @ 1463.48** (487.83+487.83+487.83)	102: :60:40 (34+34+34)	50.9 (45.5)	60.9 (51.2)	6.6 (8.8)	10.3 (15.4)	**32.2**	338.4	255.2	**7.5**
T9	**N-GUARD @ 1291.3** (430.43+430.43+430.43)	90:60:40 (30+30+30)	38.1 (38.1)	47.4 (43.4)	5.56 (8.03)	9.5 (10.7)	**25.1**	311.6	250.5	**1.8**
SEM (±)			**(1.40)**	**(1.23)**	**(5.61)**	**(5.28)**	-	**(33.99)**	**(22.76)**	-
CD (P=0.05)			**(4.48)**	**(3.93)**	**(17.91)**	**(16.87)**	-	**(105.91)**	**(70.92)**	-
CV (%)			**(4.77)**	**(3.85)**	**(42.93)**	**(42.93)**	-	**(16.43)**	**(13.34)**	

VALUES ARE MEANS OF THREE REPLICATIONS % ROC = PERCENT REDUCTION OVER UNTREATED AVAILABLE NITROGEN-STATUS POOLED % IOC = PERCENT INCREASE IN AVAILABILITY OF NITROGEN OVER UNTREATED DATA RECORDED 15-DAYS AFTER APPLICATIONS OF COATED/UNCOATED UREA AT KNEE HIGH AND TASSEL EMERGENCE STAGES POOLED = DATA POOLED OVER THE TECHNIQUES ADOPTED AND OVER THE APPLICATION STAGES VALUES IN THE PARENTHESES REPRESENT ARCSINE ANGULAR TRANSFORMED VALUES

TABLE 6.3: PHYTOTOXIC EFFECT OF VARIOUS TREATMENTS ON MAIZE (CV. PIONEER HI-BRED-30R77) AT VILL-GALUDHAN, TALUQ-DAHEGAM, AHMEDABAD DURING RABI, 2011-12

TR (T)	DOSE		PHYTOTOXIC EFFECT														
	NITRIFICATION-INHIBITOR/N-STABILIZER FOR COATING SPLIT UREA (ML/HA)	N : P : K (SPLIT N-UREA) (KG/HA)	INJURY TO LEAF TIP/ SURFACE* (0-10)			CHLOROSIS			NECROSIS			EPINASTY			HYPONASTY		
			1DAA	5DAA	7DAA	1DAA	5DAA	7DAA	1DAA	5DAA	7DAA	1DAA	5DAA	7DAA	1DAA	5DAA	7DAA
T1	**UNCOATED (0.00)**	120:60:40 (120)	0	0	0	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
T2	**UNCOATED (0.00)**	120:60:40 (60+60)	0	0	0	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
T3	**UNCOATED (0.00)**	120:60:40 (40+40+40)	0	0	0	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
T4	**AGROTAIN @ 740.87** (246.96+246.96+246.96)	120:60:40 (40+40+40)	0	0	0	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
T5	**N-GUARD @ 1980** (660+660+660)	120:60:40 (40+40+40)	0	0	0	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
T6	**N-GUARD @ 1721.74** (573.91+573.91+573.91)	120:60:40 (40+40+40)	0	0	0	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
T7	**N-GUARD @ 1463.48** (487.83+487.83+487.83)	120:60:40 (40+40+40)	0	0	0	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
T8	**N-GUARD @ 1463.48** (487.83+487.83+487.83)	102: :60:40 (34+34+34)	0	0	0	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
T9	**N-GUARD @ 1291.3** (430.43+430.43+430.43)	90:60:40 (30+30+30)	0	0	0	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP

VALUES ARE MEANS OF THREE REPLICATIONS NP = NON - PHYTOTOXIC DAA=DAYS AFTER APPLICATION *SCALE: 0 = 0%, 1 = 1-10%, 2 = 11-20%, 3= 21-30%, 4=31-40%, 5=41-50%, 6=51-60%, 7=61-70%, 8=71-80%, 9=81-90%, 10=91-100%; DATA POOLED OVER VARIOUS APPLICATIONS

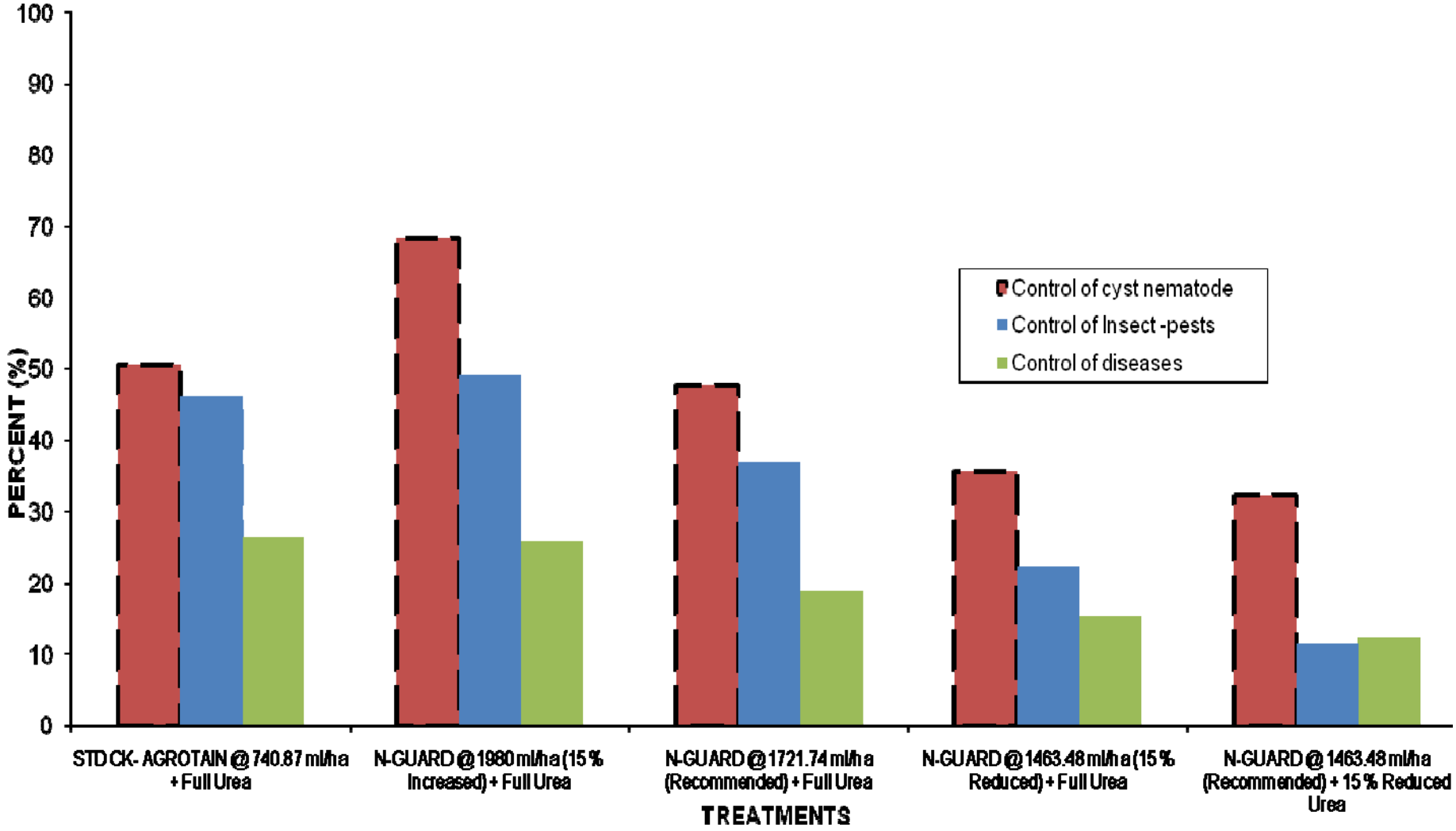
TABLE 6.4: EFFECT OF VARIOUS TREATMENTS ON GROWTH, DEVELOPMENT AND YIELD PARAMETERS OF MAIZE (CV. PIONEER HI-BRED-30R77) AT VILL-GALUDHAN, TALUQ-DAHEGAM, AHMEDABAD DURING RABI, 2011-12

TR (T)	DOSE		GROWTH, DEVELOPMENT AND YIELD PARAMETERS OF MAIZE							B : C RATIO
	NITRIFICATION-INHIBITOR/N-STABILIZER FOR COATING SPLIT UREA (ML/HA)	N : P : K (SPLIT N-UREA) (KG/HA)	HEIGHT (CM)	CROP VIGOUR (1-10 SCALE)	NUMBER OF GRAINS PER EAR/COB (NO.)	GRAIN-YIELD (Q/HA)	STOVER-YIELD (T/HA)	HARVEST INDEX (%)	IOC GRAIN-YIELD-(T1) (%)	
T1	**UNCOATED (0.00)**	120:60:40 (120)	145.7	6.7	463.8	27.3	7.88	**34.6**	**0.0**	**0.38**
T2	**UNCOATED (0.00)**	120:60:40 (60+60)	153.3	7.2	473.5	31.6	9.00	**35.1**	**15.8**	**0.59**
T3	**UNCOATED (0.00)**	120:60:40 (40+40+40)	154.3	7.5	480.4	32.2	9.12	**35.3**	**17.9**	**0.62**
T4	**AGROTAIN @ 740.87** (246.96+246.96+246.96)	120:60:40 (40+40+40)	155.8	9.2	505.1	33.7	9.16	**36.8**	**23.4**	**0.66**
T5	**N-GUARD @ 1980** (660+660+660)	120:60:40 (40+40+40)	162.1	9.3	514.6	34.8	9.38	**37.1**	**27.5**	**0.73**
T6	**N-GUARD @ 1721.74** (573.91+573.91+573.91)	120:60:40 (40+40+40)	155.1	8.6	496.0	32.6	8.96	**36.4**	**19.4**	**0.62**
T7	**N-GUARD @ 1463.48** (487.83+487.83+487.83)	120:60:40 (40+40+40)	155.0	8.0	486.1	31.3	8.71	**35.9**	**14.7**	**0.56**
T8	**N-GUARD @ 1463.48** (487.83+487.83+487.83)	102: :60:40 (34+34+34)	151.3	6.9	481.9	29.5	8.39	**35.2**	**8.1**	**0.49**
T9	**N-GUARD @ 1291.3** (430.43+430.43+430.43)	90:60:40 (30+30+30)	146.5	6.4	463.6	27.7	8.01	**34.6**	**1.5**	**0.41**
SEM (±)			**2.19**	**0.1**	**9.9**	**0.4**	**0.24**		-	
CD (P=0.05)			**6.64**	**0.2**	**30.0**	**1.1**	**0.72**		-	
CV (%)			**2.48**	**1.2**	**3.5**	**2.1**	**4.71**		-	

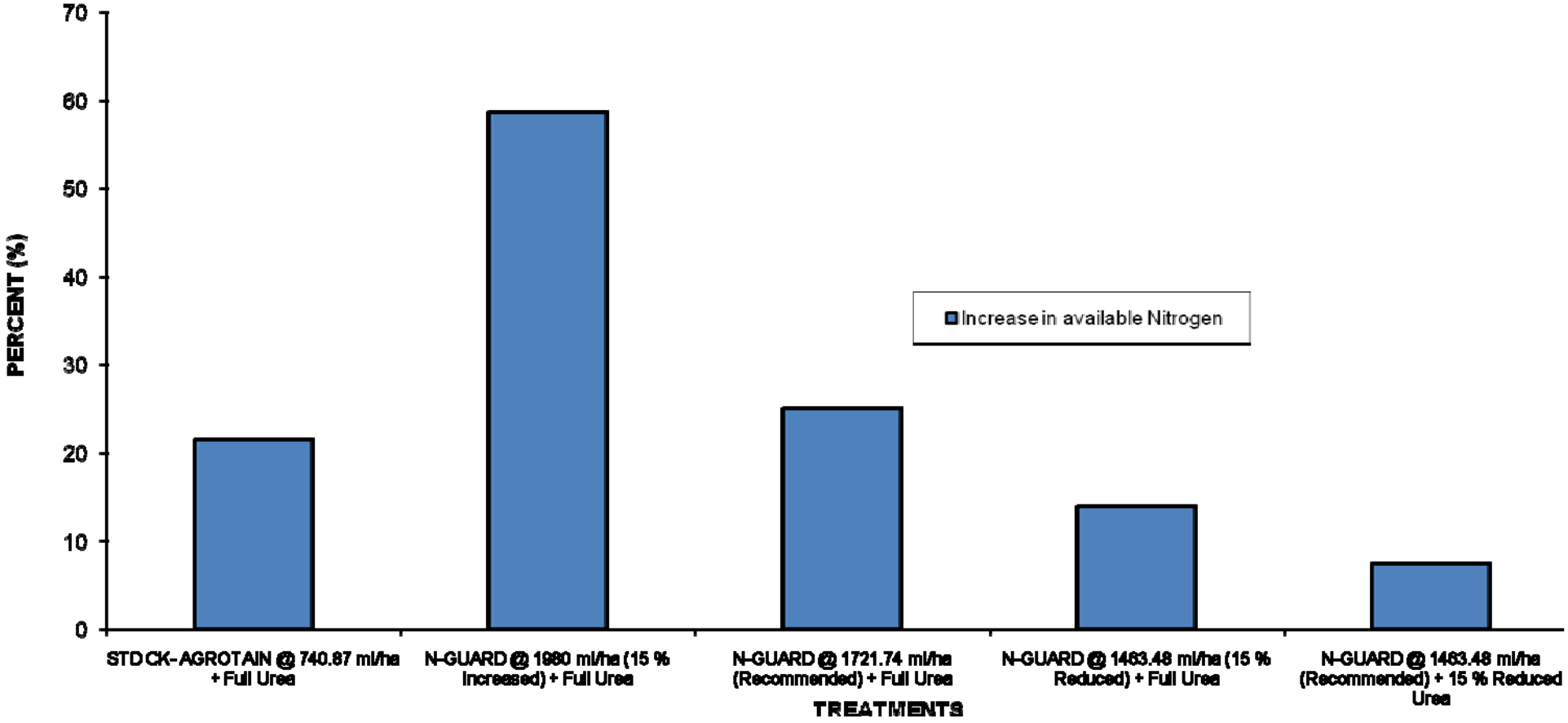
VALUES ARE MEANS OF THREE REPLICATIONS ONCE AT BASAL STAGE (T1)

IOC = PERCENT INCREASE IN GRAIN-YIELD OVER UNCOATED UREA APPLICATION

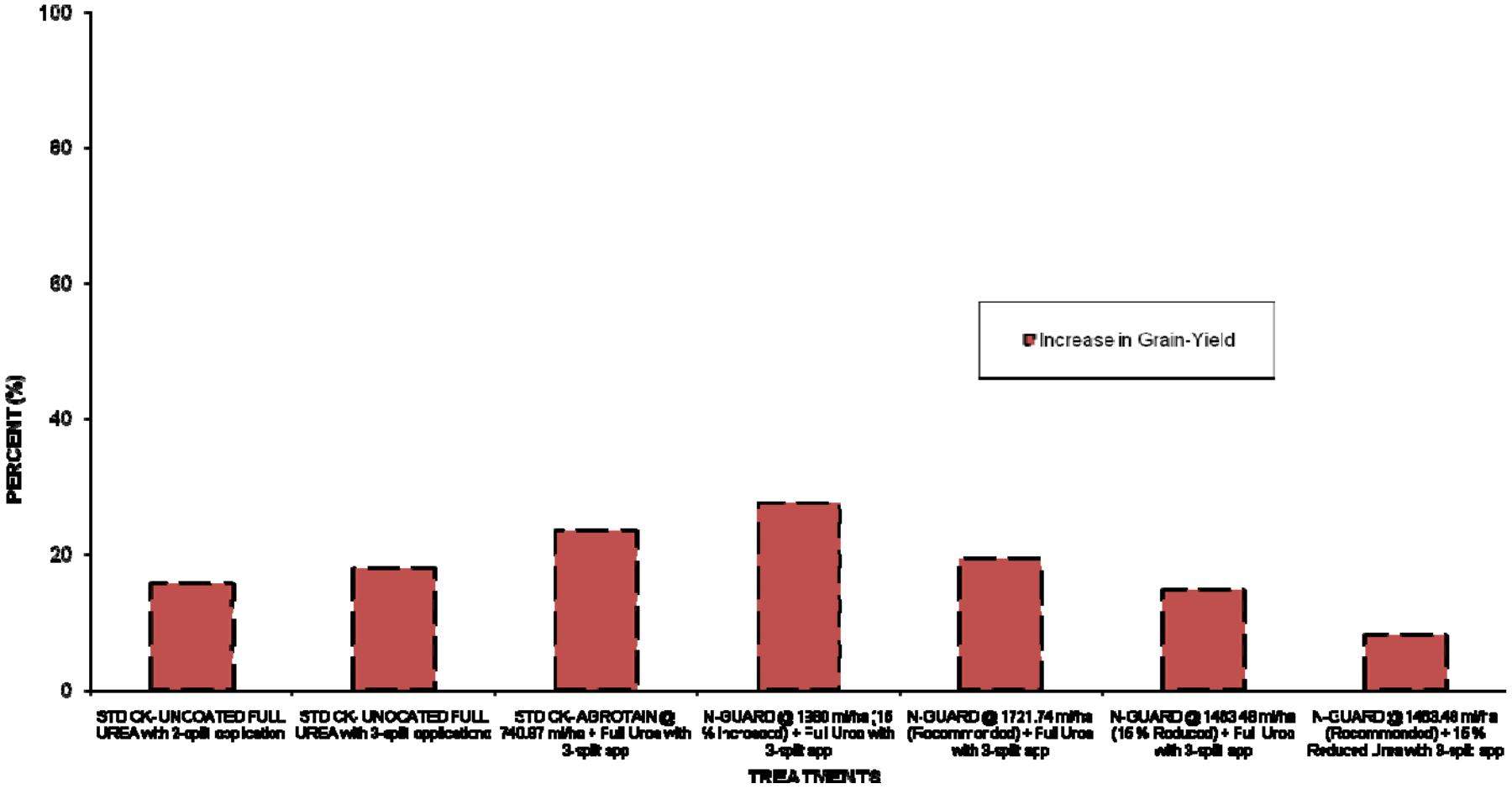
GRAPH 7.1: EFFECT OF TREATMENTS AGAINST INSECT – PESTS, DISEASES AND CYST NEMATODES OF CORN (POOLED MEAN OF DATA RECORDED 7-DAYD AFTER APPLICATION AT KNEE HEIGHT AND TASSELING STAGES i.e. 52 & 72-DAYS AFTER SOWING)



GRAPH 7.2: EFFECT OF TREATMENTS ON AVAILABLE NITROGEN STATUS OF SOIL IN 3-SPLIT APPLICATIONS OF UREA AT BASAL, KNEE HEIGHT AND TASSELING STAGES OF CORN (POOLED MEAN OF DATA RECORDED 15 DAYS AFTER APPLICATIONS AT KNEE HEIGHT AND TASSELING STAGES i.e 60 & 80 – DAYS AFTER SOWING)



GRAPH 7.3: EFFECT OF TREATMENTS ON PERCENT INCREASE IN GRAIN-YIELD IN COMPARISON TO UNCOATED FULL DOSE OF UREA WITHOUT SPLIT APPLICATION IN CORN



GRAPH 7.4: ECONOMICS OF USING COATED/ UNCOATED UREA IN CORN -EFFECT OF VARIOUS TREATMENTS ON B : C RATIO

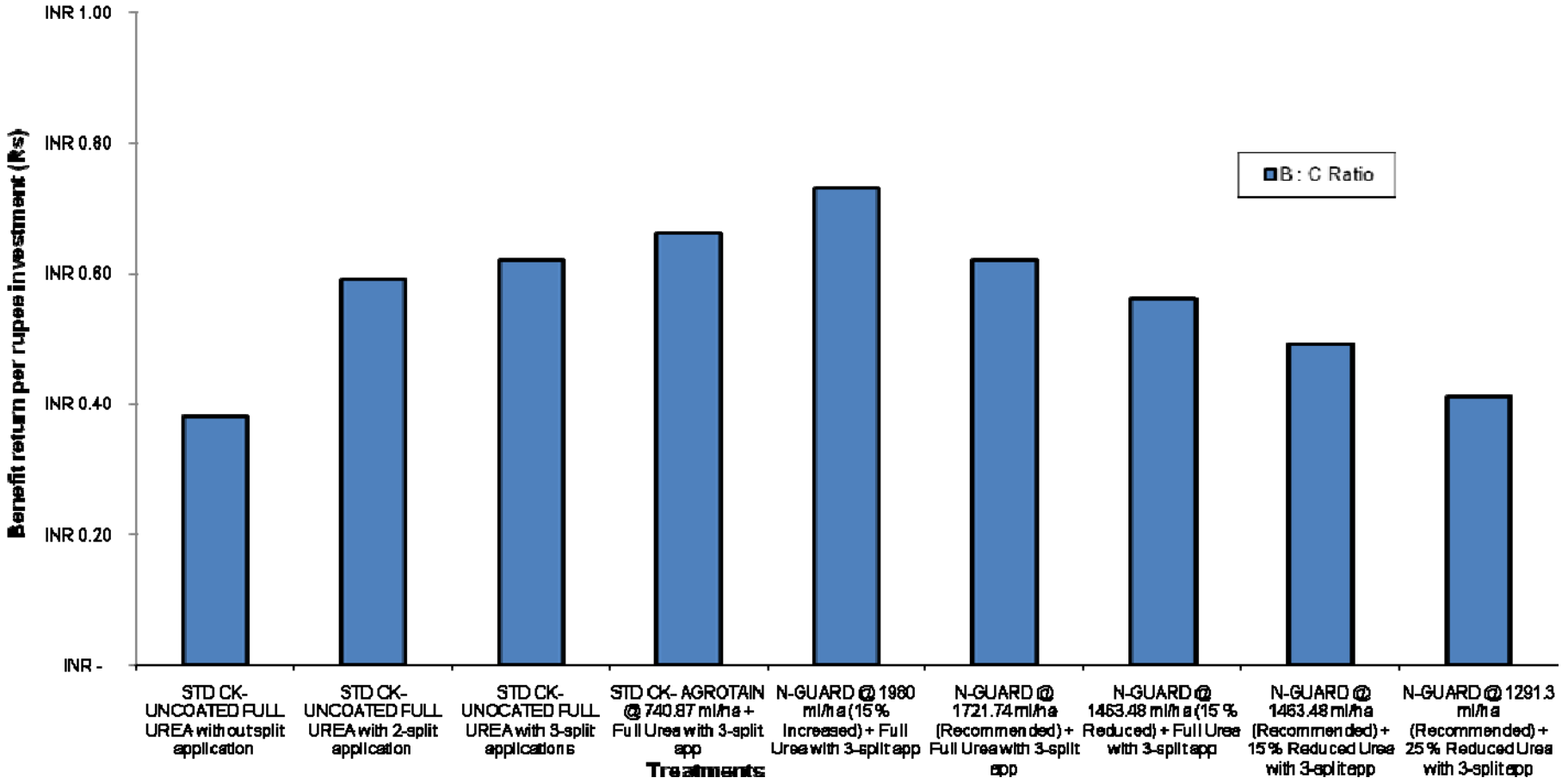
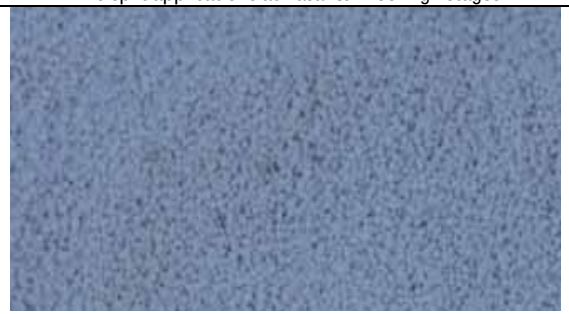
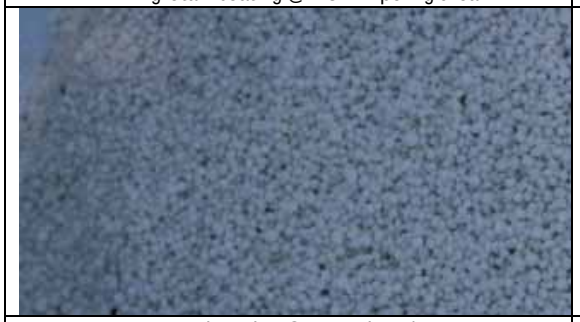
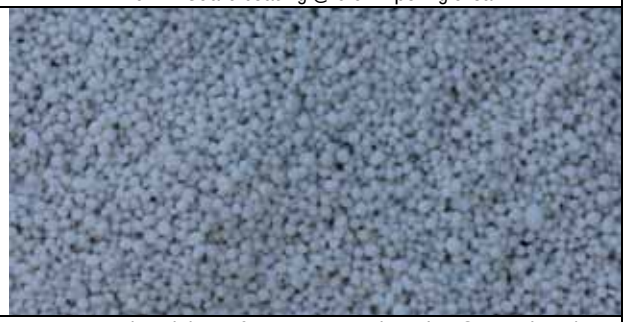


Plate 8.1: **APPEARANCE OF UNCOATED UREA AND COATED UREA AFTER MIXING N-GUARD OR AGROTAIN AT THE TIME OF APPLICATION**

No split application applied once at basal stage	Two split applications at Basal & Knee High stages	Three split applications at Basal, Knee high and tasseling stages
		
T1 = Uncoated Urea	T2 = Uncoated Urea	T3 = Uncoated Urea
T4-T9 Three split applications at Basal, Knee high and tasseling stages		
		
T4 = Agrotain coating @ 2.84 ml per kg urea	T5= N-Guard coating @ 7.59 ml per kg urea	T6 = N-Guard coating @ 6.6 ml per kg urea
		
T7= N-Guard coating @ 5.61 ml per kg urea	T8= 15 % reduced dose of urea + N-Guard coating @ 6.6 ml per kg urea	T9= 25 % reduced dose of urea + N-Guard coating @ 6.6 ml per kg urea

OBSERVATIONS 15-DAYS AFTER APPLICATIONS OF FERTILIZERS AT KNEE HIGH STAGE

Plate 8.2 **OBSERVATIONS 15-DAYS AFTER APPLICATIONS OF FERTILIZERS AT KNEE HIGH STAGE**

Insect- pest and disease problems

		
Maydis blight	Downy Mildew	Maize stem borer – Dead heart

Treatment-wise efficacies

		
T1 = Uncoated full dose of Urea (+ SSP + MOP at basal stage		
		
T2 = Uncoated ½ of full dose of Urea (+ SSP + MOP) at basal stage + Remaining Uncoated ½ of full dose of Urea at knee high stage		



T3 = Uncoated ⅓ of full dose of Urea (+ SSP + MOP) at basal stage + Remaining 2X Uncoated ⅓ of full dose of Urea at knee high and tassel emergence stages



T4 = Standard check- AGROTAIN coated ⅓ of full dose of Urea (+ P + K) at basal stage + Remaining 2 X ⅓ of full dose of urea at knee high and tassel emergence stages



T5 = N-Guard coated ⅓ of full dose of Urea (+ SSP + MOP) at basal stage + Remaining 2 X 15 % increased dose of N-Guard coated ⅓ of full dose of Urea at knee high and tassel emergence stages



T6 = N-Guard coated ⅓ of full dose of Urea (+SSP + MOP) at basal stage + Remaining 2 X Full dose of N-Guard coated ⅓ of full dose of Urea at Knee high and tassel emergence stages



T7 = N-Guard coated ⅓ of full dose of Urea (+SSP + MOP) at basal stage + Remaining 2 X 15 % reduced dose of N-Guard coated ⅓ of full dose of Urea at knee high and tassel emergence stages



T8 = Full dose of N-Guard coated ⅓ of 15 % reduced dose of Urea (+SSP + MOP) at basal stage + Remaining 2 X full dose N-Guard coated ⅓ of 15 % reduced dose of Urea at Knee high and tassel emergence stages



T9 = Full dose of N-Guard coated ⅓ of 25 % reduced dose of Urea (+SSP + MOP) at basal stage + Remaining 2 X full dose N-Guard coated ⅓ of 25 % reduced dose of Urea at Knee high and tassel emergence stages

Plate 8.3: **REVIEW OF TRIAL PROGRESS**

Trial Field

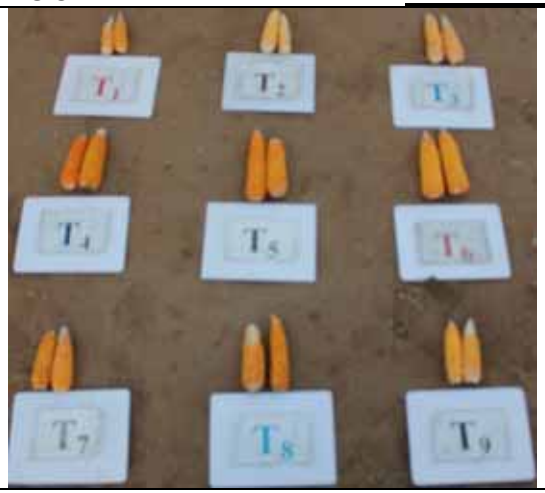
Field trial visit – Reviewing across the treatments

Plate 8.4: **NEMATODE ENUMERATION IN LABORATORY**

Counting of cysts (*H. zeae*) through Microscope (Cobb method)

Through PCR technique

PLATE 8.5: **APPEARANCE OF STALKS, COBS AND CORN-GRAINS AT HARVESTING**



9. RESULTS AND DISCUSSION

9.1. BIOEFFICACY OF THE TEST PRODUCT AGAINST INSECT-PEST, DISEASES AND NEMATODES

9.1.1. INSECT - PESTS:

STEM BORER/ DEAD HEARTS (*Chilo partellus*):

Among the various dosage treatments of N-Guard (T7, T6 and T5), the results were increasingly progressive from T7 to T5. Treatment T5 recorded the maximum control of dead hearts (stem borer) in the treated plots; which was though numerically higher (49.2%) but on par with std check treatment of Agrotain at recommended dose @ 2.84 ml/Kg urea (46.1%) and more effective than T6 (Table 6.1).

GRAIN-WEEVILS (*Sitophilus zeamais*):

No weevil-infestations were recorded to be present across the treatments (T3-T9).

9.1.2. DISEASES:

MAYDIS LEAF BLIGHT (*Helminthosporium maydis*)

Among the treatments T5 (N-Guard @ 7.59 ml/Kg Urea) and T4 (Agrotain 2.84 ml/ Kg Urea) proved to be equally effective which was closely followed by the treatment of T6 (N-Guard @ 6.6 ml/Kg Urea) and other treatments.

TURCICUM LEAF BLIGHT (*Exserohilum trucicum*)

Similar results were obtained against the control of Turcicum leaf blight in corn and the treatment T5 (N-Guard @ 7.59 ml/Kg Urea) and T4 (Agrotain 2.84 ml/ Kg Urea) proved to be equally effective which was closely followed by the treatment of T6 (N-Guard @ 6.6 ml/Kg Urea) and other treatments.

STRIPE DOWNY MILDEW (*Sclerophthora rayssiae* var. *zeae*)

The treatment T4 (Agrotain 2.84 ml/ Kg Urea) was found most effective to control the stripe downy mildew (SDM) disease of corn which was followed by the treatments of T5 (N-Guard @ 7.59 ml/Kg Urea) and T6 (N-Guard @ 6.6 ml/Kg Urea).

Overall the treatment, T4 (Agrotain 2.84 ml/ Kg Urea) proved to be more effective (26.4 %) which was though numerically higher but was statistically on par with the treatment T5 (N-Guard @ 7.59 ml/Kg Urea) with 25.9 % and followed by the treatment of T6 (N-Guard @ 6.6 ml/Kg Urea) with 18.9 % control only (Table 6.1).

9.1.3. PLANT PARASITIC NEMATODES:

CORN CYST NEMATODE (*Heterodera zeae*)

The soil samples collected from the rhizosphere of the various plots along with some roots of the maize were processed for nematode enumeration through manual counting of cysts in microscope and nematode populations through PCR technique. The results were in line with each other and the treatment T5 (N-Guard @ 7.59 ml/Kg Urea) was found to be the most effective (68.4%) and followed by the treatment of T4 (Agrotain 2.84 ml/ Kg Urea) and T6 (N-Guard @ 6.6 ml/Kg Urea) with 50.6 % and 47.8 % control of *H. Zeae* nematodes respectively (Table 6.2).

The control of insect pest, diseases and nematodes is presented for the treatments of T5-T8 in comparison to the market standard check treatment T4, indicating the superiority of T5 in comparison to other treatments (Graph 7.1)

Therefore T5 proved to be the optimum dose for the effective control of insect-pest, diseases and nematodes. The marginal gap in the efficacy of various dosage treatments of N-Guard (T5-T7) indicates that there is further scope of improvement in the result over the dose of T5; and therefore the T6 being the under-dose of N-Guard for insect-pest and diseases control.

9.2 EFFECT ON NITROGEN – STATUS OF SOIL

The soil samples collected from various plots and analysed in the laboratory revealed that the T5 (N-Guard @ 7.59 ml/Kg Urea) treated plots had the maximum available nitrogen status in soil (58.7% increase) which was more effective than the treatments of T6 (N-Guard @ 6.6 ml/Kg Urea) and T4 (Agrotain @ 2.84 ml/ Kg Urea) with 25.1% and 21.5 % increased levels of available nitrogen respectively. Treatments T6 and T4 were equally effective and on par with each other and followed by the treatment T7 (N-Guard @ 7.59 ml/Kg Urea) with a marginal gap (13.9 % increased available Nitrogen only) (Table 6.2 & Graph 7.2).

The treatment T5-resulted 37 % stabilization of the Nitrogen in soil through inhibition of nitrification; whereas T6 and T4 were able to stabilize Nitrogen to the extent of 20.1 and 17.7 % respectively through coating in comparison to uncoated urea based Nitrogen when applied in three splits at basal, knee high and tasseling stages of corn.

9.3 EFFECT ON GROWTH, DEVELOPMENT AND YIELD PARAMETERS OF CORN

9.3.1 HEIGHT

The observation recorded at maturity of crop indicated that the treatment T5- was most effective but on par with the treatment T4 which were closely followed by the treatments of T6 and T7 (Table 6.4)

9.3.2 CROP VIGOUR (1-10 SCALE)

The treatments T5 and T4 were on par with each other and were the most effective treatments and followed by the treatments of T6 (Table 6.4)

9.3.3 NO. OF GRAINS/COB

The treatment T5 was most effective but on par with the treatments of T4, T6, and T7 which were closely followed by T8 and T3 (Table 6.4).

9.3.4 GRAIN-YIELD

The Grain-yields obtained after shelling of cobs, drying and threshing from the plots of T5 and T4-treatments were on par and higher (34. 8 Q/ha and 33.7 Q/ha) than the yields resulted by the treatment-T6 (32.6 Q/ha). However the yields resulted by T6 was statistically on par with T4. The percent grain-yield gain was 27.5 % in case of T5 and followed by T4 and T6 with 23.4 % & 19.4 % gain of grain – yields respectively (Table 6.4; Graph 7.3).

9.3.5 STOVER-YIELD

The fodder obtained out of harvested stalks of corn from the treatment T5 was higher (9.38 t/ha) and more than the other treatments but was on par with the treatments of T4 (9.16 t/ha) and T3 (9.12 t/ha), T2 (9.0 t/ha) and T6 (8.96 t/ha) (Table 6.4).

9.3.6 HARVET INDEX (HI)

Harvest index measures the utilization of fertilizers (including nitrogen) which indicated that the maximum N-use efficiency in case of T5 (37.1 %) and closely followed by T4 (36.8%) and T6 (36.4%) (Table 6.4)

The comparison of T7 and T8- treatments where coated urea were applied proved to have better HI(35.9 % & 35.2 %) than the treatments with uncoated urea like T1 (34.6 %), T2 (35.1 %) and T3 (35.3 %). Treatment-T9 (34.6 %) did not prove more effective in comparison to uncoated urea treatments of T1.

It also signifies that the treatments T7 and T-8 with 15 % reduced dose of Urea can replace the uncoated full dose of urea treatments of T1, T2 and T3.

Though T9 (N-Guard coated @ 6.6 ml/Kg Urea + Full dose of urea applied at basal, knee high and tasseling stages) is not recommended, however this can replace the uncoated full dose of urea applied once at basal stage (T1) with meagre 1.5 % gain in grain yield.

9.4 B:C RATIO

The maximum B:C ratio obtained from the treatment of T5- with return of Rs. 0.73 on investment of one Rupee, which was followed by T4 (0.66). The equal value of T3 (0.62) and T6 (0.62) indicate the under-dosing of the N-Guard at 6.6 ml/Kg of Urea.

There is further scope of increasing the efficacy of test product N-Guard by improved dosages of application, because there has been the marginal increase due to increase in the dosages and the efficacy graph has not touched the plateau phase where the additional cost of investment does not add to the return of benefit.

9.5 CROP PHYTOTOXICITY

The tested dosages of applications were found safe to the crop and no phytotoxicity were recorded.

9.6 UNIQUE SELLING PROPOSITIONS (USPS)

9.6.1 PRODUCT EFFICACY

The product efficacy can be further increased by increasing the dose of application. The product has satisfactory control of insect-pests and can also be covered up by increasing dosage of application, but the control of diseases has not been up to the mark. There could be possibility of infusing some disease controlling agent of organic base. The exploration of nematode control and N-status is though satisfactory but there should be more interval for establishing the better results.

9.6.2 FORMULATION IMPROVEMENT

Since the Agrotain (2.84 ml/Kg Urea) dose is almost less than half to that of N-Guard (6.6 ml/Kg Urea), therefore N-Guard concentration preferably be made 2-times by saturating it or evaporating the water so that the dose can be halved or made comparable to that of Agrotain. Further, Agrotain after mixing with Urea gives a soothing greenish colour to Urea; which was lacking in N-Guard treated Urea. Therefore, N-Guard may be added with a light sky blue coloured dye in order to give a comparable soothing colour to mixed urea

9.6.3 SCIENTIFIC LITERATURE FOR PRODUCT

A scientific literature should accompany the product for mode of action, dose of application, crop wise variation in the application dose, method of applications etc. The accompanying literature should be multilingual.

9.6.4 EDGE OVER THE COMPETITOR PRODUCT

Combination with any diseases controlling agent of organic base at dose of T5 or even higher at 25 % increased dose *i.e.* 2277 ml/ha / 260.87 Kg Urea (120 Kg N) (or 8.25 ml/Kg Urea) will give added advantage to the product.

10. CONCLUSIONS

The following conclusion can be drawn based on the above results of the trial conducted during *Rabi* 2011-12:

Application of T5 treatment resulted 49.2 % control of insects-pests and 68.4 % control of the cyst nematodes in corn and followed by the market std check of Agrotain (T4)

This dose also stabilized the urea to the extent of 37 % in comparison to T4 which stabilized to the extent of 21% only.

The dosage of application at T5 proved to be the optimum dose and resulted into the best fertilizer-use-efficacy amongst the treatments and resulted the Harvest Index of 37.1 % with 27.5 % gain in the grain-yield

T5 also resulted the highest B:C ratio of 0.73:1 which was followed by the treatment of T4.

The B:C ratio value and the progressive trend of efficacy by increasing the dosage of treatments without reaching the plateau phase suggest for the further improvement in the dosage of application.

However, based on B:C ratio, the replacement of T1 (Uncoated full urea without split application) can be done with T7 (15 % reduced dose of N-Guard with full urea with 3-split application), T8 (15 % reduced dose of Urea coated with N-Guard at full dose with 3-split applications) and T9 (25 % reduced dose of Urea coated with N-Guard at full dose) in order to obtain B:C ratio of 0.56, 0.49 and 0.41 against 0.38 of T1.

The tested dosages of the product from T5-T9 proved safe and didn't show any crop phytotoxicity in comparison to uncoated and market std check of Agrotain.

The trial need to be repeated for consistency of results in second season to draw final conclusions.

APPENDICES

Trial – 1

Site details

SGS – Field Trial Station

Farmer Name – Jagjivanbhai Patel

Village – Galudan

Taluka – Dahegam

Ahmedabad

GPS location tracing

Longitude : N 23^0 9' 58.26"

Latitude : E 72^0 48' 51.37"

Application details per plot:

Size of the plot = 100 sq m (10 m X 10 m)								
	Dosage of applications at different stages per 100 sq. m							
	Basal				Knee-high		Tasseling	
	Agrotain/ N-guard ml	Urea Kg	SSP Kg	MOP Kg	Agrotain/N-guard ml	Urea Kg	Agrotain.N-guard ml	Urea Kg
T_1	0.0	2.61	3.75	0.67	0.0	0.00	0.0	0.00
T_2	0.0	1.30	3.75	0.67	0.0	130.43	0.0	0.00
T_3	0.0	0.87	3.75	0.67	0.0	0.87	0.0	0.87
T_4	2.47	0.87	3.75	0.67	2.47	0.87	2.47	0.87
T_5	6.60	0.87	3.75	0.67	6.60	0.87	6.60	0.87
T_6	5.74	0.87	3.75	0.67	5.74	0.87	5.74	0.87
T_7	4.88	0.87	3.75	0.67	4.88	0.87	4.88	0.87
T_8	4.88	0.74	3.75	0.67	4.88	0.74	4.88	0.74
T_9	4.29	0.65	3.75	0.67	4.29	0.65	4.29	0.65

The Fertilzers dosages of urea were spitted However, SPP and MOP were not aplitted and applied only once at basal stage.

Calibration:

In order toensure uniform application of nitrogen stabilizer / nitrification inhibitor in soil, the calibration exercise for application coated/ uncoated urea with SSP and MOP at basal stage coated. Uncoated urea at knee-high and tasseling stages were carried out before undertaking actual application. Practically Area/ weight (Kg) (Weight of the granules used for the application on the marked area) was used to calibrate the exercise.

$$\text{Weight required for application in 1-ha} = \frac{\text{Weight of the granule used} \times 10000}{\text{Distance covered } \mathbf{x} \text{ width of area covered in broadcasting/dressing(metres)}}$$

Mixing Urea with Agrotain / N-Guard:

In order to coat the granules of urea, the measured volume of Agrotain/N-Guard were mixed with the required quantity of urea.

Basal Dressing / Broadcasting :

The coated / uncoated urea (as per the protocol)were applied at basal stage along with measured quantity of SSp and MOP. Further the coated / uncoated urea alone were also broadcasted uniformly at knee-high and tasseling stages.

Lay-out:

Field lay-out Border rows				
Border rows	T7	T4	T9	Border rows
	T5	T3	T2	
	T6	T8	T1	
	T4	T7	T5	
	T2	T1	T8	
	T9	T1	T4	
	T9	T6	T3	
	T1	T6	T3	
	T3	T9	T7	
	T8	T2	T6	
	Border rows			

Trial 1

Appendix II
Individual Plot Data

DH
Nematode Control
Knee High stage
Knee-high stage

Treat. No	RI	RII	RIII	
T_3	18 (0.0)	16 (0.0)	16 (0.0)	**0.0**
T_4	11 (38.9)	9 (43.8)	9 (43.8)	**42.1**
T_5	10 (44.4)	9 (43.8)	9 (43.8)	**44.0**
T_6	12 (33.3)	10 (37.5)	11 (31.3)	**34.0**
T_7	15 (16.7)	13 (18.8)	12 (25)	**20.1**
T_8	17 (5.6)	15 (6.3)	15 (6.3)	**6.1**
T_9	18 (0.0)	15 (6.3)	15 (6.3)	**4.2**

Data in parentheses indicate % control over T_3

MLB
Knee-high stage

Treat No	RI	RII	RIII	
T_3	23	22	23	**22.7**
T_4	20	20	20	**20.0**
T_5	20	20	20	**20.0**
T_6	21	21	20	**20.7**
T_7	21	21	21	**21.3**
T_8	22	21	21	**21.3**
T_9	23	22	22	**22.3**

TLB
Knee-high stage

Treat No	RI	RII	RIII	
T_3	22	21	22	**21.7**
T_4	18	17	19	**18.0**
T_5	18	18	19	**18.3**
T_6	19	20	20	**19.7**
T_7	19	20	21	**20.0**
T_8	21	20	20	**20.3**
T_9	21	20	21	**20.7**

Stripe DM
Knee-high stage

Treat No	RI	RII	RIII	
T_3	7	8	6	**7.0**
T_4	2	1	1	**1.3**
T_5	2	2	2	**2.0**
T_6	3	2	2	**2.3**
T_7	4	3	3	**3.3**
T_8	5	3	3	**3.7**
T_9	8	6	6	**6.7**

Treat. No	RI	RII	RIII	
T_3	209 (0.0)	226 (0.0)	249 (0.0)	**0.0**
T_4	66 (68.4)	70 (69.0)	61 (75.5)	**70.9**
T_5	34 (83.7)	40 (82.3)	47 (81.1)	**82.3**
T_6	85 (59.3)	89 (60.6)	76 (69.5)	**63.1**
T_7	94 (55.0)	107 (52.7)	117 (53.0)	**20.1**
T_8	121 (42.1)	110 (51.3)	101 (59.4)	**50.9**
T_9	141 (32.5)	136 (39.8)	144 (42.2)	**38.1**

Data in parentheses indicate % control over T_3

DH
Tassel emergence

Treat. No	RI	RII	RIII	
T_3	23 (0.0)	21 (0.0)	22 (0.0)	**0.0**
T_4	12 (47.8)	11 (47.6)	10 (54.5)	**49.9**
T_5	10 (56.5)	10 (52.4)	10 (54.5)	**54.4**
T_6	15 (34.8)	12 (42.9)	13 (40.9)	**39.5**
T_7	18 (21.7)	15 (28.6)	17 (22.7)	**24.3**
T_8	21 (8.7)	17 (19.0)	17 (22.7)	**16.8**
T_9	23 (0.0)	18 (14.3)	17 (22.7)	**12.3**

Data in parentheses indicate % control over T_3

MLB
Tassel emergence

Treat No	RI	RII	RIII	
T_3	28	29	26	**27.7**
T_4	21	22	20	**21.0**
T_5	20	20	22	**20.7**
T_6	24	23	22	**23.0**
T_7	24	23	23	**23.3**
T_8	27	24	23	**24.7**
T_9	28	24	26	**26.0**

TLB
Tassel emergence

Treat No	RI	RII	RIII	
T_3	23	22	22	**22.3**
T_4	20	19	20	**19.7**
T_5	19	18	18	**18.3**
T_6	20	20	20	**20.0**
T_7	20	20	20	**20.0**
T_8	21	20	21	**20.7**
T_9	22	21	21	**21.3**

Stripe DM
Tassel emergence

Treat No	RI	RII	RIII	
T_3	10	11	9	**10**
T_4	2	3	1	**2.0**
T_5	3	4	3	**3.3**
T_6	5	5	4	**4.7**
T_7	8	6	6	**6.7**
T_8	7	7	7	**7.0**
T_9	8	7	7	**7.3**

Nematode Control
Tassel emergence

Treat. No	RI	RII	RIII	
T_3	238 (0.0)	247 (0.0)	281 (0.0)	**0.0**
0 T_4	66 (73.5)	72 (70.9)	53 (81.1)	**75.16**
T_5	30 (87.4)	42 (83.0)	45 (84.0)	**84.8**
T_6	74 (68.9)	78 (68.4)	64 (77.2)	**71.5**
T_7	84 (64.7)	97 (60.7)	103 (63.3)	**62.9**
T_8	102 (57.1)	101 (59.1)	94 (66.5)	**60.9**
T_9	134 (43.7)	125 (49.4)	143 (921)	**47.4**

Data in parentheses indicate % control over T_3

Cyst Nematode Control
Knee-high stage

Treat. No	RI	RII	RIII	
T_3	6 (0.0)	7 (0.0)	5 (20.0)	**0.0**
T_4	4 (33.3)	4 (20.0)	4 (20.0)	**24.4**
T_5	2 (66.7)	2 (60.0)	2 (60.0)	**62.2**
T_6	4 (33.3)	4 (20.0)	4 (20.0)	**24.4**
T_7	5 (16.7)	5 (0.0)	5 (0.0)	**5.5**
T_8	6 (0.0)	5 (0.0)	4 (20.0)	**6.6**
T_9	5 (16.7)	5 (0.0)	5 (0.0)	**4.2**

Data in parentheses indicate % control over T_3

N-Status
Knee-high stage

Treat. No	RI	RII	RIII	
T_3	290.92	312.39	331.42	**311.6**
T_4	362.58	329.44	423.42	**371.7**
T_5	482.19	482.97	482.97	**482.7**
T_6	417.38	358.92	339.59	**372.0**
T_7	208.78	373.37	376.8	**319.7**
T_8	392.94	303.78	318.56	**338.4**
T_9	210.92	361.39	362.42	**311.6**

Data in parentheses indicate % control over T_3

Height
At maturity

Treat. No	RI	RII	RIII	
T_1	144.1	145.4	147.6	**145.7**
T_2	153.1	153.5	153.3	**153.3**
T_3	158.8	156.8	147.3	**154.3**
T_4	156.6	153.1	157.7	**155.8**
T_5	160.1	165.1	161	**162.1**
T_6	157.2	158.3	149.9	**155.1**
T_7	153	155	157	**155.0**
T_8	150.9	155	147.9	**151.3**
T_9	153.2	141.2	145	**146.5**

Crop Vigour
At maturity

Treat. No	RI	RII	RIII	
T_1	6.9	6.6	6.7	**6.7**
T_2	7.2	7.1	7.3	**7.2**
T_3	7.4	7.6	7.4	**7.5**
T_4	9.1	9.2	9.2	**9.2**
T_5	9.4	9.3	9.3	**9.3**
T_6	8.6	8.5	8.6	**8.6**
T_7	7.9	8	8	**8.0**
T_8	7	6.9	6.9	**6.9**
T_9	6.5	6.3	6.3	**6.4**

Treat. No	RI	RII	RIII	
T_1	476.9	496.4	418	**463.8**
T_2	468.7	531.7	420.2	**473.5**
T_3	465.7	549.4	426	**480.4**
T_4	520.9	563	431.4	**505.1**
T_5	529.5	565	449.2	**514.6**
T_6	509.4	554.2	424.5	**496.0**
T_7	498.8	543.3	416.5	**486.1**
T_8	487.1	515.6	442.9	**481.9**
T_9	454.8	497.3	438.7	**463.6**

Cyst Nematode Control
Knee-high stage

Treat. No	RI	RII	RIII	
T_3	6 (0.0)	7 (0.0)	5 (20.0)	**0.0**
T_4	4 (33.3)	4 (42.9)	4 (40.0)	**32.1**
T_5	3 (50.0)	4 (42.9)	3 (20.0)	**44.3**
T_6	4 (33.3)	4 (42.9)	4 (0.0)	**33.1**
T_7	4 (33.3)	5 (28.6)	5 (0.0)	**20.6**
T_8	5 (16.7)	6 (14.3)	5 (0.0)	**10.3**
T_9	6 (0.0)	5 (28.6)	5 (0.0)	**9.5**

Data in parentheses indicate % control over T_3

N-Status
Tassel emergence

Treat. No	RI	RII	RIII	
T_3	294.69	206.31	221.06	**240.7**
T_4	294.36	206.13	397.83	**299.4**
T_5	435.8	309.54	435.42	**393.4**
T_6	338.79	250.61	368.01	**319.1**
T_7	338.5	250.58	338.11	**309.1**
T_8	220.92	250.4	294.25	**255.2**
T_9	279.95	206.09	265.32	**250.5**

Data in parentheses indicate % control over T_3

Gran Yield
At Harvest

Treat. No	RI	RII	RIII	
T_1	27.9	27.3	26.8	**27.3**
T_2	30.7	32.2	32	**31.6**
T_3	31.3	32.3	32.9	**32.2**
T_4	33.7	32.9	34.6	**33.7**
T_5	34.7	34	35.8	**34.8**
T_6	32.8	32.7	32.4	**32.6**
T_7	31.4	31.6	30.9	**31.3**
T_8	29.5	28.8	30.2	**29.5**
T_9	27.1	28	28	**27.7**

Stover
At Harvest

Treat. No	RI	RII	RIII	
T_1	7.96	7.88	7.8	**7.88**
T_2	8.69	8.93	9.37	**9.0**
T_3	8.67	9.08	9.61	**9.12**
T_4	9.15	9	9.32	**9.16**
T_5	8.98	9.6	9.56	**9.38**
T_6	8.95	9.44	8.49	**8.96**
T_7	8.71	9.27	8.14	**8.71**
T_8	8.42	7.72	9.02	**8.39**
T_9	7.91	8.06	8.06	**8.01**

Weevil infestation were nil (0.0) across the treatments

Appendix III

Standard Assessment Methods

Assessment

Parameters of observations:

1. No. Of Dead heart
2. Grain-weevil (No.)
3. PDI of Maydis leaf blight
4. PDI of Turcicum leaf blight
5. PDI of stripe DM
6. Nematode control (%)
7. N-status (mg/kg)
8. Plant height (cm)
9. Crop Vigour 91-10 scale)
10. No. Of. Grains per Ear/ Cob
11. Grain-Yield (Q/ha)
12. Stover yield (t/ha)
13. B:C ratio
14. Phytotoxicity

Methodology:

1. No. Of Dead heart : The number of affected plants showing dead heart symptoms were calculated out of total number of plants per plot/replications and percent infestations calculated.
2. Grain-Weevil (%) : Grain infested out of representative bulk of 100-grains per plots were examined for the infestation of weevils.
3. PDI of Maydis leaf blight : Percent disease indices (PDIs) were calculated by rating the disease occurance on the scale of 1-5 on 2-leaves each from upper half and lower half of 10-plants (total 20-leaves) per plot/replication by Payak and Sharma, disease rating scales in maize in india. (1983).
4. PDI of Tucicum leaf blight: As mentioned above.
5. PDI of Stripe DM : As mentioned above.
6. Nematode control : Soil samples collected from rhizosphere (inclusive of some rootlets) from the suspected, partly affected of fully affected at random 10-plants/plot were mixed well and 250 g-representative sample drawn to send the laboratory for enumeration of H. Zeae using genome specific primer through PCR technique. The number of nematodes was worked out through standard curve drawn out of H. Zeae crsts collected from soil of the untreated plot prior to carrying out the estimation process.
7. N-status (mg/kg) : Soil samples from 0-15 cm depth were collected from 6-spots per plot, mixed well and a representative sample of 300 g/plor drawn and sent to the lab for analysis by std. method.
8. Plant height (cm) : Mean height of random 10-plants/plot were calculated by measuring the height of each corn plant from the soil surface to the apex of the plant.
9. Crop Vigour (1-10 Scale) : Few vigorous plants rated 10 (100%) based on growth, development, graanness and branching were selected from the treatments trial/ adjoining

(soil sotarized) plots. Thereafter, each plots, were visited. The vigour of plants were examined and rated on 1-10 scale based on the comparison with 100% vigorous at follows.

Scale		Crop Vigour	
1	Poor Vigour	;	1-10 %
2	Fair	;	11-20 %
3	Fair	;	21-30 %
4	Medium	;	31-40 %
5	Medium	;	41-50 %
6	Higj	;	51-60 %
7	High	;	61-70 %
8	Very High	;	71-80 %
9	Very High	:	81-90 %
10	Excellent	;	91-100 %

10. No. Of Grains per Ear/Cob : Mean number of grains in random 10 cobs per plot was counted after they shelled and threshed.
11. Gran-Yield (Q/ha) : The harvest obtained from the cobs per plot after selling and drying the grains inshed for 12 days were weighed. The yields were converted into Q/ha by multiplication factor.
12. Stover Yield (t/ha) : The yield of the stalks from each plot after removal of cobs were weighed after removing the cobs to find out the Stover yield/ plot. The yield were converted into tons/ ha by multiplication factor.
13. B:C ration : B.C ratio was calculated by following formulae:

    B:C ration = Net profit (Rs/ ha) / Cost of cultivation (Rs/ha)

    Where,
    Cost of cultivation = Costs incurred on agronomic operations + Costs incurred on the fertilizers and treatments.
    = Rs. 26567 / - + Variables costs of Agrotain/ N-guard coated, uncoated fertilizers as per treatments
    Cost of Agrotain = Rs. 618 /lit
    Cost of N-guard = Rs. 125 /lit
    Cost of Urea = Rs. 6.7 /lit
    Cost of SSP = Rs. 6.0 /Kg
    Cost of MOP = Rs. 14.6 /Kg

Gross Return = Income from Variable Grain Yield + Income from Variable stover yield

    Price of Grain = Rs. 1400/Q
    Price of Stover = Rs. 700/ton

    Net Return = Gross Return – Cost of cultivation.

14. Phytotoxicity

    Visual Observation on phytototixicity (0-10) scale

    Methodology : Visual observations were recorded on 1.5 and 7 days after each application on randomly selected 20 leaves and 10-plants per plot on following parameters of observations.

1. Injury of leaf tip/leaf surface (0-10 scale as mentioned below)

2. Chrosis (P or NP)
3. Necrosis (P or NP)
4. Epinasty (P or NP) and
5. Hyponasty (P or NP)

P = Phytotoxic; NP = non-Phytotoxic

Scale	Injury to leaf tip/ surface (%)
0	No phytotoxicity
1	1-10
2	11-20
3	21-30
4	31-40
5	41-50
6	51-60
7	61-70
8	71-80
9	81-90
10	91-100

Trial 1 (AHmedabad)

	Temp(OC)		RH(%)		
Week	Max	Min	Mor	Eve	Total Rainfall
Year 2011 (Onwards)					
38	32.9	24.3	90.1	68.1	0.0
39	33.3	24.3	84.9	66.0	0.0
40	34.5	24.3	76.1	51.9	0.0
41	36.8	24.3	76.9	39.3	0.0
42	36.8	24.3	59.0	35.9	0.0
43	35.9	24.3	54.0	39.1	0.0
44	34.6	24.3	58.1	41.0	0.0
45	35.5	24.3	58.3	39.7	0.0
46	34.6	24.3	62.9	39.0	0.0
47	32.4	24.3	57.3	35.1	0.0
48	31.9	24.3	52.1	37.6	0.0
49	33.0	24.3	64.7	41.6	0.0
50	28.7	24.3	57.3	35.6	0.0
51	30.0	24.3	69.6	40.6	0.0
52	12.2	24.3	62.5	35.5	0.0

Source : Nearest State Agriculture University Data

SGS	**FIELD TRIAL OPERATIONAL MANUAL**	SBU : 1805 Job Ref. : IN/MUM/AGR/20110898/01 Page : 1 to 4 Revision : 0.0 Quotation : 098/2011- NICO ORGO MANURES E-MAIL 2011.08.11 Invoice : IN/MUM/AGR/20115047 05TH October 2011 Prepared by : Dr. Ranjeet K. Poddar Mr. Kartik D. Laijawala Approved by : NICO ORGO MANURES Authorized by Study Director : Dr. Ranjeet K. Poddar Team Member : Dr. Joseph Lopez
SGS INDIA PRIVATE LIMITED AGRICULTURAL SERVICES	**TITILE OBJECTIVE TRIAL PROTOCOL OBSERVATIONS PROGRESS OF TRIALS SUBMISSION OF REPORT APPROVAL OF MANUAL**	

1.0 TITLE :

Efficacy evaluation of 'N-Guard' (a nitrification – inhibitor) – coated urea in corn

2.0 **OBJECTIVES** :

2.1 To evaluate the comparative effects of N-Guard (nitrification inhibitor) coated, uncoated and split dose applied urea based on better nitrogen –use– efficiency.

2.2 To standardize the dosage of application of N-Guard for the coating of urea.

2.3 Assessment of yield as affected be the use of the reduce dose of coated urea in comparison to uncoated urea at full dose.

2.4 To observe the effect of application of N-Guard in form of coating of urea on incidence of disease, infestation of insect – pests and nematodes

2.5 To compare the nitrogen status in soil before application on N-Guard in form of coating, after application and at / near harvest.

2.6 To determine the cost : benefit ratio

3.0 TECHNICAL DETAILS:

Field Trial Experiment:

Crop	:	Corn
Test Product	:	N-Guard (Nitrification –inhibitor)
Target Insect Pest and Disease	:	Dead heart, MLB, Turcicum leaf blight and Strip DM
Trial Design	:	RBD
Replications	:	Three
Locations	:	One (Dehgam near Ahmedabad)
Method of Application	:	Band placement and Granular broadcasting

Time of application :

1. Basal application
2. Knee-high and
3. Tasseling stage

4.0 TRIAL PROTOCOL

Treatment		Dosage of application at different stages (kg/ha)							
		Basal				Knee-high		Just before tasseling	
		Agrotain / N-Guard (ml)	N (Urea)* Kg	P (SSP) Kg	K (MOP) Kg	Agrotain / N-Guard (ml)	N (Urea) Kg	Agrotain/ N-Guard (ml)	N (Urea) Kg
[Uncoated full N(Urea)+P+K]	T_1	0	120 (260.87)	60 (375)	40 (67.67)	0	0 (0.00)	0	0 (0.00)
[Uncoated ½ N(Urea)+P+K] + [½ N(Urea)]	T_2	0	60 (130.43)	60 (375)	40 (67.67)	0	60 (130.43)	0	0 (0.00)
[Uncoated 1/3 N(Urea + P + K] + [Uncoated 1/3 N(Urea)] + [Uncoated 1/3 N (Urea)]	T_3	0	60 (130.43)	60 (375)	40 (67.67	0	40 (86.96)	0	40 (86.96)
[Agrotain with full N @ 2.84 mg/kg urea; 1/3 coated N(Urea) +P + K] + [1/3 coated N(Urea)] + [1/3 coated N (Urea)]	T_4	146.96	60 (130.43)	60 (375)	40 (67.67	246.96	40 (86.96)	246.96	40 (86.96)
[N-GUARD with N@7.59 mg/kg urea. 1/3 coated N(Urea)+P+K] + [1/3 coated N(Urea) + 1/3 coated N(Urea)]	T_5	660	60 (130.43)	60 (375)	40 (67.67	660	40 (86.96)	660	40 (86.96)
[N-GUARD with with N@6.6 mg/kg urea. 1/3 coated N(Urea)+P+K] + [1/3 coated N(Urea) + 1/3 coated N(Urea)]	T_6	573.91	60 (130.43)	60 (375)	40 (67.67	573.91	40 (86.96)	573.91	40 (86.96)
[N-GUARD with N@5.61 mg/kg urea. 1/3 coated N(Urea)+P+K] + [1/3 coated N(Urea) + 1/3 coated N(Urea)]	T_7	487.83	60 (130.43)	60 (375)	40 (67.67	487.83	40 (86.96)	487.83	40 (86.96)
[Full dose N-GUARD with 15 % less N @ 6.6 mg/kg urea. 1/3 coated N(Urea)+P+K] + [1/3 coated N(Urea) + 1/3 coated N(Urea)]	T_8	487.83	60 (130.43)	60 (375)	40 (67.67	487.83	40 (86.96)	487.83	34 (73.91)
[Full dose N-GUARD with 25 % less N @ 6.6 mg/kg urea. 1/3 coated N(Urea)+P+K] + [1/3 coated N(Urea) + 1/3 coated N(Urea)]	T_9	430.43	60 (130.43)	60 (375)	40 (67.67	430.43	40 (86.96)	430.43	30 (65.22)

The Fertilizers dosages of N were splitted. However, P and K were not splitted and applied only at basal stage.

5.0 Observations :

Plant height
Number of kernel per ear
Grain – Yield (t/ha)
Stover yield (t/ha)
B.C ratio
N – Status before and after application of coated/ uncoated urea.

For 7-treatment

Insect – pest control (%)
Diseases control (%)
Nematode control (%)

6.0 PROGRESS OF TRIALS :

1. Material – As per protocol or procurement of branded standard checks from market; the test chemical to be provided be the sponsor (Isagro Asia).
2. Arrangement of standard check samples of Agrotain may be done by SGS against payment by Nico Orgo Manures.
3. Methodology – All experiments will be done as pr standard methodology and will be documented in report.
4. Assessment of nematode control through PCR technique on additional payment for 42 – Samples.
5. Agronomic Package of Practices – As per crop related packages of practices.
6. Crop stages of applications – As per crop related packages of practices.
7. Dosage of application – As per experiment trial protocol
8. Plot size 50 – 100 sq. meter.
9. Engagement of Manpower – Two sciemtist (part-time involvement) + 1 Technical Assostant + 1 Field attendant + labourers as per requirements.
10. Recording of data – in field book.
11. Analysis – M-stat, CROPSTAT for field data will be given depending on no. Of treatments.
12. Report compilation as per Std. template of SGS

7.0 Submission of Report :

Between 15 March – 15 April, 2012 or 15 days after harvest of the crop whichever is later.

8.0 APPROVAL OF MANUAL :

As indicated by the signature on the approval sheet of the present manual, this research trial has been approved by the SGS INDIA, Mumbai and NICO ORGO MANURES, Dakor (Gujarat).

Prepared by

Dr. Ranjeet K.Poddar
(Field Trials Specialist) SGS, INDIA

Approved by

Mr. Kartik Laijawala
(Director, Nico Orgo Manures)

Authorized by

Dr. Ranjeet K. Poddar
(Study Director)

Dr. Joseph Lopez
(Team Member)